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INDEX

A

Page.

Accident data, Raritan Copper Works 452
Accidents, influence of conditions on 767
Acme mill 317
Acupan Mining Co 882
Adirondack gold deposits again 55
Administrative continuity 712
Advancement of mining in Colorado.....G. J. Bancroft.... 910
Aeration of pulp 415
Aerial ferry 304
Agitation from a thickener.....M. D. W. Minier.... 264
Ahmeek Mining Co. report 769
Air-blasts 690
Air-compressor, portable 52
Air-lift pumping 767
Ajo 418
Alaska great goldfield 638
  Mine inspection law 234
  Mineral production 43
  Mineral production in 1914 37
  Mining laws 848, 938
  Ditto.....L. D. Leehey.... 977
  Railroad 233, 505, 627
Alaska Ebner 490, 532
Alaska Exploration Co 963
Alaska Gastineau 160, 885
  Mill.....L. E. Spray.... 612
Alaska Gold Belt Co 1002
Alaska Gold Mines Co 490, 533
  Bonds 156
  Report 781
Alaska Juneau 160, 531, 661, 773
Alien labor law (see Arizona).
Allen, A. M.....Firing boilers.... 185
Allen, A. W.....Milling gold ores in cyanide....302, 585
  Ditto.....Solution control in cyanidation.... 186
  Ditto.....A temporary zinc-box.... 657
Alloquez Mining Co 594
  Report 819
Alluvial mining, metallurgy of—I, II. John M. Nicol....837, 869
Alta Consolidated Mining Co 275, 667
Altai region, Siberia.....H. W. Turner....973, 985
Alternating current in electrolysis 804
Aluminum and copper 786
Amalgaline 914
Amalgamated Copper 531
Amalgamating plates 488, 766
  Plates, automatic dressing of.....E. S. Boalich.... 753
  Table, double-deck 113
Amalgamation in Hardinge mills 319
  Ditto.....F. J. Girard.... 110
  Ditto.....H. W. Hardinge....261, 610
  Ditto.....Francis O'Boyle.... 450
  Ditto.....K. C. Parrish.... 641
  Ditto.....J. W. Pinder.... 338
  Ditto.....G. R. Pringle.... 828
  Ditto.....M. W. von Bernewitz.... 111
A. I. M. E. constitution 2, 76
  Ditto.....E. B. Kirby, Sidney J. Jennings.... 31
  Election 282, 308
  New York meeting 323
American Placer Mining Co 235
American Reduction Co 704
American Smelting & Refining Co. report 601
American Telephone & Telegraph Co 671
American Zinc Co 422
American Zinc, Lead & Chemical Co 592
American Zinc, Lead & Smelting Co 156
  Report 856
Ammonia leaching process for copper...C. H. Benedict.... 615
Ammunition and copper 824
Anaconda Copper Mining Co 623, 821, 1004
  Exhibit.....E. S. Bardwell.... 654
  Flotation 282
  Growth 354
  Improvements at 334
  Opportunity for workmen 480
  Report 781
  Safety first work 42
Ancient river channel mining in California.....J. D. Hubbard.... 407
Andreafski district, Alaska.....E. E. Hurja.... 377
Anode, the 129
Anti-debris committee 129
Antimony in cyaniding 265
  Production 936
  Sales in New York 169
  Smelter, San Luis Potosi 776
Apex litigation, Jim Butler v. West End.....H. V. Winchell.... 763
  At Goldfield 976
Apparatus for cyanide tests.....H. F. Lunt.... 911
Aramayo Francke Mines, Ltd., report 242
Argall, P. H.....Cripple Creek ore treatment.... 135
Argentina, Mineral resources of Jujuy....A. W. Jenks.... 291
Arizona alien labor law 53
  Mineral production, 1914 90
Arizona Commercial Mining Co 595, 771
Arizona Copper Co 595
  New smelting plant 9
Arizona Copper Syndicate 496
Arizona Southwestern Copper Co 457
Arizona Venture Corporation 310
Armatures, testing burned-out.....L. V. Newton.... 329
Asbestos 998
Ashanti Goldfields Corporation, Ltd., costs 265
  Report 51
Assay of cyanide solutions.....O. E. Roodhouse.... 760
  Of ore containing metallics.....W. E. Cahill.... 865
  Ditto.....Richard Marsh.... 939
  Ditto.....G. E. McIntyre.... 641
Associated Northern Blocks (W. A.), Ltd., report 463
Atlanta Mines Co 630, 846
Atlin, hydraulic mining at.....A. D. Hughes.... 647
Atolia Mining Co 420
Attempts at iron making in India 97
Atwood Copper Co 959
Austin, L. S.....Smoke dilution at Midvale.... 579
Australia, exhibit, P. P. I. E 694
  Gold mining in Victoria 326
  Gold production, 1914 520
  Lead and zinc smelting in 802
  Lead production 8
  Zinc contracts 2, 39, 42
Austria, copper production 621
Auto trucks, severe test for 503
Automatic aerial tramway 128
  Dressing of amalgamating plates.....E. S. Boalich.... 753
  Ditto.....A. Del Mar.... 941
  Section-insulator 894
A. W. C. Mining Co 416

B

Ball, S. H., and M. K. Shaler.....Mining in Belgian Congo in 1914 403
Bancroft, G. J....Advancement of mining in Colorado.... 910
Banding in ore deposits.....Editorial.... 55
  Ditto.....C. T. Kennan.... 487
Banigan, T. F.....Speculation in mines.... 940
Banker mine 419
Banks, C. A.....Beaver Lake district.... 954
Barbour, Percy E.....Uwarra mill.... 302
Bardwell, E. S.....Anaconda exhibit.... 654
Barite 430
Barium and strontium 206
  Sulphate markets 415
Barnes-King Development Co 306, 495, 775
  Report 347
Base metals, the 936
Bates Leasing Co 886
Batopilas M. Co 1007
Battle Mountain district 629
Beatson, A. K., obituary 47
Beaver Cement Co 1005
Beaver Lake district, Saskatchewan.....C. A. Banks.... 954
Beck, John G.....Nitrate mining in Chile.... 510
Becker, C. M.....Who will engineer the engineers?.... 525
Beehive coke ovens 979
Beginnings of the Tata Iron & Steel Co....C. M. Weld.... 97
Belgian Congo, Mining in 142
  Mining in 1914.....S. H. Ball and M. K. Shaler.... 403
Ben Harrison mine 237
Ben Hur mine 697
Benedict, C. H.....Extracting copper with ammonia.... 615
Benguet district, Philippines 882
Benguet Con. Co 668
  Mill 882
Beringer, J. J. 962, 967
Berlin metal exchange 353
Big Five Operating Co 235, 307
Big Four Exploration Co 776
Billyard, J. R., and H. N. Stronck....Visualizing working conditions in a mine 440
Bingham Mines Co. report 536
Bingham New Haven G. C. & S. M. Co 536
Birkinbine, John 852
Bismuth minerals 843
Black, W. S.....A simple sieve-shaker.... 439
Black Chief Copper Co 773
Blast-furnace practice at Mt. Lyell.....Robert Sticht.... 183
Blasting, Misfires in.....J. B. Burgess.... 330
  Powder, Moisture in 151
Blister copper, Determination of gold in.....R. King.... 917
Blowpipe analysis in the field, Quantitative.....George Delius.... 725
Blue Mountain M. Co 274
Blyth, W. B.....Flotation in gold metallurgy.... 523
Boalich, E. S.....Automatic dressing of plates.... 754
  Ditto.....Latent possibilities of California mineral resources 218
Boilers at the Exposition 1012
  Excess air in 376
  Firing.....A. M. Allen.... 185
  Paint for 958
Bolivia, Milluni tin district.....F. C. Lincoln.... 470
  Quimsa Cruz tin district.....F. C. Lincoln.... 721
  Tin market 353
Bolts and nuts.....Millman.... 977
Bonella, Edmund.....Valuing placer ground....111, 585
Bonnie Mining Co 193, 379
Borax in Argentina 293

179275

Page.

Boss mine, Nevada.....Seeley W. Mudd.... 297
Platinum in 876
Boston & Montana Dev. Co..... 926
Botsford, R. S.....Dredging for platinum in the Kytlim valley 327
Boulder county, Colorado, Mineral production in 1914..... 445
Braden mine, Results at 116
Bradley Lead & Zinc Co..... 416
Brazil, Mineral industries of 682
Brewer, W. M.....Mining in British Columbia, 1914.... 103
Ditto.....Omineca mining district.... 443
British Columbia Copper Co. report..... 704
Bristol, J. J.....Valuation of dredging ground.... 825
Britannia mine snowslide 532
British Columbia mineral production 387
Mining in 1914.....W. M. Brewer.... 104
Omineca mining district.....W. M. Brewer.... 443
British Columbia Copper Co.....460, 537, 1006
Report 852
Broadwater County Mining Co..... 702
Broken Hill, New South Wales..... 8
Effect of war on 874
Broken Hill Proprietary 308, 772
Broken Hill South Silver Mining Co..... 931
Brooklyn Dev. & Mining Co..... 959
Browne, D. H.....R. H. Richards—An appreciation.... 483
Browne, Ross E.....Professors of mining.... 899
Brunswick Con. Gold Mining Co..... 320
Report 351
Buck & Charley Leasing Co..... 966
Bucket elevators.....W. S. Mann.... 187
Ditto .....M. G. F. Sohnlein.... 485
Buckeye Belmont Mines Co. report..... 404
Buffalo-Arizona Consolidated Co..... 700
Buffalo Mines Co. report 1006
Buffalo New Mexico Mines Co..... 379
Bully Hill Copper Co..... 345
Bunker Hill & Sullivan, Haulage at..... 410
Bureau plan of developing prospects..... 232
Burgess, J. B.....Misfires in blasting.... 330
Burma, A weir in 219
Burma Corporation, Mines 40
Burro Mountain Copper Co.....274, 456
Mill 193
Porphyry copper developments.....F. V. Bush.... 222
Report 818
Bush, F. V.....Burro Mountain Copper developments.... 222
Ditto.....Molybdenum.... 374
Butte & Duluth Mining Co..... 623
Butte & Superior Copper Co.....311, 387
Apex suit 623
Report 702, 856
Spelter production 337
Butte Miners Union, suit 1004

C

Cadmium, effect on spelter 880
Cahill, W. E.....Assay of ore containing metallics.... 865
Calamine 896
Calaveras Copper Co..... 665
Calcium 918
Caledonia Mining Co.....46, 346
Calgary Petroleum Products Co..... 348
California, ancient river channel mining in..... 407
J. D. Hubbard....
Chromite possibilities.....S. H. Dolbear.... 356
Magnesite deposits in..... 105
Manganese industry.....S. H. Dolbear.... 172
Meadow Lake district 296
Mine legislation 489, 533
Mineral resources, Latent possibilities of..... 218
E. S. Boalich....
Oil-fields, protection of 935
Oil production 195, 383
Petroleum in 1914.....R. P. McLaughlin.... 132
Quicksilver output, 1914 91
Callow, J. M.....Flotation of copper ores.... 826
Calorific value of fuel 229
Calumet & Arizona Mining Co.....493, 601
Calumet & Corbin Mining Co..... 305
Calumet & Hecla 594, 673, 784
Company report 970
Calumet & Montana Con. Mining Co..... 419
Camp Bird, report 926
Canada and Canadian nickel 246
Copper refinery in 960
Mineral production, 1914 447
Minerals at the Exposition 359
Canada Copper Corp., report..... 852
Canadian Copper Co.....661, 884
Canadian Mines & Finance Co..... 846
Canadian Mining & Exploration Co., Ltd., report..... 819
Canadian Mining Institute, meeting 411
Cananea Consolidated Copper Co..... 1007
Cansuran Placer Co..... 883
Capacity of electric steel furnaces 25
Of rock-crushers 919
Of vats 415
Capillary concentration 957
Caps and fuse.....T. C. Purcell.... 941
Carat 918
Carbon and cyanidation 784, 791
In cyanide solutions.....W. R. Feldtmann.... 791
Carbonate Lead Mines Co..... 964
Carn Brea & Tincroft 491
Carnotite 919
Deposits and the Rand banket.....C. T. Kennan.... 620
Ores, buying in Colorado 94
Carpenter, J. A.....Cost of mining and milling at Tonopah 583
Ditto.....Danish tube-mill pebbles and substitutes.... 139
Ditto.....Patents and metallurgists.... 374
Carr, Bernard..Practical rules for cutting mine timbers.... 409
Carr Mines Co..... 235
Carson-California Mining Co..... 740

Page.

Cashier Gold Mining and Milling Co..... 886
Caterpillars at the Exposition 541
Catlin, W. P.....Revival of Meadow Lake district.... 296
Caucasus Copper Co..... 81
Caucasus, copper industry of..... 193
Caving system at the Ohio Copper mine..... 361
F. Sommer Schmidt....
Cedar Talisman Con. Mines Co..... 927
Cerro de Pasco output 40
Centrifugal v. reciprocating pumps..... 524
Century Mining Co..... 158
Chaffee county, Colorado, mineral production, 1914..... 45
Chaffers 308
Champion Copper Co..... 453
Champion Reef Gold Mining Co. of India, Ltd., report..... 126
Change house 957
Chatham Mining Co.....343, 810
Chauvenet, Regis—A correction 828
Chemical and drug imports..... 169
Problems in Germany 75
Chief Consolidated Mining Co. report..... 312
Chiksan mine, cyanide plant.....C. W. DeWitt.... 731
Chile, nitrate mining in.....John G. Beck.... 510
Nitrate statistics 185
China, commercial conditions in 94
Lead mines 897
Mineral exhibit 906
Opportunities in.....H. Y. Liang.... 868
Shui-kou-shan lead-zinc mine.....H. Y. Liang.... 914
Standard Oil in 170
Chino Copper Co..... 312
Report 893
Chisos Mining Co..... 382
Choosing rock-drill equipment.....P. B. McDonald.... 618
Chromite 880
Possibilities in California.....S. H. Dolbear.... 356
Chuquicamata, progress at 116
Classification of technical literature 895
Clays 918
Clear Creek county, Colorado, mineral production, 1914..... 45
Cleveland-Cliffs Iron Co..... 699
Cleveland Mining Co..... 923
Cliff Mining Co., report 458
Clopper, H. G.....Florence zinc.... 826
Coal-dust fired reverberatory furnaces..... 175
Coal gas, analysis 62
Land leasing, Shafroth bill 117
Mine explosions, Japan 593
Mines, fatal accidents in 467
Mining at Dawson, New Mexico 730
Mining, British Columbia 809
Production of United States 89
Tar 734
Tar dyes 113
Cobalt Reduction Co..... 742
Coeur d'Alene Antimony Mining Co..... 346
Coeur d'Alene, Idaho, copper beds of the..... 145
In 1914 163
Cold-Goodwin mine 771
Cole, W. H..... 461
Collins, E. A.....Efficiency of tamping.... 790
Collins, Geo. E..Rhythmic precipitation of colloid ores.... 586
Colombia, Pato and Nechi placer properties..... 220
W. A. Prichard....
Taxation of mining properties 304
Colombo Mining Co..... 199
Colorado, advancement of mining in....G. J. Bancroft.... 910
Mineral production in 1914 37
Colorado Metal Mining Association 162
Colorado Minerals Separation Co..... 365
Colorado Mining Co. report..... 47
Columbia Marble Co..... 965
Commission on industrial relations 432
Commonwealth Mining & Milling Co., costs..... 803
Report 924
Compressor made into steam engine..... 804
Concentration at Mt. Morgan 260
Coniagas 960
Mine output 47
Consolidated Coppermines Co.....666, 1005
Consolidated Goldfields of New Zealand, Ltd., report..... 242
Consolidated Mining & Smelting Co. of Canada, report..... 126
Consolidated Virginia Mining Co..... 496
Constitutional extortion and the Worcester affair..... 468
Construction of undercurrents.....C. W. Haffey.... 979
Ditto.....C. S. Haley.... 679
Continuous decantation in South Dakota..... 575
Jesse Simmons....
Converter practice, records in 429, 755
Conveying machinery 672
Cooling jacket-water 843
Cooney, Michael 388
Co-operative Mining, Milling & Leasing Co..... 886
Copeland, C. E..... 537
Copeland Sampling Co..... 385
Copper 506, 638
And aluminum 785
Beds of the Coeur d'Alene.....George Huston....145, 525
Ditto.....J. C. Ray.... 299
Developments, Burro Mountain Copper Co..... 222
F. V. Bush....
Exports 156, 208
Ditto, 1914 268
Exports from Japan 802
Exports, New York 192
In ammunition 824
Industry, the War's menace to 283
Largest mass ever found 79
Leaching by ammonia.....C. H. Benedict.... 615
Leaching by the Hoffman process.....F. J. Pope.... 655
Leaching, some problems in.....L. D. Ricketts.... 515
Metallurgy, progress in .....Editorial.... 5
Mining, early days in Michigan 236
Mining, Lake Superior, Present and Future—II, III, IV.
Thomas T. Read....209, 284, 398
Ores, flotation of.....J. M. Callow.... 826

Page.

Copper ores, flotation of.....Occasional Contributor.... 680
Ores, secondary enrichment of.....A. L. Day.... 841
Prices 711
Prices in 1914 746
Producers Association 131
Production, Austria 621
Production, Germany 395
Production, Michigan 817
Production of United States, 1914.....90, 746
Refinery in Canada 960
Shares, prices, 1868 342
Shipments in Great Lakes 117
Shipments to Europe 429
Smelter, United Verde 848
Smelters, International 845
Smelting by electricity 806
Copper King mine, sold 1006
Copper Queen report 818
Copper Range Consolidated Co. report 931
Selling arrangements 191
Copper Springs Mining Co 963
Corbould, W. H.....Mount Elliott mine.... 682
Cornish mining.....W. J. Loring.... 912
Correction .....Regis Chauvenet.... 828
Corrosion of iron 958
Cossack Mining Co 625
Cost and efficiency 711
Ditto .....Heath Steele.... 718
Of assaying bullion 528
Of cyanide treatment 229
Of developing a mine 919
Of filling stopes 659
Of milling, Goldfield Consolidated 879
Of mine supplies.....B. J. Silbert.... 508
Of mining and milling at Tonopah..J. A. Carpenter.... 583
Of mining and milling gold ores, southeastern states... 60
Costs at Crown Reserve mine 614
At Hollinger mine and mill 439
At Lake View & Star mines 447
At Porcupine Crown 804
At Sons of Gwalia 445
At Wasp No. 2 mine 524
Commonwealth mine 803
Kalgurli mine and mill 29
South Kalgurli 802
Stratton's Independence 29
Cottonwood Coal Co 851
Cottrell dinner 156
Counterforts 733
Courtesy in discussion 640
Cracking of oils 696
Ditto.....E. I. Dyer.... 717
Crawford, John, Jr.....Electric smelting in 1914.... 302
Crawford, R. T.....Plumbing a shaft.... 715
Creighton, H. J. M.....Rhythmic precipitation of ferrous ferricvanide and ferrous hydroxide in jelly..... 65
Cresson Consolidated, discovery 129
Cripple Creek Deep Leasing Co 737
Cripple Creek mines dividend, 1914 85
Ore treatment 135
Crown Mines 961
Production 73
Crown Reserve Mining Co 528
Mine costs 614
Report 602
Cruse, Thomas, obituary 87
Crushing, degree of, to free economic minerals.....
D. P. Hynes.... 994
Mechanical efficiency of.....H. C. Kenney.... 572
Mechanical work of.....A. Del Mar.... 677
Culp, D. W 497
Cunningham, Noel.....Metallurgical practice at Porcupine 365, 754
Ditto.....Tube-mill tonnage calculations.... 16
Cupels 747
Custer Peak Copper Co 274
Cutler, H. C.....Efficiency of tamping.... 942
Cyanidation (see also solution control).
Cyanide, English production 473
From cyanamid 767
Low-grade 918
Plant at Chiksan mine.....C. W. De Witt.... 731
Plant at Exposition 933
Plant at Kushikino, Japan 952
Solutions, action of carbon in 791
Solutions, assay of.....O. E. Roodhouse.... 760
Solutions, determination of gold in 528
Supply 896
Tests, home-made apparatus for.....H. F. Lunt.... 911
Treatment, cost of 229

D

Daggett, John....Possibilities of the Mother Lode in depth 941
Daly-Judge Mining Co., report 814
Daly, R. A.....Origin of iron ores at Kiruna.... 148
Danish tube-mill pebbles and substitutes 239
Ditto .....J. A. Carpenter.... 139
Day, A. L.....Secondary enrichment of copper ores.... 841
DeBeers Consolidated Mines, Ltd., report 200
Dellus, George.....Quantitative blowpipe analysis.... 725
Del Mar, Algernon.....Sam Yet prospecting mill.... 371
Ditto.....Mechanical work of crushing.... 677
Ditto....Automatic dressing of amalgamated plates.... 941
Democracy at Lake Superior.....P. B. McDonald.... 677
Dennis, C. G.....Quicksilver in 1914.... 91
Denver-New Mexico Oil Co 959
Derry Ranch Gold Dredging Co 999
Design of belt elevators.....M. G. F. Sohnlein.... 485
Determination of gold in cyanide solution 528
Detroit Copper Mining Co., report 818
Devereux, W. G.....Melones Mining Co.... 939
DeWitt, C. W...Cyanide plant at Chiksan mines, Korea.... 731
Dexter White Caps Mining Co 274, 851
Diesel engine at Exposition 466
Dipper dredges 279

Page.

Disc crushers 820
Dissolution of silver and gold in thickeners.....
F. A. Voorhees.... 227
Dividends by mining companies, 1914 233
Doctor-Jack Pot Mining Co 808
Dodge, W. R.....Gold mining and milling in the Southeastern states 59
Dolbear, S. H.....Magnesite deposits and possibilities in California 105
Ditto.....Manganese industry of California.... 172
Ditto.....Ladd manganese mine.... 258
Ditto.....Chromite possibilities of California.... 356
Ditto.....Infusorial earth.... 580
Dolcoath ore deposit 491
Dolomites, Origin of 64
Dome Lake Mining & Milling Co 313, 846
Dome Mines Co., Ltd 594, 661, 846, 852, 960
Report 1010
Dome Mining & Reduction Co 274
Dominion Coal Co 83
Dominion Silver-Lead Mining Co 704
Dominion Steel Corporation 808
Double-deck amalgamating table 113
Douglas, James.....Progress in metallurgy.... 511
Downtown district, Leadville 118
Downtown Pumping Co 307
Drag 843
Drag-line excavator 782
Draining deep leads of Victoria 113
Kerr lake, at Cobalt, Ontario.....B. Hughes.... 63
Dredging cost.....J. W. Niell.... 901
Costs, Oroville 260
Ground, See Valuation.
Legislation, California 205
Dressing of tin ores 962
Drift mining in California 407
Drill-sharpener, Sullivan 859
Dust in Joplin mines 528
Dust-laying 734
Dutch East Indies, mineral production 62
Dyer, E. I.....Cracking of oils.... 717

E

Eagle & Blue Bell 460
Eagle county, Colorado, mineral production, 1914 45
Eagle Mining Co 385
Eagle River Mining Co 161
Early days in Michigan copper mining 236
East Butte Copper Mining Co 306, 459
Company Report 703
East Caledonia Mines Co 311
East Pool & Agar 492
Eastern Asia, Gold mining in 224
Eastwood, J. S.....Kennedy dam.... 691
Echo Gold Mining Co 159, 529
Eckel, E. E.....Tube-mill pebbles, their characteristics and cost 103
Eclipse Con. Mining & Investment Co 742
'Economic Geology' and its needs 430
Economic use of explosives.....R. Noblett.... 446
Edna May 660, 772
Effect of slag and fume on zinc muffle.....O. Proske.... 176
Of war on Broken Hill 874
Efficiency, Cost and.....Heath Steele.... 718
Of tamping.....E. A. Collins.... 790
Of tamping.....H. C. Cutter.... 942
Eggers, J. H.....Permanent survey stations.... 149
Eighty-Five Mining Co 456
El Centro Mining Co 698
El Oro Dredging Co 345
Eldorado county, California 235
Electric blasting accidents 415
Drills, Portable 820
Furnaces 428
Hoists 635
Mine locomotives.....E. B. Wagner.... 134
Motors, application of to gold dredges.....
G. B. Rosenblatt.... 12
Smelting at Tyssedal.....R. M. Keeney.... 527
Smelting in 1914.....John Crawford, Jr.... 302
Ditto.....R. M. Keeney.... 22
Smelting of copper ore 806
Electrolysis, Alternating current in 804
Electrolytic zinc, Reed process.....E. H. Leslie.... 17
Elevators, design of belt.....M. G. F. Sohnlein.... 485
Elm Orlu, ore treatment 993
Empire Gold Dredging Co 534
Empire-North Star suit 935, 964
Empire Zinc Co 456, 959
Engels Copper Mining Co 421
Company Report 848
Engineering Congress and mining men.....Editorial.... 94
English production of cyanide 473
Ernestine Mining Co 274
Eruptions of Mt. Lassen.....H. W. Turner.... 955
Eureka Johnnie Mine, Nevada 347
Exit Maranon placers 863
Experiments in smelter fume abatement..E. A. Hersam.... 902
On Phelps-Dodge Co. ores 803
Exploration Co., Ltd 626
Report 426
Explosives 754
Economical use of.....R. Noblett.... 446
Exposition, Cyanide plant at 933
Extracting copper with ammonia.....C. H. Benedict.... 615

F

Fairbanks district gold output 160
Placer mining in.....E. E. Hurja.... 34
Quartz mining in 114
Falls City Lead & Zinc Co 591
Fanny Rawlins Operating Co 534
Farish, John B.....Ways that are dark.... 576

Page.

Farm mine 697
Federal Drift Mining Co..... 420
Federal Mining Co..... 494
Federal Mining & Smelting Co..... 630
Report 592
Federal trade commission..... 321
Feldtmann, W. R.....Precipitating action of carbon in cyanide solutions 791
Fencing of claims..... 528
Fergus County Oil & Gas Co..... 495
Ferromanganese from California..... 1002
Feust, Arthur.....Lead wool in cyanidation.... 79
Ditto.....Practical points on sampling.... 368
Field Process Co..... 812
Fields Mining & Milling Co..... 922
Fifty Gold Mines Corporation..... 458
Filtering process at the Treadwell cyanide plant..... 256
Financing mining operations.....C. L. Paige.... 787
Ditto.....R. H. Todd.... 609
South America 896
Finch, J. A..... 1007
Fire-fighting, Mountain View mine..... 966
Fire, Extinguishing in cotton..... 958
Firing boilers.....A. M. Allen.... 185
First Aid kit..... 427
Flagg, A. L.....Shaft-sinking at Kelvin, Arizona.... 250
Florence Goldfield Mining Co..... 422
Florence Hydraulic & Dredging Co..... 494
Florence zinc 733
Ditto.....H. G. Clopper.... 826
Florida phosphates 205
Flotation 673, 675
At Anaconda 282
In gold metallurgy.....W. B. Blyth.... 523
In Korea 935
Of copper ores.....Occasional contributor.... 680
Ditto.....J. M. Callow.... 826
Of quicksilver ores 92
Preferental.....O. C. Ralston.... 980
Utah Copper Co..... 233
Flow-sheet, Inspiration mill..... 696
Fond du Lac district..... 809
Fortuna Mines Corporation.....419, 663
Fortuna Royal Gold Mining & Milling Co..... 348
Fortune Teller Mining Co..... 311
Franklin Leasing Co..... 808
Franklin mine, working costs..... 766
Free assaying of samples..... 567
Freeman, O. W.....Sapphire mines at Yogo, Montana.... 800
Friendliness v. friction at the Bunker Hill & Sullivan..... J. A. Goodell.... 57
Frontino & Bolivia mine, production..... 73
Fuller Lehigh pulverizer mills..... 394

G

Gagnon shaft, cave-in at..... 429
Garrison, F. L.....A. I. M. E. constitution.... 76
Gas from oil wells..... 881
Gasoline manufacture 353
Vapor 958
Geikie, James 461
Gem Mining Co..... 158
General Exploration Co..... 967
General Mining & Milling Co..... 742
Geologists in warfare..... 637
Georgia, Smelting in.....Herbert Lang.... 152
German iron and steel industry..... 219
Germany, Chemical problems in..... 75
Giant Mines of Rhodesia, Ltd., report..... 242
Gilpin county, Colorado, mineral products, 1914..... 45
Girard, F. J.....Amalgamation in Hardinge mills.... 110
Gold and silver extraction, Belmont mill..... 806
And silver production, U. S..... 124
Chloride 340
Determination in blister copper.....R. King.... 917
Dredges, Application of electric motors to..... Girard B. Rosenblatt.... 12
In Nigeria 896
Mining and milling in the Southeastern states..... 59
Mining in Eastern Asia..... 224
Mining in Mongolia..... 772
Mining in Victoria..... 326
Mountain district, Alaska.....E. E. Hurja.... 377
Production and the war..... 936
Production, Australia 1914..... 520
Production of the Philippines..... 451
Production, Rand 2
Production, U. S., 1914..... 53
Refining 844
Gold Crown Mining & Reduction Co..... 813
Gold Crown Mining Co..... 959
Gold Links Mining Co..... 851
Gold Nugget Placer Mining Co..... 43
Golden Center 534
Golden Cycle Mining & Reduction Co.....421, 662, 770, 999
Goldfield, Apex litigation at.....822, 996
Mining in the shale at.....J. K. Turner.... 995
Revisited—I, II, III.....T. A. Rickard....797, 829, 907
Goldfield Consolidated Mines Co.....387, 419, 535, 633
Milling costs..... 879
Mining costs, 1914..... 730
Production 122
Goldfield Merger Mines Co..... 884
Goldstrike district, Utah..... 852
Goodell, J. A.....Friendliness v. friction at the Bunker Hill & Sullivan..... 57
Goodsprings mining district, Nevada.....703, 851
Government armor plate manufacture..... 53
Granby Consolidated (Canada)..... 809
Output 104
Granby Mining & Smelting Co.....591, 597
Granites and ore deposits..... 452
Graphite 958
In Texas 1000
Schist 767
Grass Valley revisited—I.....T. A. Rickard.... 943

Page.

Gray, H. D.....Search for platinum.... 942
Gray, James 464
Great Boulder Perseverance Gold Mining Co., Ltd., report.. 51
Great Boulder Proprietary..... 660
Great Fingall 308
Greaterville Dredge Gold Mining Co..... 43
Greene Cananea Copper Co., report..... 887
Greenwood, B. C., Smelting at..... 956
Grier memorial fund..... 529
Grinding pan.....Watson Denny.... 113
Growth of mining industry, Ontario..... 784
Guck, H. A.....Lake Superior copper mining.... 79
Ditto.....'Rock' or 'ore'.... 642
Guggenheim Exploration Co., report..... 295
Guilterman, Franklin..... 749
Gumaos Placer Co., Philippine Islands..... 882
Dredge.....A. C. Ludlum.... 30
Gunnison county, Colorado, mineral production, 1914..... 45
Gwinn, J. W.....Underground haulage.... 410

H

Haffey, C. W.....Constructing undercurrents.... 979
Halbey shoveling-machine 934
Hale, A. H.....Ways that are dark.... 678
Haley, C. S.....Construction of undercurrents.... 679
Hammer-drill, profitable use of an old..... 523
Hampton-Clay County Consolidated Mines Co..... 384
Hancock, R. T.....Valuation of dredging ground.... 585
Hancock Consolidated Mining Co..... 458
Hardanger, electric smelting at..... 22
Hardenburg Mining Co..... 964
Hardinge, H. W.....Amalgamation in Hardinge mills...261, 610
Hardinge mills. See Amalgamation.
Haulage at the Bunker Hill & Sullivan....J. W. Gwinn.... 410
By motor-truck 909
In mines 360, 488
Hauling ore cars..... 917
Hayden Hill district, California..... 812
Health of miners at Broken Hill..... 21
Heberlein, C. A .....Quicksilver mining at the Oceanic mine 375
Hecla Mining Co..... 46
Report 666
Hedley Gold Mining Co..... 599
Helena Mining Bureau.....232, 386
Helfenstein electric furnace.....23, 24
H. E. M. Mining Co..... 236
Heroult, smelting at..... 23
Herrick, H. N.....Rise or raise?.... 900
Heulandite in Oregon.....G. J. Mitchell.... 755
History of geology..... 998
Hog Mountain gold mine..... 62
Hoganas iron sponge..... 696
Hoist at B. & M. shaft..... 697
Hoisting at Inspiration..... 635
Drums, rope capacity of..... 155
Holden, A. F..... 83
Hollinger Gold Mines, Ltd.....599, 809, 846, 1001
Compressor 804
Mill record in 1914..... 447
Mine and mill, costs at..... 439
Report 463
Homestake Mining Co..... 961
Aid fund 231
Report 499
Hondo Mining Co..... 770
Hope in Mexico..... 898
Hopper, W. A.....'Rock' or 'ore'.... 642
Horn Silver Mining Co..... 888
Hornaday, W. D.....Kauri gum deposits of New Zealand 181
Horner, A. L.....Rise or raise?.... 716
Horseshoe Mining Co..... 384
Horwood process 805
Hot springs district, Alaska.....E. E. Hurja.... 377
Howell, B. P.....Midas mill.... 979
Hubbard, J. D.....Ancient river channel mining in California 407
Hughes, A. D.....Hydraulic mining at Atlin.... 647
Hughes, Ben....Draining Kerr lake at Cobalt, Ontario.... 63
Hughes, W. W.....Kaolin.... 947
Ditto.....Practical points on sampling.... 525
Human side of mining.....J. F. Kemp.... 644
Humes, James.....Mining methods at Park City.... 444
Hunter, W. C..... 1007
Hurja, E. E.....Hot Springs, Gold Mountain, Koyukuk and Andreafski districts 377
Ditto.....Iditarod district.... 189
Ditto.....Placer mining in the Fairbanks district.... 34
Ditto.....Placer mining on the Seward peninsula.... 588
Ditto.....Quartz mining in the Fairbanks district.... 114
Ditto.....Ruby district, Alaska.... 266
Hurry-up Mining Co..... 158
Huston, George.....Copper beds of the Coeur d'Alene.... 145
Hydraulic mining at Atlin.....A. D. Hughes.... 647
Prospecting 734
Hydrothermal metamorphism 840
Hynes, D. P.....Degree of crushing to free the economic minerals 994

I

Ibex Mining Co..... 308
Idaho minerals at the Exposition..... 768
State Mining Association..... 197
Iditarod district.....E. E. Hurja.... 189
Idora Hill Mining Co..... 597
Idora Mining Co..... 774
Immigration 935
Improvements at the Trail smelter, British Columbia..... 74
India, Iron and steel in..... 97
Indian Mound Mining Co..... 922
Induction hoist, Largest 202

Page

Industrial journalism ... 562
Ditto ... H. M. Swetland ... 706
Unrest, Causes of ... 442
Infusorial earth ... S. H. Dolbear ... 580
Ingersoll, Frank B. ... Philippine dredges ... 118
Ingot, The ... 205
Inspiration Consolidated ... 700, 739, 924, 1000
Flow sheet ... 696
Strike ... 161
International Mines Development Co. ... 383
International Nickel Co. ... 117, 159, 246, 846
And the War ... 2
Report ... 928
International Smelting & Refining Co., plant ... 845
Interstate-Callahan Mining Co. ... 121
Report ... 887
Intervention in Mexico ... 861
Iola mine ... 61
Iron and steel in India ... 97
Mining in Michigan ... 176
Ore production, U. S. ... 124
Sponge, Hoganas ... 696
Iron Blossom Consolidated Mining Co., costs ... 155
Report ... 200
Iron Silver Mining Co., report ... 671
Irtysh Corporation ... 920
Isabella Copper Co., California ... 628
Isabella mine, Colorado ... 847
Isle Royale Copper Co. ... 626
Fire ... 40
Report ... 931

J

Japan and China ... 713
Ditto ... W. S. Kent ... 789
Ditto ... Kurt Pietrusky ... 866
And the War ... 282
Coal mine explosions ... 123, 593
Copper exports ... 802
Cyanide plant at Kushikino ... 952
Metal production in 1911 ... 729
Mineral production ... 593
Jasper County Mining Co. ... 737
Jenks, A. W. ... Mineral resources of Jujuy province, Argentina ... 291
Jennings, Sidney J. ... A. I. M. E. constitution ... 32
Jewel-Denero ore ... 415
Jim Butler apex litigation ... H. V. Winchell ... 763
Jim Butler-Tonopah Mining Co., report ... 351
Suit ... 741
Johnson electric furnace ... 26
Ditto ... Joseph Struthers ... 186
Jolly, William ... 815
Joplin district output ... 163
Shipments, 1914 ... 81
Joplin Ore & Smelting Co. ... 666
Joplin Ore & Spelter Co. ... 736
Jualin Alaska Mines Co. ... 160
Jumbo Extension Mining Co. ... 386, 845, 883, 966
Juneau district mines ... 160

K

Kalgoorlie in 1914 ... 191
Water-supply ... 587
Kalgurli Gold Mines, Ltd., report ... 51
Kali situation in 1911 ... 373
Kansas, lead and zinc in ... 817
Kaolin ... 637
Ditto ... W. W. Hughes ... 947
Kauri gum deposits of New Zealand ... W. D. Hornaday ... 181
Keeney, R. M. ... Electric smelting at Tyssedal ... 527
Ditto ... Electric smelting in 1914 ... 22
Kelly filter press ... 604
Kelvin, Arizona, shaft-sinking at ... 250
Kelvin Sultana Copper Co. ... 161
Kemp, J. F. ... The human side of mining ... 644
Ditto ... Rhythmic precipitation and colloid ores ... 78
Kemp, William ... Smelting copper sulphide ore ... 263
Kennan, C. T. ... Banding of ore deposits ... 487
Ditto ... On carnotite deposits and the Rand banket ... 620
Kennebec Mining Co. ... 814
Kennecott Copper Corporation ... 963
Kennedy Mining & Milling Co. ... 534
Dam ... J. S. Eastwood ... 691
Kenney, H. C. ... Mechanical efficiency of crushing ... 572
Kensington Mining Co. ... 160
Kent, W. S. ... Japan and China ... 789
Kerosene as a fire extinguisher ... 958
Ketchikan district ... 924
King, E. S. ... Stamp-mill test ... 109
King, R. ... Determination of gold in blister copper ... 917
King Quicksilver Mining Co. ... 665
Kirby, E. B. ... A. I. M. E. constitution ... 31
Kiruna, Origin of iron ores at ... 148
Klar-Piquette Mining Co. ... 922
Knopf, Adolph ... Platinum in southern Nevada ... 876
Knowledge and research ... R. W. Raymond ... 683
Kobuk district, Alaska ... 590
Korea, Cyanide plant at Chiksan mine ... C. W. Dewitt ... 731
Koyukuk district, Alaska ... E. E. Hurja ... 377
Kurokawa oil refineries ... 803
Kushikino, Cyanide plant at ... 952
Kwisluk river discovery, Alaska ... 344
District ... 700
Kytlim valley, Russia, Dredging for platinum in ... R. S. Botsford ... 327

L

Labor, Problems of ... 170
Labor-saving devices ... S. A. Worcester ... 727
La Cotabambas Auraria mine, Peru ... 928
Ladd manganese mine ... S. H. Dolbear ... 258
Lafayette Drift Gravel Mining Co. ... 844
Lake Angeline mine ... 153
Lake County Colorado Metal Miners Association ... 44
Mineral production, 1911 ... 46
Lake Superior copper mining ... H. A. Cook ... 69
Ditto ... Present and Future, II, III, IV
Thomas T. Read ... 201, 284, 398
Democracy at ... P. D. McDonald ... 667
Lake View & Oroya ... 442
Lake View & Star mines, costs ... 447
Lamb, Mark R. ... Notes from South America ... 842
Lampblack residue ... 73
Lang, Herbert ... Smelting in Georgia ... 1...
Large jaw crushers ... 201
Largest mass of copper ... 79
La Rose Con. Mines Co. ... 233, 704
Report ... 736
Lass, W. P. ... New filtering process at Treadwell cyanide plants ... 256
Last Dollar mine ... 850
Latent possibilities of California mineral resources ... E. S. Boalich ... 248
Leaching, see also copper
Leaching copper by the Hoffman process ... F. J. Pope ... 655
Some problems in copper ... L. D. Ricketts ... 515
Lead and zinc ... 973
Cost of production ... 806
Exports ... 156
Poisoning ... 659
Prices ... 935
Production in 1911, world ... 743, 777
Production, Kansas ... 817
Production of U. S., 1914 ... 90, 743, 777
Production, see under districts.
Smelting in Australia ... 802
Wool in cyanidation ... Arthur Feust ... 79
Leadville, Colorado, district production, 1911 ... 121
Downtown district ... 118
Zinc pigment works at ... 433
Learn Spanish, also Russian ... 937
Ledoux, A. R. ... Technical reminiscences I, II, III ... 760, 833, 903
Leehey, L. D. ... Alaska mining laws ... 977
Legislation at Washington ... 40
Lena Goldfields, Ltd., report ... 242
Leslie, E. H. ... Reed electrolyic zinc process ... 17
Ditto ... Zinc pigments and the Leadville works ... 433
Levant mine ... 492
Lexington-Arizona ... 310
Liability insurance, state managed ... 505
Liang, H. Y. ... Opportunities in China ... 868
Ditto ... Shui-kou-shan mine ... 914
Life and property in Mexico ... 567
Ditto, American ... 611
Lighting plants for steam-shovels ... 168
Lilligren, J. M. ... Specific gravity apparatus ... 260
Lime, chemical properties ... 33
Lincoln, F. C. ... Milluni tin district ... 470
Ditto ... Quimsa Cruz tin district ... 721
Lincoln Hill Mining & Milling Co. ... 230, 455, 923
Linseed oil ... 919
Litigation at Goldfield ... 822
At Tonopah, settled ... 783
Locomotives, electric mine ... 134
London mining market, and the War ... T. A. Rickard ... 6
Lone Elm Mining & Development Co. ... 494
Loring, W. J. ... Cornish mining ... 912
Louis, D. A. ... 889
Low-grade zinc ore, marketing ... 861
Lower Level Mining Co. ... 921
Lower Mammoth, Utah ... 163
Lucky Tiger Combination G. & S. Mining Co. ... 349, 493
Ludlum, A. C. ... Gumaos dredge ... 30
Luning Gold Mine Co. ... 698
Luning Idaho Copper Co. ... 698
Lunt, H. F. ... Apparatus for cyanide tests ... 911
Lusitania ... 750
Lyon Investment Co. ... 505

M

MacDonald, Bernard ... Precision of thought ... 586
MacDonald, J. A. ... Placer mining claims in the Yukon ... 335
Magdalena Exploration Co. ... 699
Magma Copper Co. ... 533, 771
Magnesite deposits and possibilities in California ... S. H. Dolbear ... 105
Magnesium ... 918
Magnetite anodes ... 803
Major Evans Con. Mines Co. ... 814
Malaguit Dredging Co. ... 882
Malay States, tin mining in ... E. J. Vallentine ... 153
Maloney, W. J. ... 309
Mammoth Copper Mining Co. ... 44, 458, 812
Zinc shipments ... 162
Manganese industry of California ... S. H. Dolbear ... 172
Mine, Ladd ... S. H. Dolbear ... 258
Manhattan Milling & Ore Co. ... 1005
Mann, W. S. ... Bucket elevators ... 187
Maranon placers, exit ... 863
Marathon mill ... 279
Marie Mining Co. ... 305
Marigold Gold Dredging Co. ... 819
Mariposa Commercial Mining Co. ... 773
Marketing low-grade zinc ore ... 861
Marsh, Richard ... Assay of ore containing metallics ... 999
Marsh Mining Co. ... 385
Suit ... 16
Martha Ball Zinc & Lead Co. ... 416, 591
Martin, F. J. ... The mine mule ... 263
Maryana Leasing Co. ... 770
Marysvale potash plant ... 1006
Marysville Dredging Co. ... 999
Mascot Copper Co. ... 739
Railway ... 963
Mason, F. H. ... Precision of thought ... 586

Page

Mason Col. Mining Co., report ... 464
Mason Valley Mines Co., report ... 887
Masonic mining district ... R. P. McLaughlin ... 27
Masonic mining district ... 957
Massachusetts ... 667
Mat. Bee Mining & Milling Co., report ... 769
Mat. Bowl, report ... 466
Matanuska coals, small ... 481
Mazzucchelli, V. and F. Mylius ... Platinum analysis ... 863
McCabe, Raymond ... 618
McDonald, T. B. ... Choosing rock-drill equipment ... 677
Ditto ... Democracy at Lake Superior ... 611
McIntyre, G. E. ... Assay of ore containing metallics ... 815
McIntyre Mines Co. ... 816
Mill ... 667
McKinley-Darragh-Savage Mines Co. ... 624
Report ... 132
McLaughlin, R. P. ... California petroleum in 1914 ... 27
Ditto ... Masonic mining district ... 703
McNamara Mining & Milling Co. ... 895
McNaughton, James ... 296
Meadow Lake district, California ... W. P. Catlin ... 772
Mechanical efficiency of crushing ... H. C. Kenney ... 677
Work of crushing ... A. Del Mar ... 87
Meier, E. W., obituary ... 216
Mekeel tunnel ... Charles S. Shaunessy ... 939
Melones Mining Co. ... W. G. Devereux ... 379
Memphis Mining Co. ... 158
Mercantile Metal Mining Co. ... 889
Merrill, Lewis A. ... 717
Metal loss ... 729
Production of Japan in 1914 ...
Metallurgical practice at Porcupine ... Noel Cunningham ... 365, 734
Ditto ... C. H. Poirier ... 611
Metallurgy of alluvial mining, I, II ... J. M. Nicol ... 837, 869
Metallurgy of quicksilver ... 92
Metals, base ... 936
Selling methods ... 975
Mexican Petroleum ... 711
Mexico ... 976
Hope in ... 898
Mineral production of ... 749
Mining regulations ... 592
Mexico-Cour d'Alene Mines Co. ... 236
Miami, Arizona, strike ... 129
Strike settlement ... 195
Miami Copper Co. ... 120, 457, 664, 963, 1000
Michigan copper production ... 197, 817
Iron mining in ... 176
Michigan-Utah Mining Co. ... 737
Midas mill ... B. P. Howell ... 979
Mill, Original Amador ... 963
Miller, H. E. and G. L. Sheldon ... Powder and its peculiarities ... 754
Milling costs, Goldfield Consolidated ... 879
Gold ores in cyanide ... A. W. Allen ... 302, 585
In Cornwall ... W. J. Loring ... 912
Millsite, national forests ... 465
Milluni tin mining district, Bolivia ... F. C. Lincoln ... 470
Mindanao ... 696
Mine, The—an educational exhibit, P. P. I. E. ... 686
Haulage systems ... 488
Legislation, California ... 489
Locomotives ... 317
Mule ... 206
Ditto ... F. J. Martin ... 263
Rescue telephones ... 503
Safety conference ... 937
Supplies, what they should cost ... B. J. Silbert ... 508
Taxation ... 268, 923
Timber, practical rules for cutting ... Bernard Carr ... 469
Waters ... 813
Mineral county, Colorado, Mineral production, 1914 ... 45
Industries of Brazil ... 682
Production. See also under county or district.
Production in 1914, U. S. G. S. estimates ... 37
Production, Missouri, 1914 ... 850
Production of Canada, 1914 ... 447
Production of Japan ... 593
Production of Mexico ... 249
Products of United States ... 351
Resources of Jujuy province, Argentina ... A. W. Jenks ... 291
Mineral Development Co. ... 490
Mineral Mountain Mining Co. ... 530
Mineral Point Zinc Co. ... 417
Minerals Separation v. Miami ... 662
Miners' electric lamp ... 427
Miners' liens ... 304
Mines Leasing & Mining Co. ... 736
Minier, D. W. ... Agitator from a thickener ... 264
Ditto ... Operation of Oliver filters ... 30
Mining, editorial ... 3
At Santa Barbara ... F. J. De Wilde ... 521
Coal at Dawson, New Mexico ... 730
Copper at Lake Superior. See Read, T. T.
Cost, Goldfield Consolidated, 1914 ... 730
Costs, Portland mine ... 337
Game, the ... 784
Human side of ... J. F. Kemp ... 644
In Belgian Congo ... 142
In Belgian Congo in 1914 ... S. H. Ball and M. K. Shaler ... 403
In the Far North (see Hurja, E. E.)
In Newfoundland ... 143
In New York City ... 1011
In shale at Goldfield ... J. K. Turner ... 995
Industry, the ... 892
Laws, Alaska ... 848, 938
Legislation ... 157
Legislation, national ... 221, 245, 269, 311, 381, 454
Machinery exhibitors at the Exposition ... 1012
Methods at Inspiration ... 695
Methods at Park City, Utah ... James Humes ... 444
Nitrate in Chile ... John G. Beck ... 510
Regulations, Mexico ... 592
Ventures in China ... 607
Visualizing working conditions in ... 440

Page

Mining Corporation of Canada ... 704
Mint estimate, gold and silver production ... 124
Misfires in blasting ... J. B. Burgess ... 330
Missouri minerals at the Exposition ... 807
Mineral output, 1914 ... 850
Missouri Zinc Field ... 158
Mitchell, G. J. ... Heulandite in Oregon ... 735
Mobile Mining & Milling Co. ... 699
Moctezuma Copper Co. ... 668
Report ... 818
Modoc Mines Co. ... 628
Mohawk output ... 40
Moisture in blasting-powder ... 151
In tube-mill feed ... 265
Moll, F. K. R. ... Preservation of timber in mining ... 68
Molybdenum ... 207, 698, 767, 918, 920
Ditto ... Parish V. Bush ... 374
Monarch Mining & Smelting Co. ... 420
Mond Nickel Co., bonds ... 93
Mongolia, gold mining in ... 772
Montana, mineral production, 1914 ... 87
Sapphire mines ... 800
Montana Continental Development Co. ... 810
Montana Phosphate Co. ... 741
Montana-Tonopah Mines Co., report ... 1005
Monte Rico Mining Co. ... 274
Morse, E. C., Ore treatment by the Vandercook process ... 254
Mother Lode copper mine ... 493
Motor-driven mine pump ... 279
Motor-truck haulage ... 909
Mt. Baker mining district ... 814
Mt. Elliott Copper Co., Ltd., report ... 126
Mount Elliott mine ... W. H. Corbould ... 682
Mt. Lassen ... 864
Eruptions of ... H. W. Turner ... 955
Mt. Lyell, blast-furnace practice at ... 183
Mt. Morgan Gold Mining Co., Ltd., Concentration at ... 260
Report ... 242
Mountain Copper Co. ... 493
Mountain King Mining Co. ... 120, 345
Report ... 701
Mountain Queen ... 772
Mountain View mine, fire fighting at ... 966
Mounted Jackhamer drills ... 393
Moving a shovel up and down grade ... 333
Mudd, Seeley W. ... Boss mine, Good Springs, Nevada ... 297
Mule, the mine ... 206
Mules for mine haulage ... 957
Mullan copper mines consolidation ... 597
Muskingum Lead & Zinc Co. ... 591
Mylius, F., and A. Mazzucchelli ... Platinum analysis ... 481
Mysore Gold Mining Co., Ltd. ... 633

N

National forests ... 265
Mining legislation (see mining legislation)
National Copper Co. ... 346
National Gold & Silver Co. ... 193
Natomas reorganization ... 821
Nevada, Boss mine ... Seeley W. Mudd ... 297
Mineral production, 1914 ... 80
Minerals at the Exposition ... 735
Report of state inspector of mines ... 119
Welfare and development conference ... 306
Nevada-California Power Co. ... 1004
Nevada Consolidated Copper Co. ... 311, 535, 666
Accidents ... 460
Report ... 893
Nevada Co-operative Mines Co. ... 927
Nevada-Douglas Consolidated Copper Co. ... 305
Nevada Hills Mining Co. ... 197, 813
Report ... 426
Nevada Industrial Commission report ... 535
Nevada Mining & Development Co. ... 630, 1005
Nevada Packard Mines Co. ... 775
Nevada Wonder mine ... 459
Ditto ... Stoping methods at ... T. M. Smither ... 757
Nevius, J. Nelson ... Precision of thought ... 112
New Arcadian ... 492
New Cornella ... 418
Tonnage ... 150
New filtering process at Treadwell cyanide plant ... W. P. Lass ... 256
New Idria Quicksilver Mining Co., report ... 601
New Keystone consolidation ... 156, 161, 191
New Mexico, mineral production, 1914 ... 37
New Quincy Mining Co. ... 738
New York metal review ... 50
New Zealand, Kauri gum deposits of ... 181
Minerals at the Exposition ... 735
Newfoundland, mining in ... 142
Newton, L. V. ... Testing burned-out armatures ... 329
Nickel determination ... 919
In aluminum ... 766
Output ... 661
Plating aluminum ... 376
Production, Canada ... 159
Shipments to Europe ... 159, 192, 246, 698
Nickel Plate mine ... 767
Nicol, J. M. ... Metallurgy of alluvial mining, I, II ... 837, 869
Neill, J. W. ... Dredging costs ... 901
1906-1915 ... 606
Nipissing Mining Co. ... 594, 667, 733, 814
Report ... 460
Nitrate deposits, Oregon ... 598
Industry, Chile ... 619
Mining in Chile ... John G. Beck ... 510
Operators of Chile ... 169
Statistics, Chile ... 185
Nitrogen ... 766
Nitroglycerin ... 919
Noble Electric Steel Co. ... 23, 925
Noblett, R. ... Economical use of explosives ... 446
North Butte Mining Co. ... 630
Report ... 273

Page

North Star Mines Co. . . . 629
Dividends . . . 44
Empire suit . . . 935, 964
Report . . . 671
North Thompson Associated Mines Co . . . 192
North Washington Power & Reduction Co . . . 704
Northern Ontario Light & Power Co . . . 753
Notes from South America . . . Mark R. Lamb . . . 852
Nova Scotia Steel & Coal Co . . . 808
November Mining Co . . . 698
Nyman Consolidated Mines Co . . . 1002

O

Oatman district, Arizona . . . 963
Oatman Gold Mining & Milling Co . . . 310
O'Boyle, Francis . . . Amalgamation in Hardinge mills . . . 450
Octo Mining Co . . . 274
Ohio mine caving system . . . F. Sommer Schmidt . . . 361
Oil exhibits at the Exposition . . . 946
Exports from Tampico . . . 275
Fields Protection of California . . . 170, 935
Refineries, Kurokawa . . . 803
Shales, regional alteration of . . . David White . . . 161
Oils and flotation . . . 673, 675
Oklahoma lead and zinc output, 1914 . . . 814
Old Dominion Co . . . 234, 811, 1000
Old Dominion Copper Mining & Smelting Co . . . 234
Report . . . 628, 811
Smelter . . . 664
Oliver filters . . . 859
Operation of . . . D. W. Minier . . . 31
Oliver Iron Mining Co . . . 454, 699
Omineca district, B. C . . . W. M. Brewer . . . 443
On the threshold . . . 639
Ontario, Effect of War on mining . . . 1001
Mines and dividends, 1914 . . . 38
Ontario Mining Co . . . 421
Suit . . . 121
Oolites, Origin of . . . 514
Opal mining . . . 695
Open-cut mining, Missouri . . . 158
Operations of the Yukon Gold Co . . . 874
Opportunities in China . . . H. Y. Liang . . . 868
Opportunity for workmen at Anaconda . . . 480
Ore treatment at Cripple Creek . . . P. H. Argall . . . 135
Treatment by the Vandercook process . . . E. C. Moore . . . 254
Oregon Gold Mines Co . . . 342, 967
O'Reilly Gold Mining Co . . . 305
Organization at the Treadwell cyanide plant . . . 217
Oriental Consolidated . . . 313, 667
Origin of iron ores at Kiruna . . . R. A. Daly . . . 148
Original Amador mill . . . 963
Orion Mining & Milling Co . . . 457, 1002
Oro Belle . . . 158
Oro Hondo . . . 960
Oro W. L. & P. Co. dredge . . . 120
Oronogo Circle . . . 347
Oroville, Dredging costs at . . . 260
Oroville Dredging Co., Ltd . . . 120
Report . . . 242
Orynski, Leonard, Sr . . . 815
Osceola Con. Mining Co., report . . . 464
Outlook for engineers . . . T. H. Oxnam, Jr . . . 789
Oxnam, T. H . . . 388

P

Oxnam, T. H., Jr . . . The outlook for engineers . . . 789
Pachuca vats, Capacity of . . . 415
Pacific Chemical Co . . . 849
Paige, C. L . . . Financing mining operations . . . 787
Pan-American finance . . . 896
Panama Canal . . . 880
Panama Mining Co . . . 164
Panama-Pacific Exposition . . . 281
The Mine . . . 686
Park City Mills Co . . . 776
Parmenter, J. G . . . 1007
Parrish, K. C . . . Amalgamation in Hardinge mills . . . 641
Parsons, A. R . . . 461
Passing of the pioneer . . . 507
Patagonia district . . . 924
Patents and metallurgists . . . J. A. Carpenter . . . 374
Pato and Nechi placer properties, Colombia . . . W. S. Prichard . . . 220
Prospecting dredging ground at . . . 298
Pebbles for tube-mills, Characteristics and costs . . . 103
Substitute for Danish . . . 259
Peck, Peter . . . 497
Penn Mining Co . . . 310
Pennsylvania Con. Mining Co . . . 458
Per capita metal production . . . 265
Permanent survey stations . . . J. H. Eggers . . . 149
Peru Gold Placers, Inc . . . 863
Peru, Largest gold mine . . . 928
Petroleum, California in 1914 . . . 132
Conservation in California . . . 714
In Argentina . . . 294
Industry of California, Report on . . . 467
Phelps, Dodge & Co., report . . . 818
Ditto . . . Sociological work . . . 658
Philippine Dredges, Ltd . . . 313
Philippine Mining Association . . . 882
Philippines, dredges . . . 148
Gold output . . . 199, 451
Lurigao iron ore . . . 852
Mineral resources . . . 668
Phoenix Mining Co . . . 420
Phosphate deposits, Montana . . . 741
Phosphates, Florida . . . 205
Picher Lead Co . . . 416
Pickles, V . . . Rand's largest central power-station . . . 225
Picric acid . . . 880
Pietrusky, Kurt . . . Japan and China . . . 866
Pig-iron output . . . 895

Page

Pindel, J. W . . . Amalgamation in Hardinge mills . . . 448
Pines Altos Mining & Milling Co . . . 630
Pioneer Consolidated Mines Co . . . 630, 818
Pit bibliography . . . 910
Pitkin county, Colo., mineral production, 1914 . . . 44
Pittsburg Mt. Shasta Gold Mining Co . . . 306
Pittsburg Placer Mining Co . . . 959
Place, for one . . . 636
Placer mining claims in the Yukon . . . J. A. MacDonald . . . 333
Mining on the Seward Peninsula . . . E. E. Hurja . . . 388
Placers in Western Canada, Regulations governing . . . 412
Platinum . . . 87, 861
Analysis . . . F. Mylius and A. Mazzucchelli . . . 484
Dredging for in the Kyshtim valley . . . 327
In Southern Nevada . . . Adolph Knopf . . . 876
Output, Russia . . . 880
Recovery in mints . . . 813
The search for . . . 751
Plumbing a shaft . . . J. A. Walker and R. T. Crawford . . . 715
Plymouth Consolidated Mines Co . . . 157, 665, 895
Output . . . 161, 196
Report . . . 739
Poirier, C. H . . . Metallurgical practice at Porcupine . . . 611
Polverde . . . 918
Pope, F. J . . . Leaching by the Hoffman process . . . 655
Porcupine Crown Mines, Ltd., costs . . . 801
Report . . . 602
Porcupine district metallurgical practice . . . Noel Cunningham . . . 365
Portable air-compressor . . . 52
Electric drills . . . 820
Portland cement . . . 958
Cement production of U. S., 1914 . . . 90
Portland Gold Mining Co., Ltd . . . 921
Mining cost . . . 337
Report . . . 426
Possibilities of the Mother Lode in depth . . . John Daggett . . . 941
Potash . . . 919
Situation in 1914 . . . 373
Powder and its peculiarities . . . G. L. Sheldon and H. E. Miller . . . 754
Boxes, safety . . . 373
Magazines . . . 919
Powder River Dredging Co . . . 703
Power drills, Fairbanks . . . 343
Plant, B. & M . . . 698
Station, Rand's largest central . . . V. Pickles . . . 225
Transmission . . . 747
Practical points on sampling . . . Arthur Feust . . . 368
Ditto . . . W. W. Hughes . . . 525
Precipitating action of carbon in cyanide solutions . . . W. R. Feldtmann . . . 791
Precision of thought . . . 431
Ditto . . . Bernard MacDonald, F. H. Mason . . . 686
Ditto . . . J. Nelson Nevius . . . 112
Ditto . . . T. A. Rickard . . . 186
Ditto . . . W. H. Shockley . . . 118
Preferential flotation . . . 974
Ditto . . . O. C. Ralston . . . 980
Premier (Transvaal) Diamond Mining Co., Ltd., report . . . 426
Present outlook for quartz mining in the Fairbanks district . . . E. E. Hurja . . . 114
Preservation of timber in mining . . . F. K. R. Moll . . . 68
Presidential withdrawals held valid . . . 320
Presidio haulage . . . 917
Presidio Mining Co . . . 382
Price of quicksilver . . . 567
Of spelter, London and New York . . . 733
Price Mining Co . . . 967
Prichard, W. S . . . Pato and Nechi placer properties . . . 220
Ditto . . . Prosperity at Pato . . . 298
Primos Chemical Co . . . 493
Prince Con. Mining & Smelting Co . . . 598
Pringle, G. R . . . Amalgamation in Hardinge mills . . . 898
Probiglo Mining Co . . . 385
Problems of labor . . . Editorial I, II, III . . . 170, 247, 397
Processes and publicity . . . 897
Profits of the Rand Mines, Ltd., subsidiaries . . . 361
Pro-German sympathies . . . 896
Progress in copper metallurgy . . . Editorial . . . 5
In metallurgy . . . James Douglas . . . 571
Professors of mining . . . 823
Ditto . . . Ross E. Browne . . . 899
Ditto . . . T. T. Read . . . 977
Profitable use of an old hammer-drill . . . 523
Property exempt from attachment . . . 488
Proske, O . . . Zinc muffles . . . 176
Prospecting at Pato, Colombia . . . 298
By hydraulicking . . . 734
Mill, Sam Yet . . . Algernon Del Mar . . . 371
River bars in cold countries . . . T. N. Turner . . . 371
Wet placer ground by shaft-sinking . . . Donald Steel . . . 66
Protection of oilfields . . . 170
Psychology in mining . . . 895
Pulleys . . . 636
Pumps . . . 933
Centrifugal v. reciprocating . . . 524
Purcell, T. C . . . Caps and fuse . . . 941
Pyrite smelting . . . Editorial . . . 53

Q

Quantitative blowpipe analysis in the field . . . E. C. Woodward . . . 865
Quatsino Copper Co . . . 928
Quebec mineral output . . . 884
Queen Regent Merger Mines Co . . . 272
Quicksilver . . . 861
Deposits of the Kuskokwim . . . 664
Extraction, wet method . . . E. B. Thornhill . . . 873
In 1914 . . . C. G. Dennis . . . 91
Mines in U. S . . . 120
Mining at Oceanic mine . . . 375
Prices . . . 935
Reduction plant, Cost of . . . 452

Page

Quilp Mining Co. ... 198
Quimsa Cruz tin district ... F. C. Lincoln. ... 721
Quincy Mining Co. ... 453, 591
Report ... 769

R

Radium made by Bureau of Mines ... 587
Ragon Development Co. ... 384
Railway dollar ... 993
Raise or rise? ... F. Sommer Schmidt. ... 611
Ralston, O. C. ... Preferential flotation. ... 980
Rambler-Cariboo Mines Co., report ... 1006
Rand and the war ... 974
Gold production. See gold production.
Largest central power station ... V. Pickles. ... 225
Rand Mines, Ltd., subsidiaries ... 364
Ray Consolidated Copper Co. ... 310
Report ... 628, 893
Ray, J. C. ... Copper beds of the Coeur d'Alene. ... 299
Raymond R. W. ... Knowledge and research. ... 683
Read, Thomas T. ... Lake Superior copper mining, present and future, II, III, IV ... 209, 284, 398
Ditto ... Professors of mining. ... 977
Reconstruction in Mexico ... 130
Records in converter practice ... 429
Red Cliff district ... 629
Red Top Mining Co. ... 311
Reed process electrolytic zinc ... E. H. Leslie. ... 17
Regional alteration of oil shales ... David White. ... 151
Regrinding at Lake Superior mill ... 288
Cost of ... 734
Regulations governing placer work, Western Canada ... 412
Reorganized Booth Mining Co. ... 386, 883
Republic Consolidated Mines Corporation ... 237, 599
Research Corporation report ... 157
Research for engineers ... E. G. Spilsbury. ... 715
Residual iron ores ... 806
Reverberatory furnaces ... 766
Anaconda ... 587
Coal dust fired ... 175
Smelting, McGill, Nevada ... 340
Revision of the mining law ... 376
Revival of the Meadow Lake district, California ... W. B. Catlin. ... 296
Rex Mining & Smelting Co. ... 158
Rhythmic precipitation and colloid ores ... George E. Collins. ... 586
Ditto ... J. F. Kemp. ... 78
Ditto ... E. A. H. Tays. ... 413
Precipitation of ferrous ferri-cyanide and ferrous hydroxide in jelly ... H. J. M. Creighton. ... 65
Richards, R. H.—An appreciation ... D. H. Browne. ... 483
Ditto ... Presentation of gold medal. ... 467
Rickard, T. A. ... Dinner to. ... 531
Ditto ... Goldfield revisited, I, II, III. ... 797, 829, 907
Ditto ... Grass Valley revisited, I. ... 943
Ditto ... Mining. ... 8
Ditto ... Precision of thought. ... 186
Ricketts, L. D. ... Some problems in copper leaching. ... 515
Rico Consolidated Mines Co. ... 665
Rico-Wellington Consolidated Mining Co. ... 235, 1003
Report ... 464
Ridge & Valley Mining Co. ... 814
Right-of-way ... 340
Rio Tinto Copper Co., Ltd., report ... 931
Rise, A. ... 897
Or raise? ... L. S. Ropes, A. L. Horner, An Innocent Bystander ... 715
Ditto ... H. N. Herrick. ... 897, 900
Rising Hope Mine ... 162
Rittman process ... 257
Rocher de Boule Copper Co. ... 742, 810
Rochester Consolidated Mines Co. ... 851
Rochester Mines Co. ... 163, 851
Rochester Weaver ... 851
Rochester mining district, Nevada ... 197, 220
Rockford district, South Dakota ... 961
'Rock' or 'ore' ... H. A. Guck and W. A. Hopper. ... 612
Rock-crushers, Capacity of ... 919
Efficiency of ... 998
Rock-drill equipment, Choosing ... P. B. McDonald. ... 618
Rocklin Mining Co. ... 527
Rogers-Brown Ore Co. ... 451
Rollin Mining Co. ... 819
Roodhouse, O. E. ... Assay of cyanide solutions. ... 760
Rope capacity of drums ... 155
Drives ... 155
Ropes, L. S. ... Rise or Raise? ... 715
Rosenblatt, Girard B. ... Application of electric motors to gold dredges ... 12
Ross, F. A. ... Speculation in mining. ... 895
Round Mountain Mining Co. ... 845
Report ... 970
Royal Gold Mines Co. ... 964
Rubber famine, The ... Editorial. ... 95
Ruby district, Alaska ... E. E. Hurja. ... 966
Ruby Hill Gold & Copper Co. ... 926
Russia, Dredging for platinum in the Kytlim valley ... R. S. Botsford. ... 397
Platinum output ... 880
Russo-Asiatic Corporation ... 41

S

Safety in California mines ... 863
Powder-boxes ... 373
Sanitation, and welfare work, U. S. Steel Corporation ... A. A. Willoughby. ... 474
Self-oiling clutch ... 393
Work, Anaconda ... 42, 188
Work, Nevada Consolidated ... 188
Saginaw Mining Co. ... 385
Salt in sea-water ... 844

Page

Salting mine samples ... 576
Sampling, Practical points on ... Arthur Feust. ... 368
Samson Mining Co. ... 591
Sam Yet prospecting mill ... Algernon Del Mar. ... 371
San Luis Potosi ... 705
San Toy Mining Co. ... 275
Sandstorm-Kendall ... 846
Sanitation work, U. S. Steel Corporation ... 474
Santa Barbara, Mining at ... F. J. DeWilde. ... 521
Santa Fe Dredging Co. ... 959
Santa Fe Gold & Copper Mining Co. ... 379
Santa Rita district ... 924
Santa Ysabel Mining & Milling Co. ... 925
Sapphire mines at Yogo, Montana ... O. W. Freeman. ... 800
Saskatchewan, Beaver Lake district ... C. A. Banks. ... 954
Scale, Use of zinc to prevent ... 844
Schmidt, F. Sommer ... A suggestion. ... 643
Ditto ... Caving system at the Ohio mine. ... 361
Ditto ... Raise or Rise? ... 611
Scratch Gravel district, Montana ... 530
Search for platinum ... 751
Ditto ... H. D. Gray. ... 942
Secondary enrichment of copper ores ... A. L. Day. ... 841
Security Copper Co. ... 313
Selenium ... 843
Self-dumping bucket ... 151
Seneca-Superior Silver Mines, Ltd., report ... 601
Senn Concentrator ... 636
Seoul Mining Co. ... 123, 460, 667, 1007
Report ... 1010
Seven Troughs Coalition Mining Co. ... 163, 274, 387
Report ... 1005
Sewall, Barton ... 117
Seward Peninsula, Placer mining on ... E. E. Hurja. ... 588
Shafroth bill to regulate coal land leasing ... 117
Shaft-sinking at Kelvin, Arizona ... A. L. Flagg. ... 250
Cost of ... 452
Shaler, M. K., and S. H. Ball ... Mining in the Belgian Congo in 1914 ... 403
Shasta Dredging Co. ... 701, 812
Shattuck Arizona Copper Co. ... 533
Report ... 351
Shaughnessy, Chas. S. ... Mekeel tunnel. ... 216
Sheldon, G. L., and H. E. Miller ... Powder and its peculiarities ... 754
Ship-purchase bill ... 215
Shipper Copper Co. ... 698
Shockley, W. H. ... Precision of thought. ... 448
Ditto ... Speculation in mines. ... 900
Shooting old drill-holes ... 452
Short Land Mining Co. ... 271
Shoveling-machines at Flat River ... W. Whaley. ... 79
Halbey ... 934
Shui-kou-shan mine, China ... H. Y. Liang. ... 914
Siberia, Altai region ... H. W. Turner. ... 973, 985
Sieve-shaker, A simple ... W. S. Black. ... 439
Silbert, B. J. ... What mine supplies should cost. ... 508
Silver and gold, dissolution in thickeners ... F. A. Voorhees. ... 227
Content of Lake Superior copper ... 80
Silver Glance Mining & Developing Co. ... 379, 960
Silver Islet, Recollections of ... 236
Silver King Consolidated ... 312
Silverton district, Colorado ... 1003
Silverton Mines, Ltd. ... 809
Simmons, Jesse ... Continuous decantation in South Dakota ... 575
Siren, Denver ... 280
Skidoo Mines Co. ... 701
Sleeman, H. R. ... Whim Well copper mine. ... 154
Smelter contracts ... 973
Fume ... 695, 822
Gas dilution, Midvale ... 579
Smelting at Greenwood, B. C. ... 956
At Lake Superior ... 289
Copper sulphide ore ... William Kemp. ... 263
In Georgia ... Herbert Lang. ... 152
Smithers, T. M. Stoping methods at the Nevada Wonder. ... 757
Smithsonite ... 896
Smoke dilution at Midvale ... L. S. Austin. ... 579
Snow-slide at Britannia mine ... 532
Snow-slides ... 505
Sociological work by the Phelps-Dodge companies ... 658
Socorro Mining & Milling Co. ... 46
Sodium carbonate ... 919
Sohnlein, M. G. F. ... Design of belt elevators. ... 485
Solution control in cyanidation ... A. W. Allen. ... 186
Some problems in copper leaching ... L. D. Ricketts. ... 515
Sonoma Magnesite Co. ... 421
Sons of Gwalia, costs ... 445
Report ... 382
South America news notes ... Mark R. Lamb. ... 832
South Crofty ... 491
South Dakota, mineral production in 1914 ... 37
South Jackson Mining Co. ... 161
South Kalgurli costs ... 802
South Lake mine ... 468
Southern Pacific Gold & Copper Mining & Milling Co. ... 667
Southwestern Mining Co. ... 382
Specific gravity apparatus ... 260
Specifications for new equipment ... 831
Speculation in mines ... 606
Ditto ... T. F. Banigan. ... 940
Ditto ... Courtenay De Kalb. ... 753
Ditto ... F. A. Ross. ... 825
Ditto ... W. H. Shockley. ... 900
Spelter ... 821
London and New York price ... 733
Prices ... 268
Prices, 1914 ... 631
Production, Butte & Superior ... 337
Spilsbury, E. G. ... Research for engineers. ... 715
Spiral-riveted pipe ... 747
Split-check system at Cripple Creek ... 999
Spotted Horse mine ... 850
Spray, L. E. ... Alaska Gastineau mill. ... 612

Page

Springfield Tunnel & Development Co ... 43
St. John del Rey Mining Co., Ltd., report ... 136
St. Joseph Lead Co ... 122 163
St. Louis Cerro de Mining Co ... 530
Star Canon Land Co., report ... 818
Stake-cushing ... 718
Stamp mill data, Brunswick Consolidated Test, E. S. King ... 109
Standard Oil Co. (California), report ... 461
In China ... 170
Standard Silver Lead Mining Co ... 814
Star Consolidated ... 210
State managed liability insurance ... 705
Mining laboratory, Nevada ... 46
Statics of the mining engineer ... 544
Steam engine made from compressed ... 501
Steam shovels moving up and down grade ... 333
Steel for drills ... 944
Pipe ... 270
Production direct from ore ... 95
Rails in Australia ... 419
Supports for mines, F. H. Wagner ... 372
Steel, Donald, Prospecting wet placer ground by shaft sinking ... 66
Steele Heath, Cost and efficiency ... 518
Stelzer Mining Co ... 457, 534
Stemming ... 734
Stephens, Emmanuel ... 497
Stewart Mining Co ... 273, 535
Suit ... 741
Sticht Robert, Blast-furnace practice at Mt. Lyell ... 183
Stope-boards ... 440
Stoping cost ... 805
Drill ... 972
Methods at the Nevada Wonder, T. M. Smithers ... 757
Storage-battery locomotives ... 622
Stotts City district ... 921
Stowell Mining & Leasing Co ... 966
Stronck, H. N., and J. R. Billyard, Visualizing working conditions in a mine ... 440
Strontium and barium ... 206
Stratton's Independence, Ltd ... 821, 862, 817, 883
Sale ... 51
Report ... 186
Struthers, Joseph, Johnson electric furnace ... 933
Sturtevant mills ... 881
Sublimed white lead ... 887
Success Mining Co., F. Sommer Schmidt ... 643
Suggestion ... 200
Sulphide Corporation, Ltd., report ... 45
Summit county, Colo., mineral production, 1914 ... 601
Superior & Pittsburg Copper Co., report ... 853
Surigao iron ore ... 119
Survey stations, Permanent, J. H. Eggers ... 959
Susquehanna Copper Co ... 698
Sutton Consolidated Mining Co., The first move ... 96
Swart, W. G ... 522
Swedish iron and steel at the Exposition ... 756
Swetland, H. M., Industrial journalism ... 885
Swisshelm Mountain Mining Co ... 885

T

Taking care of the human mechanism ... 469
Talc ... 415
Tamarack & Custer Consolidated Mining Co ... 236, 458
Tamping ... 734
Efficiency of, E. A. Collins ... 790
Tanalyk Corporation and the War ... 94
Tata Iron & Steel Co., beginnings of, C. M. Weld ... 97
Tax commission, South Dakota ... 529
Taxation of mines ... 923
Of ore reserves, Wisconsin ... 119
Philippines ... 882
Tays, E. A. H., Rhythmic precipitation of colloidal ores ... 413
Technical reminiscences—I, II, III, A. R. Ledoux ... 761, 833, 903
Teck-Hughes ... 594
Telephones for mine rescue work ... 503
Teller county, Colorado, mineral production, 1914 ... 45
Tellurides ... 957
Temiskaming & Hudson Bay ... 736, 884
Merger ... 960
Temperature ... 958
Temporary zinc-box, A. W. Allen ... 657
Tennessee Copper Co ... 667
Acid plant ... 237
Terrible Dunderberg M. & P. Co ... 1003
Testing stamp-mills ... 109
Texas, Mineral production in 1914 ... 37
Quicksilver mines, 1914 ... 91
Texas Mining Co ... 311
Thallium, properties and uses ... 33
Thickener, an agitator from a, D. W. Minier ... 264
Thornhill, E. B., Wet method of mercury extraction ... 873
Throttle-valve, improved balanced ... 1011
Timber Butte Milling Co. plant ... 1004
Tin assay ... 622
District, Quimsa Cruz, F. C. Lincoln ... 721
Exports ... 605
Mines, Alaska ... 590
Mining in the Malay States, E. J. Vallentine ... 153
Mining, Milluni district, Bolivia ... 470
Ores, dressing of ... 962
Smelting in Chile ... 821
Tinfos Iron Works, Notodden ... 23
Tintic Central Mining Co ... 163
Tintic Tunnel Co ... 536
Tirbircio Mining Co ... 419
Todd, R. H., Financing mining operations ... 609
Tolovana district, Alaska ... 810
Tom Reed Mining Co ... 596
Dividends ... 1002
Tongkah Harbour Tin Co., report ... 463

Page

Tonopah, Editorial ... 57
Consolidation ... 195
Cost of mining and milling at ... 881
District production ... 80
Mining situation settled ... 834
Tonopah Belmont Dev. Co ... 834
Mill extraction ... 806
Report ... 841
Tonopah Extension Mining Co., report ... 116
Tonopah Mining Co ... 159
Report ... 842
Suit ... 47
Tonopah Placers Co ... 494
Report ... 841
Tonnage calculations, tube mill, Noel Cunningham ... 16
Of materials hauled in mines ... 361
Tax, Michigan ... 117
Tough Oakes Gold Mining Co., Ltd., report ... 426
Trade agreements ... 341
Trail smelters, improvements in ... 74
Tramway, automatic aerial ... 158
Transvaal at the Exposition ... 951
Travers, John ... 843
Traverse tables, some uses of, James Underhill ... 519
Treadwell cyanide plant, new filtering process at, W. P. Lass ... 256
Ditto, organization at ... 217
Triboluminescence ... 695
Trinity Asbestos Co ... 999
Trinity county mining, California ... 196
Trinity Development Co ... 384
Trinity Dredging Co ... 999
Trinity River Mining Co ... 381
Tube-mill feed, moisture in ... 265
Liners, steel ... 695
Pebbles, their characteristics and cost, E. C. Eckel ... 103
Pebbles, Danish and substitutes ... 139
Tonnage calculations, Noel Cunningham ... 16
Tungsten ... 354
Ore ... 812, 919
Tunky Mining Co ... 815
Tunnel sites ... 229
Tuolumne Copper Mining Co ... 159
Tuolumne county mines ... 964
Turbo-generators ... 844
Turner, H. W., Altai region, Siberia ... 973, 985
Ditto, Eruptions of Mt. Lassen ... 955
Turner, J. K., Mining in the shale at Goldfield ... 995
Turner, T. N., Prospecting river bars in cold countries ... 371
Twin Lakes district, Leadville ... 118
Tyssedal, electric smelting at, R. M. Keeney ... 527

U

Ulrich, B. T., Undercurrents ... 866
Undercurrents, construction of, C. W. Haffey ... 979
Ditto, C. S. Haley ... 679
Underground crushing-stations ... 734
Underhill, James, Some uses of traverse tables ... 519
Union Gold Mining Co ... 701
Union Hill Mine ... 886
Union Hydraulic Gold Mining Co ... 496
Union Mines Co ... 598
United Copper Co ... 537, 852
United Eastern Mining Co ... 848, 885
United Globe Mines, report ... 811
United Metals Selling Co ... 418
United States Copper Co ... 959
United States Geological Survey at the Exposition ... 303
Building ... 395
United States Reduction & Refining Co ... 740, 770, 808
United States Smelting, Refining & Mining Co ... 592, 931
United States Steel Corporation ... 245
Suit ... 877
Welfare work, A. A. Willoughby ... 474
United Verde Copper Co ... 848
Extensions ... 963
Utah mineral production ... 89, 714
Mines and dividends, 1914 ... 38
Utah Apex Mining Co., mine ... 460
Report ... 348
Utah Consolidated Mining Co., report ... 703
Utah Copper Co ... 312
Flotation ... 233
Report ... 776
Utah Metals & Tunnel Co ... 83, 738
Uwarra gold mine ... 61
Mill, Percy E. Barbour ... 302

V

Valdez Creek placer mines ... 209
Vallentine, E. J., Tin mining in Malay States ... 153
Ditto, Valuation of dredging ground ... 262
Valley adit, Leadville ... 1000
Valor Gold Mining Co ... 999
Valuation of dredging ground, Edmund Bonella ... 111, 585
Ditto, J. J. Bristol ... 825
Ditto, R. T. Hancock ... 585
Ditto, E. J. Vallentine ... 262
Valves at the Exposition ... 972
Van Tuyl, F. M., Origin of dolomites ... 64
Vandercook process, Ore treatment by the, E. C. Morse ... 254
Vapor-pressure ... 918
Victor Power & Mining Co ... 345, 596
Victoria Mining Co., report ... 385
Victorio Mining & Smelting Co ... 960
Victory Gold Mines Co ... 849
Vindicator Con. Gold Mining Co ... 702
Vinegar Hill Zinc Co ... 922
Vipond, report ... 661
Visualizing working conditions in a mine, H. N. Stronck and J. R. Billyard ... 440
von Bernewitz, M. W., Amalgamation in Hardinge mills ... 111

Page

Voorhees, F. A.....Dissolution of silver and gold in thickeners 227
Vulcan Copper Co..... 460

W

W. P. & C. mine..... 596
Wage increase, Lake Superior district..... 769
Wagner, E. B.....Electric mine locomotives.... 134
Wagner, F. H.....Steel supports for mines.... 372
Waldo copper mine..... 387
Waldo-Bean mine..... 959
Walker, J. A.....Pumping a shaft.... 715
Wanakah smelter, Ouray..... 196
War and Japan..... 282
War and the London mining market.....T. A. Rickard.... 6
Warriedars..... 308
War's menace to the copper industry..... 283
Washington, mineral production..... 123
Profits of mines..... 164
Wasp No. 2 costs..... 524
Report..... 463
Waste of experience..... 570
Water in Pennsylvania anthracite mines..... 333
Water-pipes..... 998
Water-wheel generators..... 317
Water-wheels at the Exposition..... 352
Watson-Denny grinding pan..... 113
Ways that are dark.....John B. Farish.... 576
Ditto.....A. H. Hale.... 678
Wedge Gold Mining & Milling Co..... 164
Weir in Burma..... 219
Weld, C. M....Beginnings of the Tata Iron & Steel Co.... 97
Weldon Mining Co..... 884
Welfare work.....U. S. Steel Corporation.... 474
West End, apex litigation.....H. V. Winchell.... 763
West Toledo Mining Co..... 737
West Virginia Mining Co.....599, 847
Western Australia gold yield.....382, 962
Western Canada, regulations governing placer mining in.. 412
Western Federation of Miners, Butte suit..... 1004
Western Gold & Copper Co..... 84
Western Mining Co.....308, 455
Western Ore Purchasing Co..... 163
Western Union Mines Co.....198, 237, 536
Western Zinc Mining & Reducing Co.....433, 458
Western Zinc Oxide Co.....458, 1003
Wet method of mercury extraction.....E. B. Thornhill.... 873
Wettlaufer Lorrain Silver Mines Co..... 164
Wha Chang Antimony Co..... 169
Whaley, W.....Shoveling machines at Flat River.... 79
What mine supplies should cost.....B. J. Silbert.... 508
Wheelbarrows..... 622
Whim Well Copper Co.....H. R. Sleeman.... 154
White, David....Regional alteration of oil and shales.... 151
White lead..... 881
Paint..... 957
White Caps Mining Co.....496, 888

Page.

White Pine Copper Co., report..... 965
Who will engineer the engineers?.....C. M. Becker.... 525
Ditto.....A. Engineer.... 227
Ditto.....K. C. N. Engineer.... 413
Wilbert Mining Co., report..... 887
Willoughby, A. A.....Safety, sanitation, and welfare work, U. S. Steel Corporation..... 474
Willow Valley Mining Co..... 886
Wilshire Bishop Creek Co.....384, 596
Wilson, Jacob..... 497
Winchell, H. V.....Apex litigation—Jim Butler v. West End..... 763
Winona Copper Co., report..... 775
Wire rope service..... 376
Wisconsin ore production..... 119
Zinc district.....770, 881
Wisconsin Zinc Co..... 922
Wood pipe and tanks..... 782
Woodward, E. C.....Quantitative blowpipe analysis in the field..... 865
Worcester affair and Constitutionalist extortion..... 468
Worcester, S. A.....Labor-saving devices.... 727
Wyoming, mineral production in 1914..... 37

Y

Yak Mining, Milling & Tunnel Co..... 850
Yellow Pine district, platinum in..... 876
Ygnacio Mining Co..... 381
Y. M. C. A. work at Bunker Hill & Sullivan..... 57
Yuanmi contract suit..... 962
Ore treatment..... 844
Yuba Consolidated Gold Fields Co..... 1003
Yuba dredges at Exposition..... 859
Yukon Gold Co. operations..... 874
Yukon, Placer mining claims in..... 333

Z

Zinc Corporation..... 736
Zinc and lead..... 973
Box, A temporary.....A. W. Allen.... 657
Condensation in electric smelting..... 26
Dust embargo..... 935
Effect of impurities on..... 844
Effect of War on..... 920
From Australia..... 920
Market..... 874
Muffles, Effect of slag and fume on.....O. Proske.... 176
Ore, Marketing low-grade..... 861
Ore prices.....376, 417, 783
Ore production.....271, 936
Pigments and the Leadville works.....E. H. Leslie.... 433
Production (see under districts).
Production, Kansas..... 817
Smelters..... 922
Smelters in the U. S..... 950
Used to prevent scale..... 844

MINING PRESS

Issued Every Saturday — SAN FRANCISCO, JANUARY 2, 1915

Contents, Page 4
Buyers Directory, Page 3
Advertisers' Index, Page 4

1915 JANUARY—FIRST MONTH 1915

Mining is not all adventure, nor is adventure, judiciously planned, an altogether forbidden thing in the counting house or even in the banker's closet.—*Mining and Scientific Press, Jan. 7, 1865.*

SUNDAY FOR REST

SUN.	MON.	TUES.	WED.	THUR.	FRI.	SAT.
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

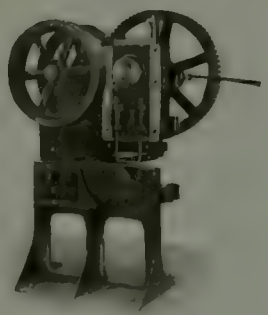
SATURDAY THE PRESS

Jan. 9, Davey's safety lamp first used in mines.....1816
Jan. 1., Iron first made with anthracite as fuel at Mauch Chunk, Pa....1839
Jan. 18, Gold discovered in California.....1848
Jan. 27, Largest diamond in the world discovered at Premier mine.....1905

"If you want to please a mining engineer refer to him as a miner. If you want to flatter a miner, call him an expert. If you want to wheedle a director, always pretend to believe him a capitalist—especially if you know he is not."—*The Cynical Superintendent.*

HOT DAY AT KALGOORLIE IN JANUARY

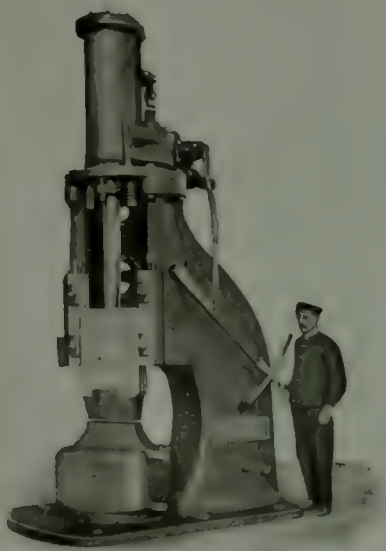
MACHINE SHOP EQUIPMENT



DOTY SHEARS

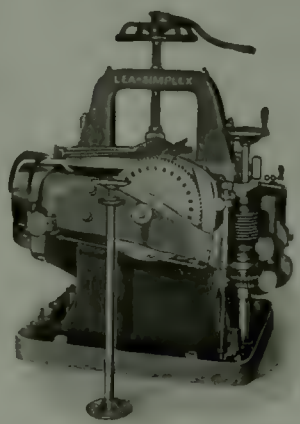
OUR MACHINE TOOL

DOTY PUNCHES



BEMENT STEAM HAMMERS

CATALOG
WILL BE SENT
ON REQUEST



LEA COLD METAL SAWS

HENDRIE & BOLTHOFF MFG. & SUPPLY CO.
DENVER, U.S.A.

SALES TALK

BY THE ADVERTISING MANAGER

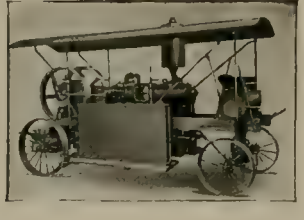
This is the first issue of the new Bulletin Service of the *Mining Press* and is devoted to the best known line of mining machinery on the market today.

The Manufacturer of the machinery described, the Ingersoll-Rand Company, was the Pioneer Builder of rock excavating equipment and its history has always been closely allied with the development of the mining industry. Its policy has always been to progress as the Industry progresses. Its designs have changed from time to time to meet changed conditions in mining.

Its various products are in such extensive use and have been so widely advertised that were you to ask the miner to enumerate, for example, the names of the various drills on the market, he would start the list with "Sergeant"—"Butterfly"—"Jackhamer"—"Leyner-Ingersoll". The same is true of any Ingersoll-Rand Product.

Undoubtedly extensive publicity could create such a situation, but it is also true that publicity alone would not maintain for the products of any manufacturer such an enviable reputation; to endure, it must be backed by value, and progress in design, material and workmanship.

Scarcely any news is published in the mining or engineering papers on the operation of specific mines and contracts, tunnel work and quarrying that does not include in the schedule of equipment some Ingersoll-Rand Products.



Only equipment possessing reliability and efficiency of the highest order could attain such recognition.

JACKHAMERS

For shaft sinking, driving small drifts, drifting benches, trimming and similar work these drills are in a class beyond compare.

The BCR 450 type has automatic rotation, mechanically operated, and may be run by air or steam. The Bull-Moose Jackhamer has automatic rotation of the hand operated type, is for air operation only and is intended for somewhat heavier work, as will be noted from the tables below. Both are rapid drillers, easy of operation and durable and will give a good account of themselves in all kinds of ground.

ESSENTIAL DETAILS

Symbol	BCR-450 type	Bull-Moose type
Length	18"	28"
Cylinder diameter	2¼"	2"
Stroke	2"	4"
Steel used	⅞" Hol. Hex.	1" Hol. Hex or larger
Weight	40 lbs.	105 lbs.
Depth of Hole Drilled	8'	12'

Bulletins Nos. 1121 and 1019

BUTTERFLY STOPER

In the mines of Lake Superior, Arizona, Colorado, and in fact all mining districts the Butterfly Stoper is bearing out our claims that over long periods of service, in raising, stoping and taking down rock it will do more work at a lower expense for upkeep than any other similar type of tool.

In a great many mines it has been adopted as standard to the exclusion of all others. An investigation will readily convince you of its superiority.

It is furnished with three styles of air feeds, and the front-head will be breached to fit any steel specified by customer.

ESSENTIAL DETAILS

Piston diameter	2"
Piston stroke	4"
Length of machine (closed)	32½"
Length of air feed	22"
Weight	72 lbs.
Size of drill steel used	1" or larger
Depth of hole drilled	6'

Bulletin No. 1211

LEYNER-INGERSOLL Water Drills

For years this drill has enjoyed an enviable reputation in mine drifting and tunnel driving, and it is today in extensive use all over the world.

It is equipped with an automatic water device for allaying the dust and cleaning the holes of cuttings while drilling, which increases the speed of drilling.

Miners everywhere are greatly reducing the cost of underground mining operations by using the Leyner-Ingersoll. It is built in two sizes.

ESSENTIAL DETAILS

Symbol	No. 18	No. 23
Diameter of Cylinder	2½"	2¾"
Length of hammer stroke	8"	10"
Length of feed	24"	30"
Diameter of hollow steel used	1¼" Rnd.	⅞" Hex.
Weight, Unmounted	150 lbs.	95 lbs.
Depth of hole drilled	8' to 12'	6' to 8'
Diameter of hole drilled	1⅝" to 2¼"	1" to 2"

Bulletin No. 1020

BUTTERFLY Rock Drill

The advent of the first Butterfly Rock Drill several years ago marked a radical departure from the prevailing reciprocating piston drill designs.

This machine has high drilling speed, is light and is very simple in construction.

In tunnel driving in the mines of the Arizona Copper Co. it helped to establish the remarkable record of 742 feet of 8x8 tunnel driven in 29½ days, 4 shifts per day, two drills in a face.

ESSENTIAL DETAILS

Symbol	C-125
Diameter of cylinder	2¾"
Length of stroke	6¾"
Length of feed	24"
Diameter of octagon steel used	⅞" and 1⅛"
Weight, unmounted	137 lbs.
Depth of hole drilled	12'
Diameter of hole drilled	1¼" to 2"

Bulletin No. 1105

INGERSOLL-RAND COMPANY

11 BROADWAY Offices the World Over NEW YORK

AIR LIFT PUMPS—STEAM PUMPS—CENTRIFUGAL PUMPS—CALYX CORE DRILLS

ELECTRIC-AIR DRILLS

For the small or isolated mine or contract where electric current is available this type of drill performs a special mission.

The electric-air drill combines with the flexibility of the electric current as power the efficiency of the compressed air drill in a complete power plant unit of great compactness and portability, solving the power plant problem and eliminating the expense of "in the mine" piping.

It is durably constructed throughout and compares favorably in drilling capacity with the standard piston drills of equal size.

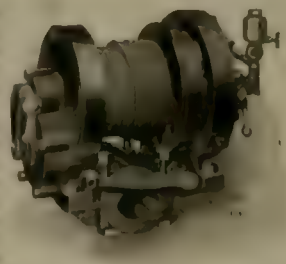
It is built in three sizes as listed below.

ESSENTIAL DETAILS

Symbol	*3-F*	*4-E*	*5-F*
Diameter of cylinder....	3⅝"	4¾"	5⅝"
Length of stroke.....	6¾"	7 "	8 "
Length of feed.....20 "		24 "	30 "
Size of octagon steel used	⅞"	1 and 1⅛"	1¼ and 1⅜"
Average horse-power required for running drill (motor output)	3	4	6

Bulletin No. 4209

"LITTLE TUGGER" HOIST



The design of this hoist is a further testament to the effort expended by this Company to excel in the product it asks the trade to buy.

It is a portable pneumatic hoist for clamping to bar, column, timber or other convenient means and is used for hoisting and lowering machines, tools and timbers in the mine, as well as hauling cars in drifts and winzes.

It has every element of safety, endurance and convenience and a comparison of the data listed below will bear testimony to its superiority for the work mentioned above.

It can be furnished for operation by steam if desired.

ESSENTIAL DETAILS

Capacity 1000 pounds at a rope speed of 85 feet per minute at 80 pounds pressure.
Clamp will fit 4½" O. D. column or arm.

Air connection	¾"
Width overall	21¼"
Length overall	16½"
Height overall	20¼"
Weight without rope	285 lbs.
Rope capacity .....500-800 ft.	

Bulletin No. 4033

LEYNER DRILL SHARPENERS

The Leyner Sharpener is an economical necessity in mining operations. It sharpens and makes all kinds of bits, true to gauge and form; and does the work more rapidly and cheaply than can be done by hand. It also shanks the steel.

Properly sharpened steel facilitates more rapid drilling and relieves the drilling machines of unnecessary wear and tear.

The Leyner Sharpener has no competition. It is built in the two sizes listed below.

ESSENTIAL DETAILS

Symbol	*No. 1*	*No 3*
Dimension in inches:		
Height	32	37
Length	52	52
Width	43	54
Weight bare, lbs.	1725	2150
Air consumption, approximate ...	75	100
Diam. bit sharpened, maximum	2¼"	3¼"
Capacity resharpening medium size steel.....50 to 100 per hr.		
Forming new bits .....20 to 75 per hr.		

Bulletin No. 4022

LEYNER OIL FURNACE

This furnace for heating and tempering drill steel is a fit companion for the Leyner Sharpener. Steels are heated quickly, uniformly, and cleanly. It burns crude oil, effecting a big saving in fuel cost in the blacksmith shop.

The capacity of the furnace is only limited by the sharpening facilities.

It is extensively used in conjunction with the Leyner Sharpener, forming one of the biggest money saving combinations that the market affords.

ESSENTIAL DETAILS

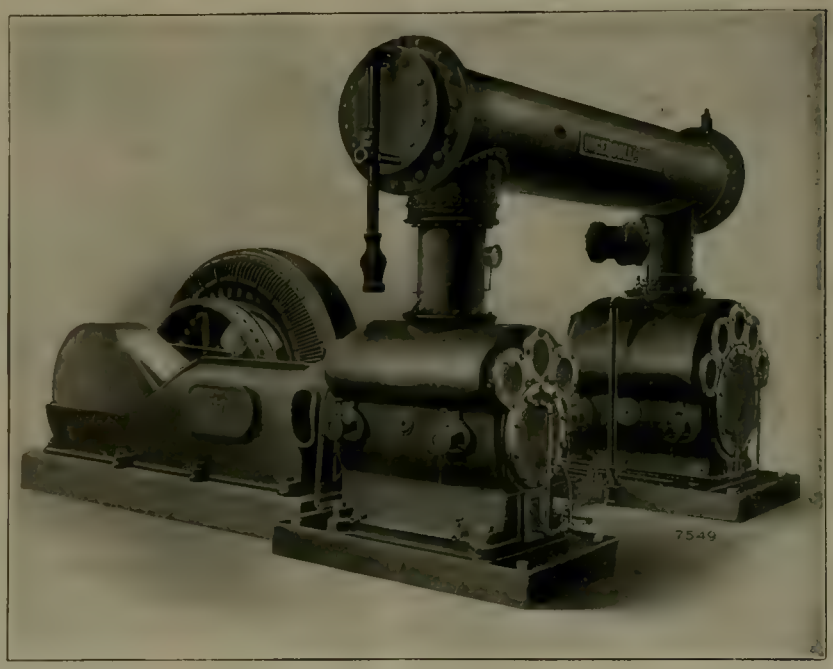
Heating surface....	7½"x10"
Heating capacity, drills per hour..	150 to 200
Air consumption per minute (free air at sea-level)	.50 to 75 cu. ft.
Oil consumption per hour	2 to 4 gals.
Floor space required for furnace only	3x4 ft.
Weight, complete..	500 lbs.

Bulletin No. 9020

INGERSOLL-RAND COMPANY

11 BROADWAY **Offices the World Over** **NEW YORK**

PNEUMATIC TOOLS—DEEP HOLE DRILL WAGONS—CHANNELERS—COAL CUTTERS



INGERSOLL-RAND COMPRESSORS

No manufacturer can point with more justifiable pride than this Company, to the performance of his air compressors. There are thousands of them in daily use in mining service, engineering work and industrial plants.

The line includes two distinctive types, the "Ingersoll-Rogler" and "Imperial," built straight line, duplex, turbo and vertical, with the following styles of drive: belt, short belt electric, direct connected electric, geared, oil engine, gasoline engine, plain steam and Corliss engine.

Sizes range between 3 and 55,000 cubic feet, pressures up to 2500 pounds.

Some of the recent "Ingersoll-Rogler" installations include the following:

Inspiration Cons. Copper Company.
Anaconda Copper Comany.
Hardaway Contracting Company.
Maryland Steel Company.

The "Imperial" compressor is the type which recently won over all other entries in an exhaustive contest conducted by the Engineers of the City of Chicago, as a result of which we were awarded the entire order for 12 machines, to furnish power for driving the water Intake Tunnels extending out into Lake Michigan.

Any of the following bulletins sent upon request.

GENERAL COMPRESSOR BULLETINS	No.
Ingersoll-Rand Compressors	3101
Ingersoll-Rogler Air Valves	3024
STRAIGHT LINE TYPES	
Ingersoll-Rogler Class ER Belt or Short Belt Driven	3030
Class NE-2 and NE2-S Belt or Short Belt Driven, for High pressures	3004
Ingersoll-Rogler Class FR Steam Driven	3209
Class NF-2 and NF2-S Steam Driven, for high pressures	3005
Ingersoll-Rogler OER Oil Engine Driven	3028
Class AA-2 Steam Driven	3003
DUPLEX TYPES	
Imperial Type XB Duplex Power or Short Belt Driven	3312
Imperial Type X Duplex Steam Driven	3311
Ingersoll-Rogler Class ORC Corliss Steam Driven	3029
Ingersoll-Rogler Direct Connected, Electrically Driven	3026
VERTICAL TYPES	
Imperial Type XII Belt or Electric Driven	3022
TURBO TYPES	
Ingersoll-Rand Turbo Compressors and Blowers	3032

INGERSOLL-RAND COMPANY

New York	Cleveland	Los Angeles	El Paso	Seattle
Boston	Knoxville	Juneau, Alaska	Salt Lake City	Birmingham
Philadelphia	Duluth	Chicago	Denver	New Orleans
Pittsburgh	Houghton	St. Louis	Butte	San Francisco

Some New Features

OUR 110th volume begins with this number. The series is long and the career of the **PRESS** has, we believe, been both honorable and useful to the mining profession. At the beginning of this new volume several changes have been made in the form and appearance of the **PRESS**. The most striking, probably, is the shortening of the name, one of the steps in modernizing the format of a journal already up to the minute in spirit. Other changes equally important are to be made.

OPPOSITE this will be found the first **Mining Press Bulletin**, a new feature in advertising. The **Bulletin** is intended to be a condensed, up-to-date catalog of the principal lines manufactured by the firm using it. Only a limited number will be sold, but collectively the **Bulletins** will constitute a combined condensed catalog of the principal manufacturers of mining and metallurgical equipment. The **Bulletins** are printed on separate sheets and so bound as to be easily detached and placed in a separate loose-leaf note book cover of appropriate size, which will be furnished at moderate price. Engineers are urged to preserve each **Bulletin**, as the series will furnish the best guide to the most essential type of machinery and equipment. It is appropriate that the first **Bulletin** is used by the Ingersoll-Rand Company, which has pioneered in so many directions, and whose drills and compressors are known in all great mining districts around the world.

ON our front cover will be found the first sheet of the Miners' Calendar that we shall print during the year. Each month a new sheet will be issued emphasizing the dates in the month that are of especial interest to mining men, and illustrating by paragraph and picture some of the world-wide phases of metal mining. Our covers for the first of each month have been reserved for this purpose, and those for certain other dates will be used in another way to improve the appearance and increase the usefulness of the paper.

OTHER changes are pending and will be made as opportunity opens the way. The purpose of them all is to increase the effectiveness of the **PRESS** to both reader and advertiser. We purpose to make the **PRESS** not only the most interesting and authoritative journal devoted to metal mining, but the most attractive as well.

MINING PRESS

San Francisco	Chicago	New York	London
420 Market St.	300 Fisher Bldg.	Woolworth Bldg.	Salisbury House

MINING PRESS

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VOL. 110 SAN FRANCISCO, JANUARY 2, 1915 No. 1

TABLE OF CONTENTS

EDITORIAL Page.

Greeting 1
Notes 2
Proposed Institute Changes 2
Mining 3
Special Review Numbers 4
Progress in Copper Metallurgy 5

ARTICLES

THE WAR AND THE LONDON MINING MARKET.

By T. A. Rickard 6

The European war has so completely upset the normal currents of trade that the usual review of the market is impossible. Numerous mining enterprises have been hindered by the capture or destruction of steamers carrying machinery to them. Tin and nitrate shipments have decreased. Fortunately, less than 1% of the gold output comes from the areas in conflict, though disturbance of trade, by limiting mine supplies, is reacting even on gold mining. Copper shipments from the United States have decreased. Zinc smelting faces the necessity for extensive readjustment, since fighting has been most severe in zinc-smelting regions. War killed speculation in mining shares, but made gold mines the most liquid of assets.

ARIZONA COPPER'S NEW SMELTING PLANT 9

A new smelter built by an old company to treat fine ore by means of reverberatories. A series of illustrations with brief text.

APPLICATION OF ELECTRIC MOTORS TO GOLD DREDGES.

By Girard B. Rosenblatt 12

Gold dredges see hard service, and motors designed for such dredges must be with this in view, as also the short life (roughly 10 years) of the plant. The drive of the bucket chain is the real problem of the dredge. It is recommended that motors for this service be capable of carrying rated load continuously with a rise not to exceed 40° in any part; be capable of developing a torque 25% in excess of the rated full load torque, at a speed of 75% of its synchronous speed for two hours with a rise not to exceed 55°; have a maximum and starting torque of not less than 2.5 times full load.

TUBE-MILL TONNAGE CALCULATION.

By Noel Cunningham 16

A method used at the Hollinger for determining the tonnage actually handled by tube-mills working in closed circuits. It rests on four screen tests and is easily and quickly applied.

ELECTROLYTIC ZINC—THE REED PROCESS.

By E. H. Leslie 17

Many attempts have been made to treat zinc ores electrolytically. The Reed process depends upon the Hering system. It is being applied at Palo Alto to the zinc residue from the Mammoth smelter, and a successful technical operation has been worked out. In precipitation the anode is sponge-lead and the cathode aluminum. After deposition, the sponge-lead anode with its zinc sulphate coating is placed in an acid charging cell where it becomes a cathode with a dummy lead anode. It is thus restored to its original condition for re-use.

MINERS' HEALTH AT BROKEN HILL 21

Abstract of a report made to the parliament of New South Wales.

ELECTRIC SMELTING IN 1914.

By Robert M. Keeney 22

The year saw the completion and operation of the largest electric iron-smelting furnace built up to date. Work was started on the first commercial electric zinc-smelting plant to be constructed in the United States, and the first aluminum plant since expiration of the Hall patents was well started. As the result of the European war, the one electric pig-iron plant in the United States started the manufacture of ferro-manganese. Increased attention was paid to the manufacture of other ferro-alloys, and one company has renewed the manufacture of sodium in the electric furnace for later conversion to sodium cyanide.

MASONIC MINING DISTRICT, MONO COUNTY, CALIFORNIA.

By R. P. McLaughlin 27

The Masonic district lies 16 miles north of Bodie, California. No important discoveries were made till 1902 and it was in 1907 that rich ore was found. The geology of the district is briefly discussed, and the opinion is expressed that such orebodies as are discovered will be found to be extremely irregular.

ORE TREATMENT AND COSTS AT STRATTON'S INDEPENDENCE.. 29

Summary of operations for 1911-12, 1912-13, 1913-14, with detailed costs, totaling $1.38, for 1913-14.

COSTS AT THE KALGURLI MINE AND MILL 29

Detailed costs covering production of 127,870 tons of ore averaging $9.60 per ton. Dividends amounted to $461,000 and all costs $4.69.

DEPARTMENTS

DISCUSSION:

The Gumaos Dredge. *By A. C. Ludlum* 30
A brief note on the excellent performance of a pioneer boat.

Operation of Oliver Filters. *By D. W. Minier* 30
Detailed statement of practice at the Commonwealth mill, Pearce, Arizona.

Shall the Institute Express Opinions?
By Edmund B. Kirby and Sidney J. Jennings.. 31
Statements for and against the proposed amendments to the constitution of the Institute.

CONCENTRATES 33

MINING IN THE FAR NORTH.

Placer Mining in the Fairbanks District.—Continued.
By Emil Edward Hurja 34
Continuation of the notes on present conditions at Fairbanks printed in the *Press* December 19.

MINERAL STATISTICS 37

REVIEW OF MINING: Special correspondence from New York; Washington, D. C.; Butte, Montana; London; Houghton, Michigan 39

THE MINING SUMMARY 43

PERSONAL 47

SCHOOLS AND SOCIETIES 47

THE MARKET PLACE:

Metal Prices 48
New York Metal Review 49
Current Prices of Ores, Minerals, Chemicals, Oil, and Candles 50

COMPANY REPORTS 51

NEW MACHINES AND DEVICES:

A Small Portable Air-Compressor 52
Commercial Paragraphs 52

Interior View of Our Plate Shop

TANKS—Air Receivers; Steam Drums; Pressure Tanks, Riveted or Welded. Storage for Oil, Water or Solution.
WATER JACKETS—For Smelting Furnaces, Welded or Riveted.
RETORTS—Timber Treating, Vulcanizing, Steaming, Drying or Staining. Any Pressure.
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FLANGING—Tank and Boiler Heads, all Standard Sizes. Miscellaneous, Special.
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The Wedge Mechanical Furnace

Patented

Dead or Sweet-Roasting Gold Ores

A uniform dead or sweet-roast of gold ores for cyaniding can be secured in Wedge Furnaces.

Furnaces are constructed to use whatever fuel may be available. You can use oil, gas, coal, coke, charcoal or wood.

On account of the detailed construction of the Wedge Roaster, designed for sweet-roasting, you can secure a more uniform calcine than has been secured in previous practice with a different style of rabbling.

Wedge Furnaces are in commercial use, dead-roasting gold ores, also in commercial use, dead-roasting iron ores, where it is necessary to practically eliminate all the sulphur contents.

Write us stating analysis of ore, concentrates, mixture or material to be roasted, characteristics and physical condition of same, number of tons to be treated per 24 hours, and results desired in the calcine.

Wedge Mechanical Furnace Company

115 Chestnut St., Philadelphia

Sink Your Shaft with Sullivan Air-Jet Sinkers,

—and economize time, labor and power

Sullivan Air-Jet Sinkers at Work in a Shaft

The advantages of these tools for sinking shafts include:

(1) **Greater Speed** than is gained with tripod drills, because **Air-Jet Sinkers** have no mounting to move, require no set up, and lose no time cranking out steel.

(2) **Less Labor** is needed, since the tool is run by one man and is light and easy to handle.

(3) **Reduction in Power,** because **Air-Jet Sinkers** use less air than tripod drills.

(4) **Less Powder** and less waste excavation. Each hole is placed and pointed exactly where it will pull the ground to the best advantage.

Sullivan Air-Jet Sinkers

are equipped with hollow steel, through which air is discharged in varying amounts as needed, to clean the hole.

¶ **A Cushion Device** reduces vibration and permits high cutting speed without excessive jar to the operator.

¶ **Repairs are Light,** because all parts are made of hardened steel, from bar stock, or are drop forgings.

Bulletin 1366-L.

Air Compressors Hoists Rock Drills Diamond Core Drills

SULLIVAN MACHINERY COMPANY

122 South Michigan Ave., Chicago, Ill. 461 Market St., San Francisco

Boston, Butte, Cobalt, Ont., Christiania, Denver, El Paso, Joplin, Juneau, Knoxville, London, Montreal, Nelson, Paris, Petrograd, Pittsburgh, Seattle, Spokane, St. Louis, Sydney, N. S. W., Vancouver

Progress in Metallurgy

DORR CYANIDE MACHINERY

The Dorr Agitator

has been installed in nearly every well known mill erected this year in North America and 19 machines have replaced other types. Its reliability and great economy in power have attracted much attention. Among well known companies installing them are:

Porcupine Crown M. Co.....Ont.
Hollinger Gold M. Co.....Ont.
McIntyre-Porc. M. Co.....Ont.
Porc. Vipond M. Co.....Ont.
Tough-Oakes M. Co.....Ont.
Porc.-Miracle M. Co.....Ont.
Liberty Bell G. M. Co.....Colo.
Caylloma M. Co.....Peru
Beguet Cons. M. Co.....P. I.
Fund(icion) de los Arcos....Mex.
Cam & Motor Co.....Rhodesia
Frontina-Bolivia Co.....Bolivia
Tomboy Mines Co.....Colo.

The Dorr Tray Thickener

furnishes a simple means of obtaining great settling space with small ground area, and of increasing the capacity of Dorr Thickeners already in operation. During 1914 they have been installed by

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Anaconda Copper M. Co....Mont.
Hercules Mining Co.....Idaho
Tomboy Mines Co.....Colo.
Liberty Bell M. Co.....Colo.
Aurora Cons. M. Co.....Nev.
Tonopah-Belmont M. Co.....Nev.

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Timber-Butte M. Co.....Mont.
National Copper Co.....Mont.
Mountain Copper Co.....Cal.
Spassky Copper Co.....Russia
Braden Copper Co.....Chile
Broken Hill South Co....Australia
Broken Hill Prop., Ltd..Australia
Sulphide Corporation ...Australia
Great Cobar M. Co.....Australia
Wallaroo & Moonta Co..Australia
Amalgamated Zinc Co...Australia

Continuous Counter-Current Decantation

Owing to the success of the Porcupine-Crown plant the following companies, in the same district, have installed this method of treatment:

Hollinger-Acme, an addition of 900 tons capacity; Porcupine-Vipond, 150 tons; Porcupine-Miracle, 150 tons; Tough-Oakes, 150 tons; McIntyre-Porcupine, an addition of 150 tons.

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Published figures from the Gold Roads Mines Co. show a net profit of 60 cents per ton made by changing from filtration to Continuous Counter-Current Decantation.

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Just think of one unit handling 1300 tons of solids and recovering three million gallons of clear water per day.

The construction of large units in the open air with steel or concrete walls and dirt bottoms secures great economy.

Send for our Catalogue and full data regarding the above, and also the Dorr Classifier

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58-inch Semi-Steel and Bronze Valves, weight 42,000 pounds,

BUILT BY

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San Francisco, California,

FOR THE

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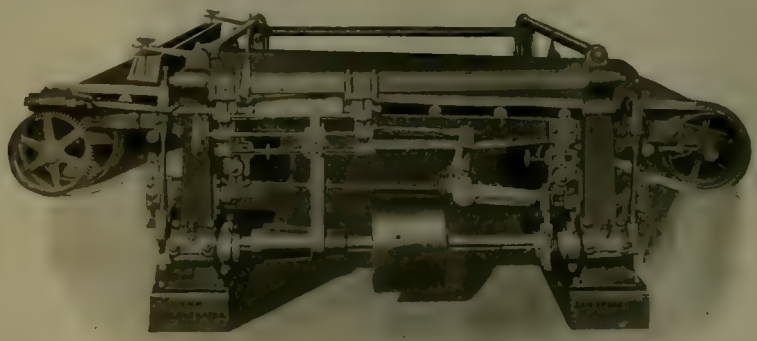

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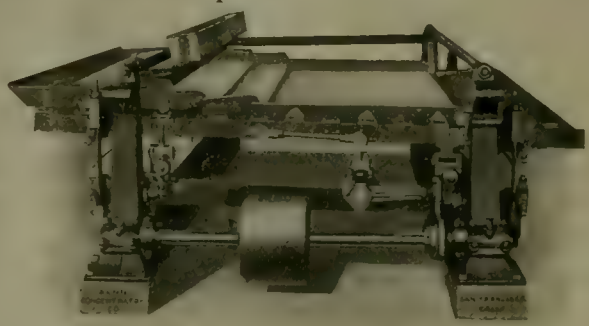

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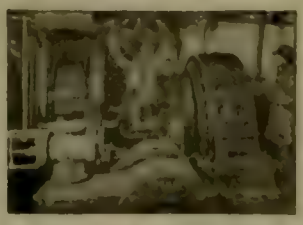

500 H.P. G-E Motor Driving Underground Hoist Nourse Mines In use 6 years. No delays.

300 H.P. G-E Motor Driving Underground Hoist, Silver King Coalition Mines Co., Park City, Utah.

700 H.P. G-E Motor Driving Hoist, Crow's Nest Mines, Keystone Coal & Coke Co. 2½ years in use, 65% overloaded No delays

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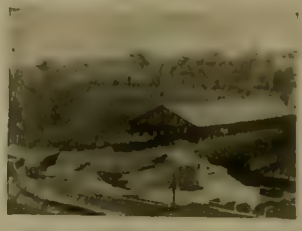
Many reports are coming in from hoists driven by G-E motors. One was designed for 24 trips per day, but has hoisted 40 for 2½ years without delay. Another has been in use six years, while others still have been in use two years or more, and in every case the report was the same: "Operation satisfactory; no delays due to electrical causes."

Mine hoists driven by G-E motors have low operating costs because, first, there are no boilers to be fired night and day; second, the absence of vibration on rope—increasing its life and that of the head gear, etc.; and, finally, because the power consumption is nothing during idle moments, but always available when needed.

Send for new hoist bulletin, "Mine Hoist Equipment."



Tipple and Track Arrangement, Crow's Nest Mine; 75,000 tons per month. In use 2½ years.

Electrically operated Tipple and Washer with Belt Conveyor, J. K. Dering Mine, Clinton, Ind.

Mine Fan Driven by G-E Multi-speed Motor, J. K. Dering Mine, Clinton, Ind.

Greensburg Coal Co.'s Tipple and Hoist House. Note absence of steam escaping.

300 H.P. G-E Motor Driving Hoist, Greensburg Coal Co. Shaft, Greensburg, Pa. Over a year in successful operation.

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For Texas, Oklahoma and Arizona business refer to Southwest General Electric Co., (formerly Hobson Electric Co.)—Dallas, El Paso, Houston and Oklahoma City. For Canadian business refer to Canadian General Electric Company, Ltd., Toronto, Ont. 5258

If You Were Asked

to draw up a set of correct legal conclusions from a miscellaneous collection of legal facts, you wouldn't try. You'd get an able lawyer, let *him* "dig up" the facts and look to *him* for correct and intelligent conclusions.

And, in the same way, correct conclusions regarding the value of your mining properties are *not* to be derived from miscellaneous facts, drawn from miscellaneous sources. Let

LONGYEAR SERVICE

"dig up" the facts, arrange them coherently and give you the intelligent result.

Here are the details of Longyear service:

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GREETING

It will be remembered that in a certain city an altar was once raised to the 'unknown God.' It is more than half suspected that this was a prehistoric Scotch attempt to play safe by 'not overlooking any bets.' With the deepest sincerity, however, at this, the beginning of a new year, the Editor would like to offer on the altar of friendship a tribute from himself and his associates to our unknown friends. Strangers by face, men we never have seen, most of them men we never shall see, yet we feel between them and us the ties of real friendship. From time to time these unknown speak to us by letter and even by gift. They save out and send to us something choice from their minds or their mines, and the *Press* becomes richer by an item or the inspiration for one, while the editorial desk becomes all cluttered up with a miscellaneous assortment of specimens and keepsakes that need only some labels and a catalogue to afford the basis for a really admirable public museum. It is the letters we like best—letters written, mayhap, on nondescript paper with pencil or balky pen, dated "in camp" and, judging by the alignment, written on a board held slantwise on the knee while the beans boil. Such a letter brings the very feeling of the outdoors to us here in the office; and it brings, too, the very innermost feeling of the men who write. Prospectors would rather handle pick than pen, and only deep feeling stirs these friends of ours to write. They like, or they dislike, what we have said; and they say so frankly—giving reasons. Their reasons are always worth attention, and I assure you, Mr. Prospector, that your letters really do receive our "most thoughtful attention." It is curious, in view of the infinite ways open to an editor to make mistakes, that many more of the letters are complimentary than the reverse. Occasionally "with great regret"—we like that phrase—an old subscriber refuses longer to tolerate a young and foolish editor who perhaps has mixed over much war news with technical articles, or who has too consistently stood "on the side of the operators." One of our friends, an old Foreman whom we have never seen but for whom we have conceived a liking as well as sincere respect, writes that, while he does not expect us to employ our time in writing articles such as appear in *The Age of Reason,* many of the changes in mining of recent years have not been for the better and "none for the betterment of those employed," and that "if you even made an effort to print truth you would find your paper more widely read and appreciated." He adds that "it is not with pleasure that I write this"—and that takes away the sting. We believe him to be honest, we strive to be honest ourselves, and yet here we differ so widely. What is the truth? The question is no easier to answer here today and about matters of common knowledge in the profession, than it has been in all times and all ages. Therefore we welcome that spirit of charity—that willingness to believe the other honest, even though he be stubbornly mistaken—and to our many unknown friends, to the great multitude of our readers who never call, who never 'phone, who never write, but who, since they continue to take the *Press* either agree with us or extend the mantle of charity over our errors and omissions, to all these we offer our hearty thanks for another year's support and our hearty good wishes for the year 1915.

To our other friends, whether they be contributors, readers, or advertisers, our thanks are no less sincere. The year that has just closed has been a trying one for all, and the immediate future offers little promise of improvement. A great war cannot be fought without the whole world suffers; and a great war is not worth fighting unless it be fought to finality. We may believe as earnestly as possible in the rightness or wrongness of either side, we may hope keenly for the success of the arms to which we give support, but let us remember against the hard days of reconstruction, that these fighting peoples are the same peoples with whom we have so long had pleasant ties of business and friendship. Centuries of civilization do not altogether disappear over night; the superficial aspects of civilization may be temporarily obscured, but fundamentally the great mass of the people in each of the countries at war are the same right thinking, careful living, and well meaning people they have been all these years we have known them. Take a lesson from our friends the Prospector and the Foreman—if we must differ, let it be in kindness rather than bitterness.

What the New Year may bring in a business way to each of us cannot be foretold, but at least it will be an interesting year in which to live. In Europe one of the world's great contests will be in progress and possibly will end. In the Americas peace and industry seem likely to dominate the scene. In California we shall celebrate the opening of the Panama canal with two expositions, and at San Francisco we shall expect

to see many of our friends. Before the year closes we hope to have shifted many an 'unknown' into the 'known' column and to have intensified if not enlarged the field of our friendships. Until that pleasant day arrives when we may give you our good wishes in person, we take this means of extending them to you.

H. Foster Bain.
For the Editors.

A CONTEMPORARY records that the smokeless coal operators of West Virginia met in Philadelphia last month. It is well known that conditions are bad in the soft coal industry, but it is disheartening to learn that even stogies are beyond the reach of the operators.

RAND gold production for the first 10 months of 1914 amounted to 6,579,044 ounces, as compared with 7,143,892 ounces in the same months of 1913. The total for 1913 was 8,430,998 ounces. For 1914 it will probably be about 6,950,000 ounces. To the first of November Indian output had amounted to £1,930,649, that of West Africa, £1,424,671, and that of Rhodesia, £2,958,827.

METALLURGISTS will note with regret the absence in this number of the *Press* of the customary review of cyanidation by Mr. Alfred James, who, in the midst of war scenes finds no heart for the task. We shall later present a summary, but may note now the further peaceful conquests of the continuous decantation process, and the inroads threatened by flotation, to which such a staunch cyanider as Mr. Charles Butters has become a zealous convert.

CANADIAN questioning as to the supplying of nickel from Sudbury mines to Germany and its allies, has been met by a frank open letter from Mr. A. Monell in which it is stated that full information regarding shipments is at all times in the possession of Dominion authorities. It is also stated, as against the rumor that the Krupps are interested in International Nickel, that no European steel-maker, no individual connected with any such concern, or anyone in European financial circles, exerts any influence in the conduct of the Company or any of its subsidiaries. As to refining in Canada, Mr. Monell points out that the location of works is determined by economic conditions and that any material change in these would react to the detriment of the Canadian nickel industry. We are glad to record this full and frank statement. A company possessing a practical monopoly of any material used by the whole world has heavy and peculiar responsibilities to face, and frankness is important in meeting the difficulties that lie in the road. We sympathize with Canadians in the natural desire that their mines should not serve to equip the enemies, for the moment, of their country; and also the wish that as much as possible their raw materials should be worked up within their own national boundaries. In time nickel refining, as well as nickel mining, will be an important Canadian industry, but for the present, economics demand that Canada and the United States share the industry.

IN our New York letter the difficulties of the Australian zinc producers who have contracts with German smelting companies are discussed. As mentioned last week, the plans for a new smelter at Swansea are temporarily, at least, set aside, and it seems probable that the alternative of a new plant in the United States will, in turn, be given up. The obvious course is to ship the concentrate to the United States for treatment in existing plants. There is an adequate excess smelting capacity, and the freight movement would be along natural lines. In view of the complicated legal situation, investment in new plant to treat the Australian ore would not be warranted.

PROPOSED INSTITUTE CHANGES

Among matters which will come before the annual meeting of the American Institute of Mining Engineers in February, none is more important than the proposed changes in the Constitution, striking out the strong inhibition that now exists against the Institute expressing any approval or disapproval of technical or scientific matters or "any proposed enterprise which is outside of the management of meetings, discussions, and publications of the Institute, and the conduct of its affairs by the Board of Directors." The proposals have been before the membership for the better part of a year, but have not been as thoroughly debated as their importance warrants. As matters now stand, and as the rule has been interpreted, the Institute is absolutely tied and can do nothing but talk. In even so innocent a matter as joining the other national technical societies in issuing a common style-sheet, it has been held that the Institute could not bind itself. Recently the matter of revision of the United States mining law has been before the Institute and its members. There is no difference of opinion as to the need of some change, though much difference as to what changes should be made.

It has been proposed that Congress should appoint a commission to codify existing laws, study the situation, and report back to Congress, which would then exercise its constitutional authority (and also probably its pleasure) as to making any change. The appointment of a committee to visit Washington and urge this matter—in substance the mere investigation of a subject of the greatest and most direct importance to mining—produced a protest from the strict constructionists. Upon opinion of counsel being taken, it was held that the Institute had in fact no authority to appoint such a committee, though, in event of the proposed commission being established, it might, without violence to its own constitution, suggest to the President the advisability of appointing a mining man or two

upon said commission. These are two specific instances among many which might be cited, arising from conditions as they are, and in which the Institute was prevented from being useful, without any possible harm to any of its members. This, we hold, is a condition that results in preventing good rather than doing good. It is proposed to remove this restriction from the constitution. To make such action effective, amendment of the articles of incorporation would be necessary, and is in mind though not embodied in the formal proposal. It should be noted distinctly that the present proposal is merely to untie the hands of the Institute. No affirmative action on any proposal, or even on any plan of procedure for obtaining such action, is suggested at this time. That is a matter for the future, and we have no doubt that a sufficiently conservative attitude will be observed by the Board of Directors and the Institute membership in event of the amendments being adopted. The present matter is the determination of the question whether the Institute wishes to maintain the old attitude of absolute refusal to participate in any form whatever in matters which require more than talk. As against this, the arguments advanced are, so far as they have come to us, founded on the belief that at some time in the future, under conditions not yet realized, the Institute, if allowed to act at all, may act unwisely. We believe Mr. E. B. Kirby is right when he says in his letter in our Discussion department that, essentially, this is a feeling that we know so much better than our successors possibly can, as to what is good for them, that we are warranted in making it impossible for them to act for fear they may sometime act unwisely. We shall print other letters on the subject and shall write of it again, but boiled down to the essentials we believe this is the question: Do we as a matter of fact know the future so much better than those who will live in the future that we may justly prevent their doing what they may then consider wise for mining?

MINING

It has been said by one of the world's great physicists, that "if you want to arrive at intelligible issues—not to say conclusions—in any discussion, begin by settling the meaning of the terms you are going to use." The word 'mining' is not only the first in the name of the periodical you are reading, but it is so much the term oftenest employed that the compositors used to keep an extra supply of the letter m in their fonts in the days before 1906, when the type of this periodical was set by hand. In order to obtain a definition of 'mining' I turn to the Standard dictionary, for which I have a kindly feeling because my worthy friend the late W. H. Pettee, professor in the University of Michigan, was responsible for the definitions of words appertaining to the subject under discussion. Mining is therein defined as "the business or work of a miner or mine prospector." On turning to the word 'miner,' I find that he is "one who mines, especially one whose occupation it is to excavate ore, coal, etc., in a mine." Next, a 'mine' is said to be "an excavation, properly underground, for digging out some useful product, as ore, metal, or coal." Finally, 'ore' is defined as "a natural substance, sometimes forming part of a rock, containing one or more metals." An excavation that is not underground is usually termed a 'quarry,' the origin of which is seen in the French synonym, *carrière*, from *carrer*, to square, it being the place where squares of slate or cubes of stone are cut. *Carrière* comes from the Old French *quarriere*, itself derived from the Latin *quadratus*. 'Mine' comes from the Low Latin *mina, minor, minatus*, all of which mean something threatening. We have this meaning clearer in *minæ*, or threats, and in 'minatory,' which suggests the forefinger raised in warning. In its Latin sense a 'mine' was an excavation for confounding the enemy. Thus the military significance is older than the industrial, for the Romans were soldiers first and exploiters afterward. Mining is also the business of the 'prospector,' the latter word signifying one that can look forward. Assuredly this is a necessary function of the miner, whose work depends upon the sane use of the constructive imagination, whereby from feeble signs on the surface he can imagine or foresee the ore that lies in the heart of the hillside. The common saying that "a miner can see no farther than the point of his pick" is saturated with untruth; if it were so, he would be a fool to spend laborious days in breaking hard rock; and, what is more, if he did, the result would be nothing. Mining to be successful requires the ability or instinct to see beyond the point of the pick, sometimes many hundred feet ahead of it, and to anticipate changes in the ore due to causes that the miner has taken painstaking care to note. Indeed, foresight—the forward mental glance—is a quality fundamental to successful mining; not only as regards the behavior of the mineral lode, but in respect of the whole series of complicated processes to be performed before the result of the miner's labor is realized in terms of money.

Turning to Agricola, as made accessible to us by the Hoover translation, we find that the venerable authority describes mining as "a calling of peculiar dignity." According to him "prosperous republics, not a few kings, and many private persons, have made fortunes through mines and their produce." We may congratulate the republics; but most of us will—I believe—consider that the kings of the olden time made money by so many cruder methods that they might have left the mines to the "private persons." While the mining profession of that early day "promoted wealth by good and honest methods," it appears that the incubators of wild-cats and the pirates of finance were not unknown even then, for Agricola describes them in terms that breathe no antique air: "They either advertise the veins with false and imaginary praises, so that they can sell the shares in the mines at one-half more than they are worth, or, on the contrary, they sometimes detract from the esti-

mate of them so that they can buy shares for a small price." The same old game today, as yesterday, and until the pick is blunted forever. Yet, he insists, mining is "a calling of peculiar dignity." The trickery and the thieving is no essential part of it, nor even the scheming and gambling that loom so large in the eyes of the stock exchanges and financial press. These agencies, useful as they are, not infrequently make the mistake of putting the cart before the horse. Even the general public, using the shares of mining companies as a means of speculation or buying them with the idea of profitable investment, is apt to overlook the fact that such operations are incidental, not fundamental. Undoubtedly the charm of a successful financial venture is a factor in furnishing the inducement for raising capital, and for distributing the risk so that it may not fall too heavily on single purses; undoubtedly mining in its world-wide aspect has gained in scope and even in stability by means of the appeal to, and support from, an international clientele; without such support the digging of the metals would be restricted to smaller operations and to fewer territories. Nevertheless the function of mining is not to create counters for a gamble; that is only an incidental feature of a venturesome business.

Mining is a basic industry; it depends not upon the gambling, but upon the honest work whereby the useful and necessary minerals are extracted from the earth in order to furnish the material structure of civilization. The sunlit Mediterranean no more exists as a frame for Monte Carlo than mining for the pastime of Wall and Throgmorton streets. Share dealing is the frill on the essential digging and delving of the mine; brokerage and promotion are bubbles on the great stream of beneficent activity originating from the exploitation of mineral deposits; mining is "a calling of peculiar dignity," not a funny game for persons of nimble wit and facile morality. It is one of the two original occupations of humanity. As life progresses, man has learned to live less on the direct product of the field; literally, he does not live by bread alone; the complex way of living we call civilization depends increasingly upon the metals. By means of them we move, communicate and construct; by the use of them we obtain heat, light, and a thousand comforts. They furnish the munitions of war no less than the implements of agriculture and the instruments of scientific research. The world may suffer a diminished supply of the metals for a while, as during a great war, but not for long. It can endure the obliteration of all its stock exchanges before it can dispense with the products of the mine. Lacking them, it reverts to a material barbarism in which the finer fruits of the human spirit decay. Under the barren overburden of ruthless militarism, as under the gentle meadows of peaceful progress, is the bedrock of metal. On that the sky-scrapers of civilization are founded. The relapse of war serves to give thundering emphasis to the fact. Mining is a basic industry.

T. A. Rickard.

SPECIAL REVIEW NUMBERS

Contrary to our custom of recent years, we do not present our readers today with an Annual Review Number. The reasons for the change lie both in the business and editorial situation. As to the first, it may be said that among technical journals the constant tendency of recent years has been away from special numbers. Formerly such extra efforts were common and advertisers were continually importuned to furnish funds for some wonderful extra edition that was to secure marvelous publicity at a minimum of cost. Frankly, results have shown that this was a poor policy for both advertisers and publishers. Money spent spasmodically in advertising is ineffectively spent. It is persistent work that counts, since the benefits of advertising are cumulative. The *Press* never went far in the field of special numbers, though it has several notable ones to its credit. From a business point of view, however, it is better for both publisher and advertiser that the work of making the best paper in the field should be steady and persistent. Instead of the best review number, it is our ambition to print the best paper each week in the 52 that make up the year. Other papers will in time follow this plan. We are merely adopting it first. From the editorial point of view the situation is similar. With a special number in prospect, the tendency to save up special articles for it is strong. There is also the necessity, in order 'to round out' the number, to fill in with padding and rehash. The most successful editor cannot obtain a notable review of each department in mining and have them all ready and all fresh, for the same week. The reason is obvious—nothing of consequence may have happened in some of the departments, and in others the man who should write the review may, for any one of a dozen reasons, be unavailable at that time. As for statistics, the significant figures in many lines are not available the first of January, some, such as iron ore shipments, Alaska gold output, and others, are already old. Many are not yet collected. Formerly certain journals made a great pretense of collecting their own figures. There was always but a small infusion of original matter, and for years all the technical journals have received, with a uniform release date, their most important figures, such as the estimates of gold and silver production made by the Bureau of the Mint, and the admirable reviews of the industry now furnished by various geological surveys and mine inspectors, from public agencies open to all. The *Press* prints this week, and will print each week, such of this material as is available and authentic. It will also print throughout the year, and as time and writer come into happy coincidence, significant reviews of technical progress in various lines and of mining development in the numerous states and countries in which its readers live. These reviews will be authoritative and up to date. As evidence of good faith we publish in this number numerous brief reviews of districts, and a careful summary of progress in electric smelting, by Mr. Robert M. Keeney.

PROGRESS IN COPPER METALLURGY

The progress of copper metallurgy is much like that of the amoeba; a thrust forward comes now at one point, now at another, but the net result is that the whole body progresses at a fairly steady rate. The conditions to be met change from month to month, and attention is directed now at one set of conditions, now at another. Today when everyone is talking of hydro-metallurgical methods, it is hard to realize that a decade ago blast-furnace smelting, now largely neglected, was a similarly absorbing topic. At that time the roasting of copper ore was nothing like the fine art it has since become, nor had reverberatory furnaces reached their present stage of development, so that the heat efficiency of a reverberatory furnace was low. Blast-furnace smelting, with the ore in intimate contact with the fuel, was so much more efficient and cheap that metallurgists were generally confident that it would continue to hold the leading place. The ore deposits then worked and the methods of mining then in vogue were such that lump ore was abundant and the view seemed justified. In the immediately preceding period blast-furnace smelting had developed a problem through mining operations (in most places) penetrating to depths below the oxidized ores, so that the sulphur and iron content of the ore mixture became too high and the copper content of the resulting matte too low for economical work. Copper metallurgists were clever enough to perceive quickly that if the sulphur and iron could be oxidized in the blast-furnace they would furnish heat, thereby doing away with the necessity for an equivalent amount of coke, which is expensive, and besides, being bulky, displaces ore in the smelting zone and so cuts down daily capacity. Many bright minds addressed themselves to the study of this problem, and it was not so long before an elaborate technology was worked out so thoroughly that, with an ore high enough in sulphur, it was found quite possible to smelt copper ore in the blast-furnace without using any coke at all.

The successful smelting of copper ore in the blast-furnace without the use of coke was a notable achievement, and yet the economic advantage was largely nullified by an extraneous circumstance which could scarcely have been foreseen. The period was one of rapidly increasing use of copper, and the geologists and mining engineers were busy in searching for new deposits of copper ores. They soon found that large deposits of material containing 25 to 50 pounds of copper per ton, in the form of disseminated sulphides, were available if any use could be made of them. Direct smelting of such ores was out of the question, but in the Lake Superior region, ore of a like content had been, for many years, cheaply concentrated. It had not been supposed that such low-grade sulphide ores could be profitably concentrated, but properly directed experiments soon showed that they could, and that with large-scale, low-cost mining and milling a good operating profit could be made on the operation. But no blast-furnace could possibly handle the resulting finely crushed sulphide concentrate, roasting and smelting in reverberatory furnaces became a physical necessity. This directed attention toward both these operations, and it was soon found possible to reduce the cost of roasting, improve the product and to increase the tonnage per roaster. Even greater progress was made with the reverberatory. Changes in the design increased its thermal efficiency and tonnage smelted, and the introduction of boilers into the flues leading away from the reverberatory made a great saving in the cost of fuel. About this time crude petroleum became abundant and cheap, through other extraneous causes, and its use as a fuel led to smoother working and cheaper costs in those regions where its comparative cost per ton, plus relative freight costs, enabled it to supersede coal. The amount of flue-dust made by a reverberatory is small, and its economy in this regard as compared to rehandling the abundant flue-dust made by a blast-furnace, coupled with the reductions in operating costs made by the improvements above mentioned, soon put reverberatory smelting almost on a par in operating cost with blast-furnace smelting, and the latter now no longer enjoys the tremendous lead it so long possessed. Blast-furnace smelting, except as an adjunct to reverberatory smelting, therefore bids fair in the future progressively to decrease.

The fine crushing to which low-grade ore must be submitted to prepare it for concentration leaves it in a state of division most suitable for the application of hydrometallurgical processes, and the tailing from such concentration may therefore be considered as material ready prepared for treatment on which all costs up to that point have already been paid. This gives to such processes an advantage not previously possessed, and a great amount of study has been directed toward devising for low-grade copper ores some wet process that in cheapness, efficiency, and completeness of recovery might be at least comparable with the cyanide process for gold. Notable progress has been made already in this endeavor, and the advance still continues. Oxidized ores, and low-grade ores which have not been subjected to concentration, will share in the benefits which such a process will bestow upon the treatment of copper ores. All the work so far goes to indicate that the leaching solution used in nearly every case will be a dilute solution of H_2SO_4, and the necessity for an abundant supply of cheap acid is likely to affect general smelting operations in such a way that the necessary sulphur may be recovered from the smelter fumes. This is fortunate for the smelter men, since of recent years they have been increasingly harassed by suits to recover for damages alleged to have been caused by the sulphur content of the escaping gases. Recent tendencies in copper metallurgy have therefore been the working of lower and lower grade deposits, the devising of large-scale mining operations to reduce the cost, a tremendous growth in milling in order to reduce smelting costs, the necessary employment of reverberatory smelting, with improved technique, and lowered costs.

The War and the London Mining Market

By T. A. RICKARD

Since August a state of war has existed in Europe and the following principal countries have been drawn into it:

Great Britain	Germany
France	Austria
Russia	Hungary
Belgium	Turkey
Serbia	
Japan	

To these must be added the overseas dominions and colonies of the countries implicated:

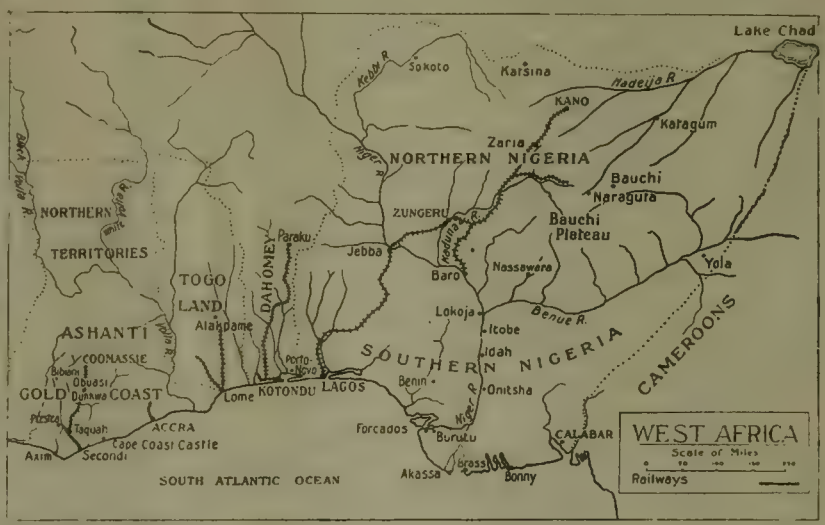
Canada	German Southwest Africa
Australia	South Africa
New Zealand	Belgian Congo
India	Cameroons
Egypt	Togoland
Samoa	Angola
West Africa	Arabia

Montenegro must be included; also Portugal, for the Germans have invaded Portuguese East Africa, while the fighting at Kaiochau brings China into the arena. Naval operations have taken place off the coasts of Iceland, South America, and East Africa, in the Persian gulf, and on the high seas generally. In short, it is apparent that the fighting and devastation have spread over the whole map. It is a world-war. Mining is a world-wide industry. Therefore the conflict has produced most serious and highly complex results.

Fortunately the mines whence come the metals necessary to modern ways of living are situated inland, and chiefly in the mountains of the interior, in distant regions, so that they are far removed from actual warfare. Europe is a consumer rather than a producer of the non-ferrous metals. The shock of war has destroyed a market rather than closed a source of a commodity essential to civilization.

Immediately after the declarations of war, in the first week of August, the entire system of ocean transport was disorganized. But that did not last long. Soon the British navy established control over the main trade routes and a resumption of maritime commerce became possible to the Allies and to neutral countries. But not without risk. Among the casualties of mining due to the war, may be mentioned the loss of pumping and hoisting machinery, together with converter parts, intended for the Ridder, Tanalyk, and Kyshtim mines in Siberia, all of which went to the bottom of the North Sea in the *Bruno*, which was sunk by a floating mine in September. The *Clan Grant*, sunk by the *Emden's* guns in the Indian ocean in October, carried machinery and supplies for the gold mines of the Kolar district, while the *Troilus*, another victim of the *Emden*, had a cargo of 925 tons of tin from the Straits Settlements. Sundry shipments of copper—beginning with that on the *Kroonland*, arrested at Gibraltar early in the war—have been stopped or delayed on their way from New York to European destinations.

The dislocation of trade along the South American coast, due to the general internment of German shipping, and the later raids of one or two German cruisers, injured the mining industry of Chile, Peru, and Bolivia. Most of the nitrate works had to be closed; at Chuquicamata delay was caused by the fact that orders for cement and machinery had been placed in Germany just before the war; in Bolivia the tin mines ceased operations until the government made arrangements to buy and to store the concentrate. Unquestionably, the



mining regions of South America have felt the war acutely.

Shipments of tin from Northern Nigeria ceased entirely during August on account of the use of the railways for the transport of French troops and military supplies from Dahomey across Nigeria to the Cameroons. In the same way, copper mining in Namaqua-land was hindered by operations against Raman's drift on the border of German Southwest Africa. On the other hand, the insurrectionary movement headed by De Wet and Beyers, in the Union of South Africa, had no immediate effect on the mining industry, especially of the Rand, because the resulting military operations took place at a distance from the mines; nor did this futile revolt

affect the supply of native labor to the Rand gold mines.

Siberian mines have escaped serious injury. The immediate effect of Russian mobilization was to withdraw about a third of the workmen, except in the Altai, where the nomadic Kirghiz are employed. In October the arrival of Austrian prisoners of war, on parole, helped the mines, for many of these prisoners were allowed to accept employment. Of course, the building of new plant had to cease, on account of the delay in shipments of machinery; development work underground also had to be curtailed; but production proceeded much as usual, because the metals find a domestic market. Gold, of course, is readily absorbed; but copper also, the Russian import-tax serving as a bounty, which makes the price of copper about £103 per ton to the Siberian producers. So far, the war has done but little direct harm to Russian mining, and we shall be surprised if the conclusion of peace does not cause fresh friendly attention to be given to operations, in Siberia more particularly.

Gold Production and the War

As regards gold, it is a fortunate fact that Europe yields less than 1% of the world's production. Of the total, 63% comes from regions under the British flag, chiefly the Transvaal and Australia, while 18% comes from the United States. None of the Russian output is derived from regions anywhere near the arena of war. To promote uninterrupted production in the British dominions, the government arranged with the Bank of England to advance 97% of the value of the gold when deposited at local banks, the remaining 3% being adjusted subsequently, after the bullion had been shipped to London, this being postponed until it could be done safely, under convoy. Thus English mining companies were able to realize upon their gold in London. The American and Siberian gold mining districts were not affected by the war, each having an ample domestic market for their precious produce. A more immediate danger was a shortage of supplies, such as cyanide, zinc, and drill-steel, as well as machinery parts. The South African mines had been obtaining fully 60% of their cyanide from Germany, the total consumption on the Rand alone in 1913 being over 10,000,000 lb. of that chemical, representing an expenditure of $2,120,000. Other gold mining districts were, wholly or partly, dependent on German manufacture. However, an adequate supply was soon assured from Scotland, as regards the major demands, while successful efforts were likewise made at New York for an increase in the domestic output, concurrently with the release, through Holland, of some of the stock accumulated in Germany. Fortunately, the disorders in Mexico had diminished the requirements of the silver mines, otherwise the scarcity in the United States and Canada would have been more pronounced. Zinc, in sheet form, for making the shaving used in the precipitation of gold, was another prime requisite. The supply, for South Africa particularly, suffered from the closing of the Belgian and German smelters, but the relatively small quantity required in cyanidation was soon forthcoming, chiefly from the United States.

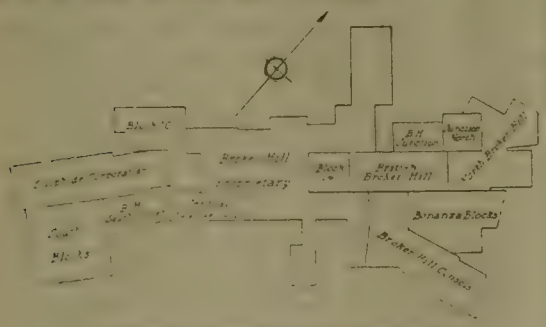
Copper has played an important part in the war, not only as a metal necessary to the manufacture of armament and munitions, but as contraband causing friction between neutrals and belligerents. Among the latter, Russia is the biggest producer of copper, her output of 45,000 tons being wholly absorbed in domestic consumption. The copper mines of Mansfeld and Rammelsberg contribute about 25,000 tons to the German consumption of 250,000 tons per annum. England consumes 140,000 tons of copper and produces none, while France uses 100,000 tons, all of which is imported. The United States yields 550,000 tons, or slightly more than half the world's total production of this metal, and consumes 340,000 tons; so that an export of 210,000 tons is required to maintain the normal level of output. Owing to the loss of the German market, besides the general slackening of world-wide industry, involving a lessened consumption of copper, by no means compensated by the use of it in war apparatus, the copper mining industry of America has suffered severely. For a while Holland served as a side door into Germany, the shipments to Rotterdam in September amounting to 5500 tons of copper, as against a normal annual consumption in Holland of 1000 tons only. The subsequent closing of the North Sea, owing to the presence of mines, has closed this market. As the war proceeds the embargo on contraband is becoming more effective, and more irritating to neutral countries desiring to continue business with belligerents. This, however, was anticipated in America as early as August, at which time the larger copper mines reduced their operations to half-capacity, while many of the smaller mines ceased production entirely. At the same time the decline in the price of the metal from 13¼c. in July to 11¼c. in October, tended further to restrict output. This result is due mainly to the closing of the German ports, that country consuming one-quarter of the world's entire copper production. Meanwhile, the corresponding drop in the London price of copper, from £65 in June to £51 in October, has compelled most of the Australian copper mines to curtail production or to cease operations entirely. The Mount Morgan, Wallaroo & Moonta, and Mount Lyell are working on half-scale. The Hampden-Cloncurry and other mines in Queensland have had to shut down owing to a suspension of selling contracts. Indeed the dependence of the Australian copper industry on the German market is strikingly emphasized.

Zinc Mining and Smelting Upset

As regards lead and zinc, the invasion of Belgium and the belligerency of Germany have stopped the smelting of the Broken Hill concentrates that formerly went to Belgium, Rhenish Prussia, and Silesia. This means the temporary cessation of an important industry in Europe and the crippling of an equally important industry in Australia. The mines at Broken Hill in 1913 yielded 525,000 tons of concentrate containing 45%

zinc and 5% lead, representing therefore 236,250 tons of metallic zinc and 26,250 tons of lead. This output was accompanied, as a part of the ore-dressing operations, by the production of 350,000 tons of lead concentrate, carrying 65% lead and 6% zinc, containing therefore 227,500 tons of lead, with 21,000 tons of non-recoverable zinc.

Naturally mining operations at Broken Hill were disorganized as soon as the war severed communication with the European smelters to which this big production had been consigned. Of the total output of zinc concentrate only 21,000 tons was being treated elsewhere, namely 12,000 tons by the Broken Hill Proprietary Company at Port Pirie, in South Australia, and 9000 tons by the Central Zinc Company at Seaton Carew, in England. Of the lead concentrate, the Port Pirie smelter was receiving 170,000 tons, while 30,000 tons was consigned to the Sulphide Corporation's smelter at Cockle Creek, in New South Wales. Thus 500,000 tons of 45% zinc concentrate and 150,000 tons of 65% lead concentrate were being treated in Europe, and of this grand total only 9000 tons of zinc concentrate was diverted from Belgium and Germany.



PRINCIPAL PROPERTIES AT BROKEN HILL.

During September an arrangement was made whereby the Port Pirie smelter undertook to treat only one-half the Broken Hill Proprietary's output and was thereby enabled to accept the production of the North, South, and Zinc Corporation mines, each of which, as well as the Proprietary, is working on half-time. The British Broken Hill is shut down. The Cockle Creek smelter has been unable to accept any tonnage except the output of its affiliated mine, namely, the Central, belonging to the Sulphide Corporation.

The enforced idleness of the German and Belgian smelters also affected the Bawdwin mine of the Burma Corporation, which had just begun to ship its complex zinc-lead ore to Rotterdam, for the German smelters. It also affected the Sardinian, Algerian, and Spanish zinc ore and concentrate that formerly went to Belgium; and the Bolivian tin concentrate, a large part of which used to go to Essen and Hamburg, both in Germany.

Sundry schemes for the erection of a zinc smelter in England, together with serious talk of building a large lead plant, have not come to fruition, largely on account of adverse monetary conditions, but several groups of experienced financiers have the matter under consideration. It remains to be seen whether the war will last long enough to effect a permanent transfer of industry. As Great Britain consumes exactly the amount of zinc that is contained in the concentrate shipped from Broken Hill, it would seem advantageous to extract that zinc at a domestic smelter, seeing that the fuel, clay, and labor are available. Indeed, the further erection of a lead smelter adjacent to a zinc plant commends itself on economic and political grounds.

One immediate result of the war is to lay bare the fact that the German metal companies and their associated smelters have obtained a big control of the metal trade in London. Most of the Australian lead and copper companies have been tied to them, while the price of zinc has been manipulated by the cartel to such an extent as to constitute a scandal. Indeed, the English mine operators are becoming aware now to what a surprising degree the German metal merchants and brokers, together with their New York allies, have gained a hold on the big business of buying and selling the metals. Obviously any glaring abuse of this control can be rectified by insistence, on the part of the mining companies, upon the inclusion of a clause in their contract specifying that the final adjustment of payment shall be made on the price at which the metal recovered, from the ore or concentrate, is actually sold. At present both the miner and the consumer are the easy victims of the broker who speculates on the rise and fall of metals with an unfair knowledge of the conditions affecting the market.

Speculation Killed by War

War has killed speculation in mining shares, and it has put a quietus on the promotion of new enterprises. The pun that floating mines in the North Sea engage more attention than the floating of mines in the City is inevitable, because it conveys a fundamental fact. The great industry of mining, however, proceeds in every quarter of the globe, except where the warring hosts are assembled. A productive gold mine is today the most liquid of assets. The metals are still wanted, and will be wanted in increased quantity as soon as hostilities cease. Material civilization is built with them. When this abnormality of organized murder is ended, the peoples of the earth will return with intensified ardor to the expansion of those peaceful industries that depend so largely upon the produce of the mine.

Gold recovered from 873,635 cu. yd. of gravel at the Lena, Siberia, from October 1, 1913, to September 30, 1914, totaled 370,256 oz., worth £1,391,532. A further £108,618 was saved from slag and outside purchases, making a total value of £1,500,150 ($7,200,000).

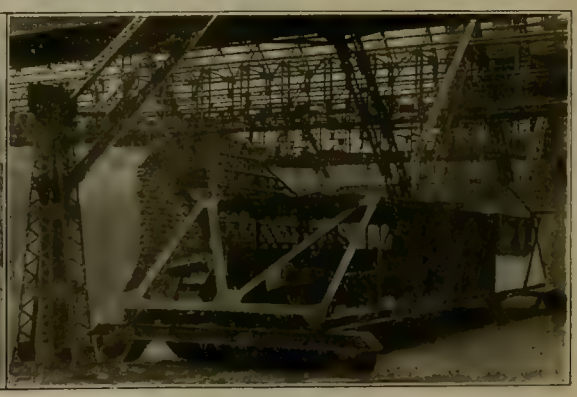
Gold output of British Guiana, South America, for the current year to November 5, was $937,636, compared with $1,167,246 in that period of 1913. The diamond yield was 9517 and 5941 carats, respectively.

Arizona Copper's New Smelting Plant

The Arizona Copper Co., Ltd., one of the old and well established copper companies of the Southwest, completed and put into operation last year a smelting plant that is in many particulars a model of the best modern practice. Through the courtesy of Norman Carmichael, general manager, we present a number of views of the plant. The total cost was $2,100,000. A detailed statement of construction costs was prepared by E. Horton Jones, the constructing engineer. An abstract, with flow-sheet of the works, was printed in the *Press*, August 8. L. D. Ricketts, as consulting engineer, was responsible for the design, and Repath & McGregor drew the plans. While ample space has been left for blast-furnaces, smelting is for the present conducted entirely in oil-fired reverberatories. Steel and concrete have been used liberally in construction.

There are three reverberatory furnaces, eight Herreshoff roasters, and three stands of converters. The whole plant is designed so as to have ample capacity in reserve and so insure continuity of operation. It is served by the Arizona & New Mexico railroad, and within the works there are 1½ miles of electric trolley road and about four miles of standard-gage steam road. The plant is on the San Francisco river about two miles below Clifton. The Company owns eight producing mines at Morenci, Metcalf, Longfellow, Garfield, and Coronado. Over 90 per cent of the ore treated comes from the concentrators. Such coarse ore as comes from the mines is crushed and sampled before treatment. In addition to the smelter the Company operates a leaching plant for treatment of oxidized ores and has been the pioneer in much good work.

STOCK PILES AND SAMPLING WORKS.



MESSITER RECLAIMING MACHINE.

AIR-COMPRESSORS AND TURBINES.

BOILER MACHINE SHOPS.

Power from waste-heat boilers is supplied for the smelter and for transmission to the mines. The boilers are Stirling class M No. 26 water-tube. Curtis turbines furnish current at 13,200 volts, for transmission to the mine and the current taken at 440 volts for general use and 110 for lighting around the works. Connersville rotary pumps circulate water for the turbines. Nordberg blowing engines furnish air to the converters. They are cross-compound, duplex, steam cylinders being 22 by 42 in., and air cylinders 44 by 42. They are designed for steam at 160-lb. pressure and 75° superheat and each engine compresses 10,000 cu. ft. to 12 lb., at 71 r.p.m. Guaranteed steam consumption is 1.1 lb. per 100 cu. ft. of air.

ROASTERS' CALCINE DISCHARGE.

After sampling, the ore goes to bedding piles from which it is reclaimed as needed and sent to the roasting department, over a Merrick weightometer. Herreshoff air-cooled furnaces are used. These furnaces have six roasting hearths and one for drying. They are of 21½ ft. diameter, 18 ft. high, and each requires 3 hp. and 2400 cu. ft. of air per minute at 1¾ oz. pressure. The air is furnished by Buffalo fans driven by General Electric motors. The capacity of the roasters is 70 to 100 tons per day. The dust goes to a 48 by 180-ft. chamber with double hopper bottom and 1325 sq. ft. cross-section. In it pieces of No. 10 steel wire and ⅜-in. chains are suspended, the wire on 4-in. centres.

FLUE-DUST CHAMBER AND ROASTERS.

DISCHARGING SLAG.

CASTING MACHINE.

CONVERTERS.

There are three 22 by 100 ft. reverberatories, of which one is held in reserve. They have the usual silica bottom and are fettled through holes in the roof, using silicious ore. Converter by-products as well as silicious ore are brought to the furnace in small cars running on track over each side of the furnace. Each furnace has two matte tapholes from which matte is drawn into 20-ton cast steel ladles. Slag is taken away in Treadwell slag cars hauled and tilted by electricity. Oil is fed by the Wilgus system, and tank capacity is sufficient to permit careful measurement and recording of the amount of oil used by each furnace. The reverberatories furnish heat to seven boilers of 712 hp. each.

CONVERTERS; MATTE RECEIVING END.

FIRING END REVERBERATORY FURNACE.

There are three converter stands, and four 12-ft. upright Allis-Chalmers shells. The converters are lined with magnesite bricks, and are built with 15-in. vertical distance from the bottom of the dished portion to the tuyeres. Matte is brought to the converters in 12-ton ladles, handled by means of Morgan cranes. Each crane is of 40-ton capacity and has a 15-ton auxiliary hoist. Work is expedited by storing silicious ore so it may be spouted direct into the converters. There is a separate chamber for converter dust. It is 25 by 130 ft. and is hung with steel wires and chains as in the larger chamber. Copper is cast in two straight-line casting machines.

MATTE SLIMING END OF REVERBERATORY FURNACE.

Application of Electric Motors to Gold Dredges

By GIRARD B. ROSENBLATT

A gold dredge is a piece of machinery designed to dig gold-bearing gravel, sand, or clay, and to treat the material so dug in such a way as to recover the gold content. It, accordingly, consists essentially of two parts, one the digging part, and the other the gold-saving part.

Hard Service in Dredging

From the point of view of the application of electric power, the digging end is of particular interest, as the mechanical requirements are severe and the speed control must be exceptionally good. The gold-saving end does not differ very materially as to motor applications from those of the usual metal mining mills, except possibly that the equipment is exposed to a little more abuse and that compact methods of drive are necessitated.

Electric power has been applied very generally of late to the driving of gold dredges, owing to its convenience and economy. Of the $88,400,000 worth of gold produced last year in the United States, nearly a fifth came from dredges, and in view of the fact that gold is being recovered by means of dredges in practically all of the Western states, in most of which localities hydro-electric central-station power is available, a few remarks regarding the essential characteristics of successful motor drive may be of interest.

In designing electrical apparatus and applying it to gold dredging, the electrical engineer is often too prone to approach the problem from the point of view that the dredge should be designed particularly to permit of the most favorable application of electrical apparatus. A successful dredge is primarily designed to make money. Electric drive is merely an incident in the process, so that, while it is unquestionably often advantageous to modify the ordinary dredge design so as better to accommodate it to the characteristics of the electric drive, nevertheless the fact should not be lost sight of that the electric drive is simply an incident to effect economy, and that other considerations are often of greater importance than the most advantageous installation of a particular type of motor in a particular manner.

In considering how electric drive can help the dredge make money, the following factors enter into the total charge against the electric plant: (1) Interest on investment, which is affected by the first cost of any particular arrangement; (2) power charges, which are affected by the efficiency of the motors and the system of control; (3) maintenance charges, which are affected by the type of apparatus chosen; and (4) delay charges, which may be very seriously affected by proper or improper application.

As stated above, the gold-saving end of a dredge does not offer any particularly great problems in the application of electric drive. A motor is required to drive either a shaking or revolving screen, which removes the coarse rock from the finer gold-bearing sand and gravel. This motor may be either geared or belted to the screen. Gearing is preferable on account of its saving in space, but belt drive is preferable as far as the motor is concerned on account of the damping effect upon the vibration incident to the screening operations. Squirrel-cage motors are generally used for this purpose and are entirely successful, but some designers advocate motors with phase-wound secondaries in order to reduce the strain at starting. The writer is inclined to favor the squirrel-cage motor on account of its freedom from details which may increase the maintenance charge.

All of the gravel and sand which passes through the screen must be washed in order to obtain the gold from it, and for this purpose a considerable volume of water must be pumped. Centrifugal pumps are usually used on account of the low head and large volume to be handled, and these are best driven by direct-connected squirrel-cage motors. Apart from those features which tend to reduce the maintenance charge, such as adequate insulation, adequate air gap and adequate bearings, the efficiency of these pump motors deserves consideration as the amount of total power used by the dredge for pumping is very considerable, usually as high as 40%, and sometimes higher.

Handling the Tailing

The tailing or residue that is sorted out by the screen must be removed to some distance from the hull of the dredge so that it will not pile up under the hull and strand the dredge. Two methods of taking care of this material are in use. One, the less common, is to pass the waste down a chute, helping its progress with a stream of water. The other, and by far the more common, method is to employ a belt-conveyor running out of the back end of the dredge for a distance of 90 ft. or more, which conveyor is commonly referred to in dredge practice as a stacker. This stacker is motor driven. The service is reasonably severe, owing to the fact that the motor is usually at the far end of the stacker and therefore often exposed to the weather, and also due to the fact that when the stacker has been at rest, considerable torque is required to start it loaded. In cold climates, a stacker when at rest is often likely to freeze, due to the moisture contained in the waste being carried by it. Starting under these conditions is particularly arduous, and in some places this trouble is overcome by putting the stacker in a continuous canvas tent like a tunnel and passing steam pipes from a little low-pressure heating boiler up inside this tent.

*Abstract from *Transactions* of Am. Inst. Elec. Engineers.

This again makes life hard for the motor, because moisture vaporized by the heat of the steam pipes rises to the far end of the stacker where the motor is situated, and there often condenses on the motor whenever that machine is shut down and allowed to cool. Accordingly, a motor for stacker service should primarily be designed with adequate insulation to resist continued moisture, and in some cases drip guards have advantageously been placed over the ventilating openings in the motor. Squirrel-cage motors with heavy torque characteristics have been used successfully for stacker drive, but the general tendency is to use motors with phase-wound rotors in order to obtain a good starting torque. Here again is the question whether complications of a phase-wound motor are justifiable, and in my opinion it is probably preferable to use a squirrel-cage motor designed for good torque characteristics, with possibly a trifle more resistance in the secondary circuit than is found in standard squirrel-cage induction motors. A stacker motor is comparatively small compared with the total motor installation on the dredge, and a slight loss in efficiency on such a small unit is more than offset by a saving in maintenance.

The Digging End

The application of electric power to that portion of the mechanism used for digging, is a much greater problem than anything met with in connection with the other applications on the dredge.

Power is required at the digging end primarily for driving the bucket chain, but some power is also required for lifting and lowering the ladder and for operating the devices that pull or hold the dredge up against the bank so that the buckets will bite into their work. Ordinary winches similar to those often used on seagoing vessels are used for these purposes. The duty of the motors is entirely akin to ordinary hoisting service and of very intermittent nature. An intermittent rated wound-rotor motor with high torque characteristics is successfully used.

The drive of the bucket chain is the real problem on the dredge, and no system that has ever as yet been devised has proved itself entirely free from all objections. For one thing, power requirements are at times excessive, and vary through a wide range. Accurate speed control is also essential. Good economy is of importance on account of the comparative size of the digging motor compared with the rest of the installation (in this connection it might be stated that the digging motor is usually from 35 to 45% of the total motor capacity on the dredge). Greatest of all is the problem of adequate and successful mechanical connection between the motor itself and the bucket chain.

The power requirements for driving the bucket chain under ordinary conditions may be calculated reasonably close when the size of buckets, the number of buckets handled per minute, and the type of ground to be dug are taken into consideration. The following table gives some fairly typical test results.

Place	Size buckets, cu. ft.	Buckets per minute	Motor rating, hp	Aver. hp input
Oroville	5	18	75	65
Marysville	7	20	150	140
Marysville	7½	19	200	155
Conrey	9	18	150	185
Natoma	14	21	400	285
Folsom	13½	20	300	202
Boston & Idaho	15		300	285 ?
Conrey	17	22½	550	460

These are all close-connected chains, ordinary digging.

However, should one of the buckets in a bucket chain encounter a boulder of larger size than it can handle, the demand on the motor is immediately increased, and may even cause the motor to pull out if no protective devices are provided. Also, if the buckets run into particularly sticky clay in the course of their digging, the load on the motor may be very much increased, and as such a condition is seldom momentary, the continuity of the overload may burn out the motor unless the speed of digging is reduced.

In addition to these requirements, during digging the motor drive must also be capable of revolving the bucket chain slowly at no load for the purpose of repairing the buckets, inspecting the chain, and similar work required for the purpose of mechanical maintenance.

The bucket chain is driven through a hexagonal spindle at the top of the ladder, over which spindle the buckets pass. Each one of the flat sides of this spindle or tumbler, as it is termed, engages with a corresponding flat side on the under side of the bucket, and the drive is accordingly a positive drive, just like any chain drive would be. If the tumbler turns, the bucket chain has got to move or break. It cannot slip. An adequate and successful method of transmitting power from the driving motor to the tumbler has been the source of considerable study by dredge designers the world over.

Belt Versus Gear Drive

The tumbler shaft usually carries two pinions, one on each side, which engage with two gear wheels carried on a common shaft. This shaft is connected through an adjustable slipping friction to another drive shaft by means of gearing, and the motor drives the last-named shaft. It may be either belted or geared to this shaft. Belting the motor is, of course, the easier on the electrical apparatus, but on the other hand, has certain disadvantages. A large and expensive belt is required on account of the tremendous torques involved. There are sometimes difficulties due to maintenance, because of the moisture that is often present on board a dredge. The belt sometimes slips just when maximum torque is wanted. Occasionally, under the heavy stress due to the slipping friction having rusted, a belt will break. Also, a belt transmission for the transmission of the torques involved, takes up considerable space, and space on a dredge is valuable.

On the other hand, gearing, while economical in space and entirely positive in action, has the disadvantage that it imposes severe service on the electrical equip-

ment, in that every strain and every vibration from the bucket chain finds its way back to the revolving part of the motor. Flexible couplings have been tried between the motor and the driving gear, but without success. The large variations in torque encountered, sooner or later ruin any type of flexible coupling that has as yet been tried. The gear drive has, however, proved entirely successful where a motor has been secured that will adequately withstand the stresses. Of the two methods, belt *v.* gear drive, each has its ardent devotees, its advantages and its disadvantages.

Motors for Digging Service

From a consideration of the above, it will be seen that the motor required for digging service on an elevator dredge must have the following characteristics:

(*a*) It must be a varying-speed machine; and if in addition it can be made an adjustable-speed machine, this would be a considerable advantage.

(*b*) It must be capable of being revolved at light loads and very low speeds.

(*c*) It must be capable of developing a maximum torque, at any speed from zero to approximately full-load speed, of several times its normal rated torque.

(*d*) It must be capable of carrying, for prolonged periods of hard digging, a torque overload of approximately 25% at a speed reduction of probably 25 per cent.

(*e*) It must be of substantial mechanical construction, particularly as to shaft and bearings, in order to resist a heavy belt pull when belt drive is used, or repeated shocks of severe gear thrusts when gear drive is used.

(*f*) It must be reasonably efficient.

In order to obtain all of the above characteristics, it has often been suggested that a direct-current motor of the type used in steel mills, with possibly variable-voltage speed control, might prove advantageous for digging service on big gold dredges. However, every investigation that has been made (at least to my knowledge) of this matter has developed the fact that the losses in efficiency due to the conversion from alternating current to direct current, practically offset the advantages gained by more flexible control under the ordinary cycle of operation, and further, the first cost of such an installation is prohibitive, considering the ordinary life of a dredging venture. In this connection it might be stated that, while there are exceptions, the average dredge is about worn out at the end of 10 years, and will then require either complete rebuilding and remodeling, or will operate with so many shut-downs due to breakages and the like, that rebuilding or scrapping will prove most economical. Accordingly, any installation more expensive than ordinary must show a saving that will repay the extraordinary expense in 10 years, and this no combination of direct-current equipment has as yet been able to show.

Therefore, the only type of motor left available is the moderate speed wound-rotor induction type, and for the most successful application the motor should be designed with special reference to the work it has to do.

Type of Motor Recommended

From experience with the troubles of a dozen dredges, large and small, I would recommend specifications embodying the following: (1) The motor should be capable of carrying rated load continuously with a rise not to exceed 40° in any part. (2) The motor should be capable of developing a torque 25% in excess of its rated full-load torque, at a speed of 75% of its synchronous speed, for a period of two hours, with a rise not to exceed 55°. (3) The motor should have a maximum torque and a starting torque of not less than 2.5 times its full-load torque. (4) The shaft shall be of such material and dimensions that strains due to the developing of maximum torque shall not appreciably affect the dimensions of the air gap on any side of the motor. (5) The bearings shall be designed to resist an upward thrust, and shall preferably be of the design known as rolling-mill bearings furnished with stud bolts and lock nuts, instead of the usual design employing cap screws. (6) The lubrication of the bearings shall be adequate. On motors of 200 hp. and over, at least two oil rings per motor bearing are recommended. On motors of 500 hp. and over, the use of gravity feed lubrication should be considered.

The problem of control of large motors used for digging service on gold dredges would be more simple if direct-current motors could economically be used. As, however, their use is impractical, the control for alternating-current motors that most nearly approaches direct-current control is desirable. The control must permit reversing the direction of the motor, principally to permit the bucket line being backed away from obstructions. For service during the repair of the bucket line, small variations in speed should be obtainable, particularly at part loads. A control permitting continued running at low-speed points is particularly necessary.

Magnet-Switch Control

For small motors on little dredges, say employing a digging motor of 100 hp. or less, the ordinary drum-type controller proves adequate. For larger installations, a combination of magnet switches controlled by a master controller has been used in a large number of installations; but for the larger motors the ideal control seems to be the liquid rheostat.

Magnet-switch control has been used satisfactorily on a considerable number of dredges employing digging motors as large as 400 hp. The large fleet of big dredges operated in California by the Natomas Consolidated mostly employ magnet-switch control on dredges having digging motors of 300 hp. and larger. It has, however, several distinct disadvantages for dredge service. The principal disadvantage is that a limited number of definite points only are available with this type of control, unless the number of magnet switches in

the secondary circuit is made large, which in turn makes the controller inordinately expensive. Therefore, small variation in speed particularly at light loads, is not available with this type of control, and in order to obtain slow movement of the bucket chain it is customary to start the motor and then plug it, with consequent strain on all mechanical parts, as well as wear on the control contacts. Further, this type of control does not allow the dredge operator to pick out any particular speed at which he desires to run. He can only pick a particular point on the controller, and the corresponding motor speed will depend on the torque being exerted by the motor.

Another disadvantage of this type of control is the tremendous amount of resistance required for a large motor, as the resistance must be sufficient in amount to permit very low motor speeds at light loads, and large enough in capacity to permit continuous operation at reduced speeds with heavy torques. This makes a bulky resistance, and unless the resistance is large enough there is considerable danger from overheating of the grids starting a conflagration.

Liquid Rheostat Control

The liquid rheostat for digging-motor control has, on the other hand, none of the disadvantages of the magnetic switch control. There are no definite steps, and the speed of the motor may be varied by infinite gradations. The operator simply moves the rheostat handle until he obtains the speed he desires. In other words, he does not work for any particular point on the rheostat, but works simply with the idea of getting the speed he wants. For large motors, the liquid rheostat and its accessories take up much less room than would a corresponding magnetic switch control and its attendant resistance, and there is never any danger of the electrolyte used (water and common washing soda) causing a conflagration.

However, the liquid rheostat for use on dredges must be modified from the forms commonly used for hoist service and the like on land. The first liquid rheostat installed in dredge service was on one of the Natomas dredges with a 400-hp. motor, and while it was operative, it was not entirely satisfactory, because certain essential details of design and application were overlooked. A similar liquid rheostat on which these details have been given due attention is now being used on one of the dredges of the Conrey Placer Mining Co., and has been quite successful and satisfactory in operation with a 550-hp. digging motor, which I believe is the largest digging motor on any elevator-type gold dredge in operation today anywhere.

In order to keep down the size of the liquid rheostat for this work, it is practically necessary to provide some means of artificial cooling for the electrolyte. Usually this is accomplished by circulating cooling water through the coils in the rheostat tank. On the Natomas rheostat the mistake was made of pumping water from the pond in which the dredge floats through these cooling coils. Due to the operation of the dredge, this pond water is usually pretty muddy, and often carries a large percentage of solids in the shape of silt. At Natoma this silt coated the inside of the cooling pipes, thus reducing their effectiveness and eventually clogging them up, necessitating a shut-down while they were blown out with compressed air. Shut-downs on a dredge cost money, because to realize the greatest return on the investment the dredge must be digging all the time. Therefore, this feature made the Natomas rheostat undesirable. At the Conrey Placer Mining Co.'s property the cooling system consists of a series of pipe coils immersed in the pond, and the electrolyte is pumped from the rheostat tank through the coils and back again, instead of pumping pond water up to the tank and through the coils installed therein. There has never been a shut-down on the Conrey dredge due to the rheostat or its cooling system. The motion of the dredge in the pond is sufficient to keep silt from settling on the cooling coils.

Another point that was overlooked in the Natomas installation was the fact that dredges swing, and often rock considerably. This causes the electrolyte to splash out of the rheostat. Usually such loss by splashing was replaced by pouring in additional water, but this, of course, changed the density of the electrolyte and caused the operators some trouble. On the Conrey rheostat, baffle-plates and enclosing covers were supplied, which effectually prevented any splash.

Another trouble that was experienced at Natoma was that, due to deficiencies in the cooling system mentioned above, the electrolyte very often attained a high temperature during hard work, which caused excessive evaporation. Under certain conditions this evaporation was so great that the annoyance and expense of bringing the amount of fresh replacing water required on the dredge and filling the rheostat was considerable. This trouble has been obviated at the Conrey installation by having an adequate cooling system.

All in all, it may be said that for large digging motors of say 350 hp. and more, the liquid rheostat makes an ideal method of control, provided the rheostat is of adequate mechanical construction for the service and is provided with a proper and sufficient cooling system. Both liquid rheostat and magnet switch control may be arranged to give the same advantages as to protection against acceleration at too high a rate and against excessive overload due to sudden changes in speed.

Small Economies Necessary

It will probably be gathered from the above remarks that the successful application of electrical apparatus to gold dredging operations depends on a multiplicity of details, each of which may be of comparatively minor importance in itself, and this is true. With the areas that are now still available for dredging, a multitude of small economies must be practised in order to make the process commercially successful. When it is considered that many dredges dig for about 4 to 5c. per

cu. yd., and that the gold content of the ground often runs as low as 7c. per cu. yd., it can readily be seen that a matter of 1c. economy or waste may make or break the concern doing the dredging. Therefore, maintenance deserves consideration. But most of all, freedom from shut-downs is of prime importance. The dredge cannot make money while it is not digging; but interest, not only on the money invested in the dredge, but on the money invested in the purchase price of the land that is being dredged, goes on just the same, and therefore stoppages must be avoided at any reasonable cost, and this should be particularly borne in mind in the selection and application of the electrical apparatus and its control.

A digging motor that may be of sufficient capacity, but cannot be adequately controlled, may break a bucket chain and put the dredge out of business for 24 hours. Ordinarily, dredge operators figure on operating 24 hours a day, 365 days a year; and a fair average is to expect the dredge to be actually performing its operations for 85% of the total time.

On account of the high load factor, and on account of the comparative uniformity of a large percentage of the load, as well as on account of the comparatively large blocks in which the power is purchased, dredges make a particularly attractive load for hydro-electric central stations, and a few figures as to the power consumption of dredges may be of interest in this connection.

Moderate size dredges with buckets of about 5 to 7.5 cu. ft. capacity will handle from 60,000 to 100,000 yd. per month, at a power consumption of from 1.25 to 1.75 kw-hr. per cu. yd. Larger dredges with buckets up to 15 cu. ft. capacity will dig from 125,000 to 250,000 cu. yd. per month, and will take from 1 to 1.5 kw-hr. per cu. yd. The large dredge of the Conrey company, mentioned above, which has buckets of 17 cu. ft. capacity (I believe the largest in the world), has handled 520 cu. yd. of material per running hour. Including delays, this means 325,000 cu. yd. per month. Handling material (heavier than usual) weighing 3000 lb. per cu. yd., its power consumption was 1.28 kw-hr. per cu. yd. The above figures are total power taken by the dredge for all purposes. The power taken by the digging motor is about 40%, on an all-day average, of the total power. From such test results as are available, the power for digging seems about proportional to the yardage dug; that is, the kilowatt-hours are proportional to the yardage handled times the number of hours during which it was dug.

Tube-Mill Tonnage Calculation

By NOEL CUNNINGHAM

It is often difficult to determine the tonnage actually being handled by tube-mills working in closed circuit with classifiers. Where either tube-mill feed or discharge can be deflected and weighed for short periods, it is still a quite inexact determination, as an accurate moisture sample is essential, and where a portion of the pulp is cut out of the flow and weighed, if the amount is sufficient accurately to determine weight of total flow, it is next to impossible to get a close sample for moisture. In any case, only by averaging a number of weighings and moisture determinations can data of any value be obtained.

The following method is, I believe, original with myself, and allows a close determination of tonnage from four screen tests which are often either daily or periodic routine. The four samples required for these screen tests are: (a) battery discharge; (b) tube-mill feed; (c) tube-mill discharge; (d) classifier overflow.

The object of the calculation is to determine the ratio of dry tons tube-milled to dry battery tonnage. The calculation is based upon the fact that the minus 200-mesh material coming to the classifier is equal to the minus 200 which leaves the classifier.

Let a = per cent –200 in the battery discharge.
b = per cent –200 in the tube-mill feed.
c = per cent –200 in the tube-mill discharge.
d = per cent –200 in the classifier overflow.
B = battery tonnage dry.
T = dry tons tube-milled.

Now the –200-mesh material coming to the classifier is that in the battery discharge (aB) plus that in the tube-mill discharge (cT), while the –200 material leaving the classifier is that in the tube-mill feed (bT) plus that in the classifier overflow (dB), hence:

$$aB + cT = bT + dB$$

and $\frac{T}{B} = \frac{d-a}{c-b}$ = ratio dry tons tube-milled to dry battery tonnage.

Thus knowing the dry tons passing through the battery daily, the dry tons actually tube-milled daily can be readily calculated from the routine screen tests.

It is interesting to study the limits of this ratio in practice. I should say in a general way that the –200 in modern fine-grinding plants for the four screen tests entering into the above calculation would lie between the following limits:

	Per cent –200. Min.	Max.
Battery discharge	10	30
Tube-mill feed	2	8
Tube-mill discharge	35	60
Classifier overflow	60	90

The lowest value of $d - a$ within these limits would be 30, and the largest value of $c - b$ would be 58; hence within the above limits, tons tube-milled could never be less than half of battery tonnage. In the same way, the highest value of $d - a$ within the limits above would be 80 and the lowest value of $c - b$ 27, or the maximum tonnage tube-milled within the above limits could not be over three times battery tonnage. Generalizing, I should say that for mills where tonnage is being pushed this ratio would be about 1.75, and never under 1.

Electrolytic Zinc—the Reed Process

By E. H. LESLIE

In the development of modern metallurgy, one of the chief stumbling-blocks has been the treatment of certain zinc combinations which have been unamenable to all known metallurgical processes. The solutions proposed for this problem have been many, and the failures have been about as numerous as the proposals. The Reed process, which has been experimented with on a semi-commercial scale for the past year or more at Palo Alto, California, is an electrolytic method of zinc reduction, the technique of which method has been fairly well worked out in so far as the reduction of the zinc is concerned, but those economies of operation so essential to commercial success of the process are still in course of development. The Company secures a high extraction from the material carrying the zinc in the form of a solution of zinc sulphate ($ZnSO_4$), and from this solution recovers the zinc in metallic form with the aid of electricity. These features have passed the experimental stage. The operations have now been conducted continuously for more than three months. There is no doubt but that a material reduction in operating costs will be effected by large-scale operations and the improved equipment necessary for such work.

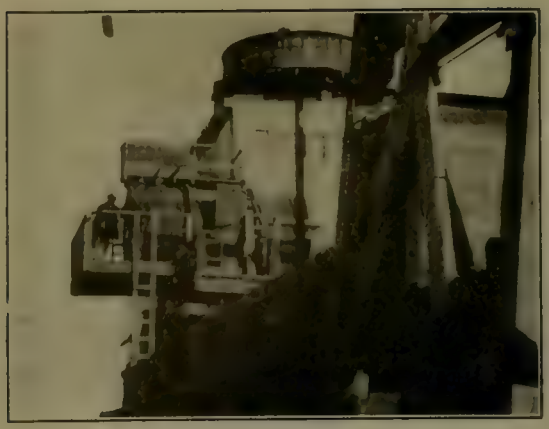
It will be the purpose of this article to discuss the metallurgical process and *modus operandi* rather than production costs and commercial possibilities; in that with the present state of development of the process but little more than a guess can be made as to what the possibilities of the process are, and the present work is being confined to small-scale operations for the purpose of determining the refinements necessary for most economic procedure.

Electrolytic zinc processes are not new, but have been fraught with many difficulties owing to the inamenability of zinc to electrolization in cells on a commercial scale; impure solutions, formation of excess sulphuric acid, spongy zinc, and lack of capacity have been real impediments to its commercial application. The process as being conducted at the Reed Zinc Company plant at Palo Alto presents many novel features and has overcome many of the difficulties of the earlier metallurgists who have worked on the subject. As a basis for the present process, it may be said that the electrolytic process which was patented by Carl Hering, of Philadelphia, has been used. This process has been modified and changed by Messrs. Reed and Leach and brought to its present state of development, which is one of promise and at least a long step toward a commercial electrolytic zinc process.

In electrolytic processes in which the reaction at one electrode is not the exact reverse of that at the other electrode, there is a gradual and progressive change in the electrolyte. This is due to the fact that something is either added to or extracted from the electrolyte or formed or decomposed in it, thereby changing its composition or concentration. In such cases it may happen that the cumulative change thus produced in time interferes with the proper continuance of the desired electrolytic process.

The object of the Hering process is to provide means by which such objectionable cumulative changes in the electrolyte may be prevented, thus enabling the desired process to be continued. This is accomplished by using an electrode of such nature and material as to combine chemically with the objectionable ingredient as it is formed in the electrolyte, thereby rendering it inert as far as the electrolyte is concerned, and thus preventing the latter from being contaminated. In many cases the

GENERAL VIEW OF THE LEACH PLANT, PALO ALTO.



DIGESTER ABOVE THE VATS.

objectionable ingredient which is thus removed from the electrolyte is a useful product, and the Hering process further contemplates the recovery of this ingredient by removing the electrode with which it has combined and passing the reverse current through it in a second electrolytic process. Thus when it is desired to extract electrolytically a positive ion—say a metal—from a solution containing the same, unless the anode is one which continuously replenishes the solution with the metal, which is being thrown down at the cathode, the negative ion with which the metal is combined may remain in the solution and thus cumulatively hinder the further extraction of the metal. To prevent this setting free and accumulation of the negative ion formerly in combination with the metal, Hering's process employs the use of an anode of such nature and material as upon the passage of the current will chemically combine with this ion to form an insoluble compound which adheres to or unites with the anode. After the anode has been acted upon in this manner to its full capacity, it may be removed from the solution and placed in another electrolyte and subjected to the action of a current in the reverse sense of that originally employed, thus setting free the combined ion and restoring the plate to its original condition.

In extracting zinc from a solution of zinc sulphate in the presence of an excess of sulphuric acid, an accumulation of the sulphate radical from which the zinc is separated (which forms sulphuric acid when insoluble electrodes are used) hinders the efficient extraction of the zinc. This is because sulphuric acid, being less stable than zinc sulphate, electrolyzes more readily, setting free hydrogen at the cathode with a consequent loss of energy, and also tending to form a loose and spongy, instead of a dense and adherent, deposit of zinc on the cathode. Furthermore, the presence of sulphuric acid formed at the anode tends to redissolve the zinc.

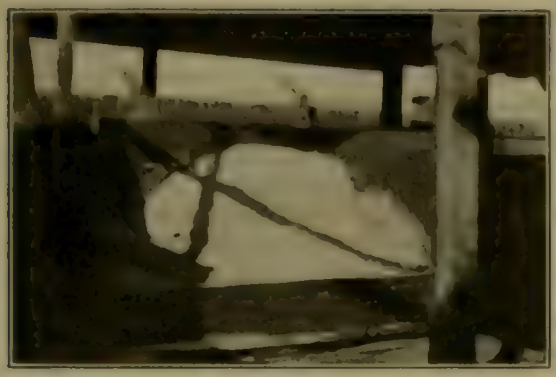
These reactions are even more apparent when nearly all of the zinc has been extracted from the solution, as there is then present a relatively large per cent of sulphuric acid. With the Hering process there is employed in the electrolyzing of the zinc sulphate solution an anode of spongy lead, the cathode being of any material suitable for the deposition of zinc. The sulphate radical, as it is set free by the electric current, then combines with the spongy lead of the anode, forming insoluble lead sulphate, which adheres to the anode and can be removed with it from the solution. After the anode has thus been completely sulphated, it is placed in another cell containing water or any other desired electrolyte, and upon being constituted a cathode by a current in the reverse manner, the sulphate radical is again set free with the formation of sulphuric acid if water be the electrolyte. The spongy-lead anodes must, of course, be of a capacity corresponding with the quantity of zinc deposited on the cathode in the first operation, or else they must be replaced by new plates from time to time. Their exhaustion is indicated by a rise of the voltage between the terminals of the electrolytic cells. It is to be noted that in the first operation, during which the zinc is extracted, the voltage required to obtain the zinc is about 1.6 volts less than that theoretically required to extract zinc from its sulphate, as the sulphating of the lead anodes gives rise to a direct electromotive force of this magnitude. This, however, in a continuous process, is no gain, as a counter electromotive force of the same amount must be overcome by the current from the external source in the subsequent operation when the anodes are restored to their original condition.

This is the Hering process of electrolization upon which an endeavor is being made to produce zinc on a commercial scale from ores and smelter by-products which have been inamenable to the recognized processes of zinc metallurgy.

Work at Palo Alto

At the present time the Palo Alto plant is concerned solely with treating a bag-house product from the Mammoth smelter at Kennett. A large tonnage of this material has been accumulated during the past years, and to date has baffled every effort of the metallurgical en-

TREATMENT VATS.



ZINC SULPHATE AFTER CRYSTALLIZATION.

gineer. The composition of the bag-house dust or 'fume,' as it is termed locally is as follows:

Gold, ounces	0.05
Silver, ounces	11.00
Copper, per cent	1.1
Iron, per cent	5.0
Lead, per cent	8.2
Arsenic, per cent	6.2
Zinc oxide, per cent	14.6
Zinc sulphate, per cent	38.6

This material is delivered in freight cars over a turnout from the main line of the Southern Pacific to the plant, which is situated about three-quarters of a mile southwest of the western end of the Dumbarton 'cut-off' and about three miles east of the town of Palo Alto, California. The plant is convenient to deep water, railway, and the power-lines of the Pacific Gas & Electric Co. Its proximity to San Francisco, the smelters of California, and west coast mines makes the location favorable for such a project. As cheap power, however, will be the governing element of the commercial success of large-scale operations, this will be the primary and determining factor of location for such plants.

The 'fume' as delivered at the plant is stored in bins from which it is elevated in 250-lb. buckets to the charging floor. Here it is dumped through a chute into the digester, which is a unique device made after designs by C. J. Reed. It consists of a cylindrical vat, 6 ft. diameter and 12 ft. long, made of wood and about which there is fastened 'T' rails of standard gage. The digester is supported by these rails, which impinge on four car wheels—being a converted street-car truck—and when put in operation cause the digester to revolve. The inside is fitted with four longitudinal baffles which give the pulp a thorough agitation. The digester and driving mechanism is mounted on a second truck which moves on rails by means of a motor and trolley over the eight treatment tanks.

The 'fume' is charged through a manhole in the digester similar to that used in boiler construction, and is here mixed with a weak solution of sulphuric acid of 1.20 sp. gr. A lead-lined centrifugal pump is used for elevating the acid from the acid tank to the digester. When the charge, which at capacity is about 150 cu. ft., has been put in the digester, the manhole is closed and the digester revolved by the driving mechanism, and the 'fume' treated for a period of about three hours. Before discharging, the charge is sampled and 'fume' or acid added according to the state of acidity. The charge on being discharged must be acid for best results, as this assumes the almost complete extraction of the zinc. If too acid, more 'fume' may be added.

When digested the charge is moved over one of the 'acid' vats, of which there are five in this series of eight treatment vats, and dumped. Here it is allowed to settle for 3 or 4 days, when the solution is decanted. The settling and decanting is a slow process, and for this reason filtration can and is about to be substituted at this point in the procedure. The solution is then returned to the digester and more 'fume' is added in order to neutralize the acid present and precipitate a part of the copper, iron, and other impurities.

The second digestion occupies about three hours, after which a part of the solution is decanted from the digester and the remainder settled, decanted, and filtered in the tanks. This second operation is much faster than the first, it being only necessary to allow the solution to stand over night. The solution is now pumped by a monteju (what is known as an 'acid egg' in the Middle West) to the evaporating plant.

Residue from Digesters

The residue, as filtered from the neutral solution, is returned to the digester and here mixed with the next charge and so re-treated. The residue or tailing from the first acid treatment is discharged, dried, and will be eventually given a further treatment. Analysis of the residue or tailing is as follows:

Gold, ounces	0.06
Silver, ounces	19.1
Lead, ounces	26.3
Cu, per cent	2.75
SiO_2, per cent	10.9
Iron, per cent	11.8
Zinc, per cent	6.5
Sulphur, per cent	9.8
CaO, per cent	2.7

A glance at the above analysis shows the residue to be

EVAPORATION DEPARTMENT.

a valuable product and well worthy of further attention.

There are four pine tanks in the storage department of the evaporating and purifying department, one for solution and three for 'mother liquor.' From the solution tank the zinc-bearing solution flows by gravity to the evaporator.

Evaporating Department

The evaporation of the solution to the proper density for crystallization of the zinc as sulphate is done in a trough evaporator which is 40 ft. long, 2½ ft. wide, and has a depth of solution of 12 in. This trough is lead lined and fitted at one end with a Dutch oven fire-box in which crude oil is burned. In the top of the furnace are fitted three iron flues connected with three lead flue pipes which are of 4 in. diameter. The flue pipes are laid through the entire length of the evaporation trough and discharge the burned gases of combustion into the air. The process of evaporation is a slow one, it requiring about two days to evaporate 75 cu. ft. of solution. The present equipment is ample for the experimental work being done and the limited capacity of the plant, but with large-scale operations this department would be materially increased.

The process of crystallization is for the purpose of purification and is the last step in the purification process. Crystallization of zinc sulphate is performed in 8 lead-lined vats into which the solution from the evaporator flows by gravity. These vats are 8 ft. long, 4 ft. wide, and 3 ft. deep, inside dimensions. The vats are lead lined and across their width there are fitted thirteen wooden pieces spaced equi-distantly from one another, and from these bars there are suspended lead strips, there being 3 of these from each bar. These sheets of lead, upon which the zinc sulphate crystals form, are 10 in. wide and 3 ft. long, extending almost to the bottom of the vats.

The process of crystallization is continuous, one vat being cleaned up every day. The time required for crystallization is about eight days. In this process the $ZnSO_4$ crystallizes out first, forming on the lead strips to a thickness of from 1 to 2 inches. This salt contains 22½% of metallic zinc, which is removed from the plates and vats and stored in a bin for further refining. The 'mother liquor' is pumped back to the storage tanks and re-evaporated and again crystallized. The re-evaporation of the 'mother liquor' requires from 12 to 15 hours.

This process of purification has been found greatly to abet the subsequent electrolytic precipitation of the metal, and as such forms an important step in the process. As crystallized the zinc sulphate ($ZnSO_4$) is usually snow white, but sometimes tainted with arsenous salts and some copper.

The zinc sulphate is removed from the storage bin in a barrow and shoveled into a vat which is sunk in the ground, to permit of a gravity flow of the solution from the cell room. Here the zinc sulphate crystals are dissolved in the weak solution returned from the electric cells after extracting the zinc, and the solution thus formed is elevated by a small centrifugal pump to the purifying vat. Here a small amount of zinc dust is added and the charge agitated by air, in this manner precipitating the copper and other metals electro-negative to zinc, the process requiring about twelve hours. The purified solution is then filtered through canvas by vacuum and pumped to a storage tank. The solution as stored for the electrolytic refinery contains about 8 lb. zinc per cubic foot.

In the electrolytic plant there are 15 cells, 8 of which are 'charging' and 7 'depositing' cells, placed in alternate order. The charging cells are connected by lead pipes permitting a continuous flow of the solution, as are also the depositing cells. In the depositing cells a sponge-lead anode is used with an aluminum cathode. Upon the passage of the current through the zinc sulphate electrolyte, the zinc is deposited at the cathode on aluminum, and sulphuric acid at the anode. The acid combines with the lead, forming lead sulphate. The reaction which takes place is expressed by the following formula:

$$ZnSO_4 + Pb + \text{electric energy} = PbSO_4 + Zn$$

After deposition takes place, the sponge-lead anode of the depository cell with its lead sulphate coating is removed to the charging or acid cell, where it becomes the cathode with a lead 'dummy' for the anode. The current upon being passed in a reverse manner through this charging cell causes the lead sulphate, formed on the anode of the depository cell, to be reduced back to sponge lead, the reaction being as follows:

$$PbSO_4 + H_2O - \text{electric energy} = Pb + H_2SO_4 - O$$

Oxygen Recovery

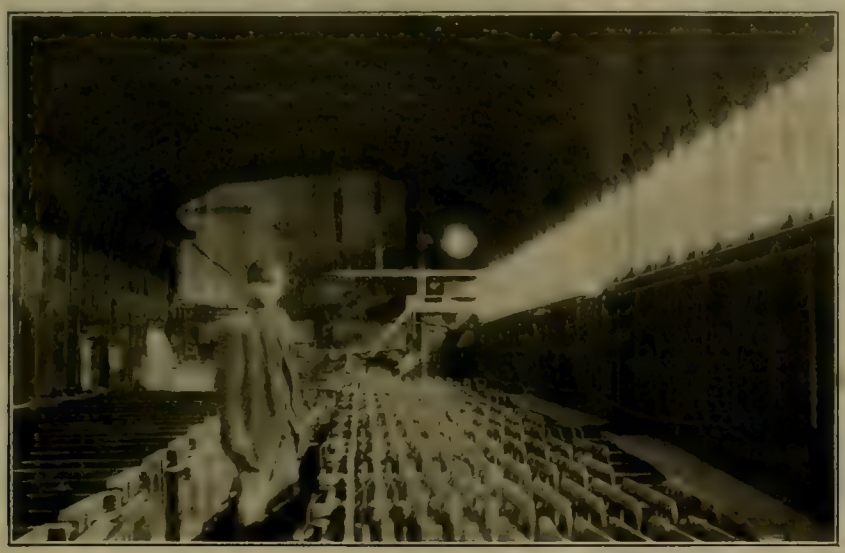
The Company controls patents for the recovery of the oxygen liberated at this state of the process, but the equipment for the recovery of this element has not been installed. In that there is about one-fourth, by weight, as much oxygen as zinc produced, it is believed that its recovery is of commercial importance. The lead 'dummy' used as an anode in the charging cell is gradually converted into sponge lead and may replace the sponge-lead anode in the depository cells. The deterioration of the anodes, however, is very slight. Some of the anodes have been in use for over a year and show no deterioration. They can scarcely be distinguished from new anodes.

The electrolytic department is fitted with a traveling crane moving over the cells and suspended from a track. A small hoist with attachment for gripping the plates of the cells is attached to the crane, and in this manner the transfer of plates from the depositing to charging cells and the reverse is greatly expedited. The current is supplied by the Pacific Gas & Electric Co. A small generator being used which is connected with a 25-hp. motor. Current is supplied to the cells at 350 amperes and 32 to 42 volts for the 15 cells. At the present time only 3 electros are being used in each cell, as no effort is being made to run the plant at capacity, and will

not until all of the refinements of the process have been determined.

The cell solutions as discharged from the cells by gravity are collected in sump tanks. The solution from the depositing cells, after passing through the 7 cells, flows to the weak solution tank, and the small trace of acid is here neutralized with scrap zinc. It is then conducted to another tank where the zinc sulphate crystals are added, and it is brought up to strength and returned to the electrolytic department for deposition. In the charging cells water is run into the first of the series, but with the formation of sulphuric acid in accordance with the reaction mentioned; the solution emerges from the last charging cell as what is termed locally 'strong acid.' This is used in the digester in the preliminary treatment of the ore.

The electrolytic zinc, as stripped from the cathodes after about 48 hours of deposition, is in plates of about $\frac{1}{8}$" in thickness and of a firm minutely crystalline texture. The sheets thus formed are melted and cast into



ELECTROLYTIC PRECIPITATION DEPARTMENT.

bars which are a very high-grade product averaging 99.88% zinc.

The process as installed has demonstrated that electrolytic zinc is well within the range of probability. It is being made with an extraction of 93% of the zinc content of the material treated; a marked advance in extraction over the smelting methods universally employed, and the product is a high-grade spelter of excellent quality. From a commercial standpoint the process is yet to be proved, and I am not able at this time to discuss in detail its commercial possibilities. The present plant and equipment is not a fair criterion by which to judge the possibilities of the process from a commercial standpoint. Large-scale production would embody some mechanical changes in the handling of the materials and solutions which would materially reduce the cost of production. The power question, power being the chief expense, is the important factor to be considered, and upon this, to a large extent, would depend the commercial success of the process. It will be understood that the process in its present state is being employed solely for the treatment of ores and smelter products which have been inamenable to all known metallurgical methods. E. R. Leach and his associates have been making a thorough investigation of its possibilities for the past year or more, and their efforts have thrown a new light upon the possibilities of electrolytic zinc extraction. The process is one that is full of promise as to possibilities and application. Its inventors and sponsors are to be congratulated upon the new technique which it has developed.

Miners' Health at Broken Hill

A commission of three has submitted an important report to the New South Wales parliament on various phases of industrial conditions in the lead-zinc-silver mines at Broken Hill. They recommended the following: (1) That no person suffering from tuberculosis be permitted to work underground. (2) All persons working underground be examined once in every six months by a medical officer appointed by the government. (3) No person be permitted to work underground unless he can read and intelligibly speak the English language. (4) That lead poisoning and its *sequelae* (results) be made diseases which are chargeable on the Miners' Accident Relief Fund. (5) Investigations be made as to the liability of miners at Broken Hill to pneumonia, and that compensation be given if this disease be found to be an added and exceptional risk of the miners' calling. (6) In mine air the maximum of CO_2 be 1%, and the minimum of oxygen 19%. (7) Provision be made on each level of any shaft to provide shelter from the cold air for those who are waiting to be hoisted to the surface.

Two dredges of the Orsk Goldfields Co., Russia, produced gold worth R.72,700 ($35,000) from 119,050 cu. yd. of gravel during October. Tributers also recovered R.15,300 ($7500).

Accommodation for certain employees at the Mt. Lyell mine is being provided. First-aid and rescue-work instruction has been started.

Electric Smelting in 1914

By ROBERT M. KEENEY

During the past year, smelting of ores in the electric furnace made notable advances in the clarification of several fundamental technical questions upon which the electric smelting of iron and zinc ores depends. The year saw the completion and operation of the largest electric iron-smelting furnace built up to date. Work was started on the first commercial electric zinc smelting plant to be constructed in the United States. The first aluminum plant to be built in this country since the expiration of the Hall patents was well under way at the close of the year. As a result of the high price of ferromanganese, caused by the European war, the one electric pig-iron plant of the United States started the manufacture of ferromanganese. There was also increased attention paid to the possibility of local manufacture of other ferro-alloys such as ferrochrome and ferrotungsten, because of foreign conditions. The lack of a supply of cyanide has resulted in one company, formerly a producer of sodium, renewing the manufacture of this metal in the electric furnace for later conversion to sodium cyanide.

The chief points of technical interest in which there have been important developments during the past year are the following: (1) The use of coke instead of charcoal as a reducing agent in electric smelting of iron ore; (2) the introduction of much larger units than heretofore built for the manufacture of pig iron, ferrosilicon, and calcium carbide in the electric furnace; (3) increased attention directed to the production of pig steel directly from ore in the electric furnace; (4) further progress made in the solution of the condensation problem in electric smelting of zinc ore.

Use of Coke as a Reducing Agent

In the early experiments on electric smelting of iron ore, at Livet, France, in 1904, and at Sault Ste. Marie, Canada, in 1906, coke was used as a reducing agent. With the small furnaces employed in both cases, coke seemed as advantageous as charcoal for a reducing agent in the electric furnace manufacture of pig iron. But as the first commercial development of electric iron smelting was in Sweden and California, where at that time charcoal seemed to be the cheapest reducing agent, little attention was paid to the use of coke for this purpose until recently, within the past two years. In Sweden there is no immediate need for a change from charcoal to coke; but it has become evident, just as in the production of blast-furnace charcoal iron, that the forests for the manufacture of charcoal are rapidly being depleted in spite of decreased consumption since the introduction of the electric furnace. At some time in the future, some reducing agent other than charcoal must be employed. With the electric smelting of iron ore in Norway, it was absolutely necessary to use coke for that purpose, because there are few forests in Norway. In California, it appeared at first that charcoal could be obtained cheaply and in quantity, but later when the wood had to be hauled from a distance, the cost increased to such an extent as to render imperative the securing of some cheap reducing agent. Coke is not as expensive as charcoal in most localities and can be obtained in greater quantity.

Where Coke Fails

Up to the beginning of 1914 a study of existing data and experience with coke in the electric smelting of iron ore would indicate that the only satisfactory reducing material for the smelting of iron ore was charcoal. The trial run at Trollhättan, Sweden, had shown that coke was not as suitable as charcoal for use in the electric shaft furnace. From the somewhat meager reports then existing regarding operation at Hardanger, Norway, with an electric shaft furnace of the Trollhättan type, the difficulties of that plant were commonly laid to the use of coke as a reducing agent. The work done in the low rectangular furnace at Heroult, California, also indicated that coke was not suitable for electric smelting.

Practically all authorities agree that the basic reason for the difficulties encountered in the use of coke in the electric furnace, is because coke is a much better conductor of electricity than charcoal, especially after it becomes hot. Hence, when coke is used, the resistance of the charge becomes lowered, and, as the smelting in the electric iron-reduction furnace is done by the heat produced by the resistance which the electric current meets in passing through the charge between the electrodes, more current is required to produce the same amount of heat.

The causes of the economic failure of the electric pig-iron plant at Tyssedal, Hardanger, Norway, which had ceased operation during 1913, were investigated by several commissions and engineers. The Norwegian electrometallurgical commission,[1] through J. H. L. Vogt and P. Farup, reported that the shaft furnace, the Trollhättan type, has proved a success with coke as a reducing agent as a result of the runs at Hardanger, which conclusion is contrary to the Trollhättan deductions with a similar furnace.

They state that while the operations at Hardanger were not economically successful, the cause should be attributed partly to the nature of the ores treated and partly to their low iron content, together with the unsatisfactory type of roaster used for agglomeration and poorly designed electrical machinery.

G. Odequist, in a paper before the Christiania Poly-

[1] 'Electrothermic Iron Ore Smelting in Norway,' *The Eng. & Min. Jour.*, July 25, 1914, p. 158.

teknik Forening, did not agree with the committee in its conclusions, but believed that the unfavorable results were due to the type of furnace, which, in his opinion, was not adapted to coke because of the greater variation in the electrical resistance in the furnace itself by the use of coke, owing to which the average load as well as the production is diminished. Also, he considers that the greater quantity of limestone needed to flux the coke ash increases the power consumption. Lindemann, a Norwegian engineer, lays the failure of the Hardanger plant to the fact that the furnace had never treated the sort of charge which would render smelting profitable. The briquettes charged crumbled in the furnace and the 'fines' were not properly agglomerated. In a review of the paper by Odequist, J. Harden[2] concludes that the failure of electric smelting at Hardanger was due to a variety of causes, but that the use of coke in the type of furnace employed was one of the more important factors.

FIG. 1. ELECTRODES IN HARDANGER FURNACE.

At the Tinfos Iron Works, Notodden, Norway, it is reported that pig iron is being made in the electric furnace with coke as a reducing agent. Four single-phase furnaces, each of 1250 kw. capacity, are installed at this plant in such a manner that one furnace is connected to each phase of a three-phase circuit with one furnace held in reserve. The charge is fed into the furnace around the electrode through two feeding shafts leading to a low rectangular crucible. The shafts are intended more for distribution of the charge in the crucible than for securing any reduction by the furnace gases. The current passes through an upper rectangular electrode, through the charge, and through the conducting carbon bottom. Coke is said to work satisfactorily in a furnace of this type. A similar plant has been recently built at the Ulefos Iron Works, Telemarken, Norway.

The Helfenstein furnace, which has three upper vertical electrodes, each suspended in a separate chamber of a low rectangular furnace with a conducting hearth common to all three chambers acting as the neutral point of a three-phase circuit, has given excellent results in the electric smelting of iron ores at Domnarfvet, Sweden.

In regard to the use of coke in this furnace, Helfenstein[4] states that the two essential conditions for successful smelting with coke are: (1) the tension in the smelting furnace must be lower, and the density of the current in the electrode must be higher; (2) the furnace gases must be removed after having passed through a comparatively thin layer of materials in the melting chamber. He considers that due to the existence of these conditions in his large furnace, it is possible to substitute coke for charcoal as a reducing agent.

As a result of 90 days' operation of the low rectangular furnace of the Noble Electric Steel Co. at Heroult, California, with coke as a reducing agent, J. Crawford[5]

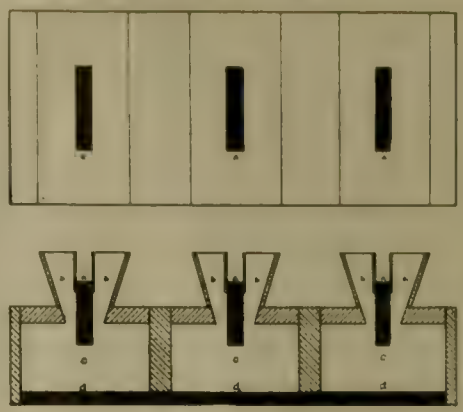


FIG. 2. ELECTRODES IN HELFENSTEIN FURNACE.

has drawn the following conclusions: (1) any ordinary grade of coke, by crushing it, can be used satisfactorily from both a metallurgical and an electrical standpoint to produce any normal grade of pig iron; (2) if the coke is of the proper size when it reaches the smelting zone, operations may be carried on with as high voltage, low current densities, good power factor, and as cool a roof when using coke as when using charcoal; (3) the power consumption per unit of production is higher with coke than with charcoal, but the increase is due to the extra amount of slag made; (5) the carbon consumption per unit of production is higher with coke than with charcoal; (5) except for the somewhat more open grain, no difference has been noted thus far in the physical characteristics of iron made with coke, and iron made with charcoal; (6) crushed coke has a tendency to make the charge hang in the furnace, which might prohibit its use in a shaft furnace. A mixture of 15 to 25% of lump charcoal with the coke appears to prevent the hanging of the charge.

[5]*Bull.* Amer. Inst. Min. Eng., June 1914, p. 1289.

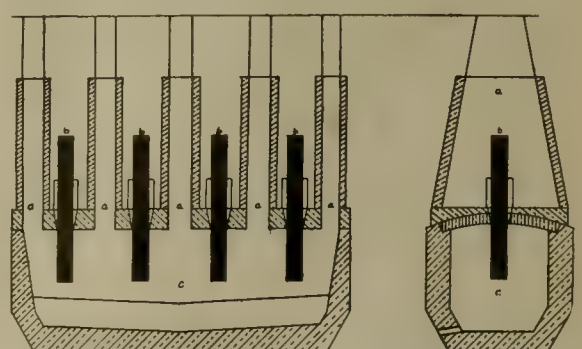


FIG. 3. ELECTRODES IN CALIFORNIA FURNACE.

[2]Harden, J., 'Electric Iron Smelting at Hardanger in Norway.' *Met. & Chem. Eng.*, 1914, pp. 82, 223, 444.

[3]Hanson, H. T., 'Smelting Iron Electrically with Coke as a Fuel.' *The Iron Trade Review*, Dec. 4, 1913, p. 1003.

[4]Helfenstein, A., 'Large Electric Furnaces for Pig Iron. The Helfenstein Furnace at Domnarfvets.' *Iron and Coal Trade Review*, April 3, 1914, p. 505.

The conclusions of Crawford, which are the result of some of the most extensive work yet done on the subject, are summarized in the statement that coke has nothing to recommend it over charcoal for an electric furnace reducing material excepting the difference in price.

Shaft Furnaces and Crucible Furnaces

As a result of the work during 1914, with coke as a reducing agent in electric smelting of iron ore, it is evident that considerable progress has been made toward the solution of the problem. The so-called shaft furnace of the type built at Trollhättan and Hardanger does not appear to be so well adapted to the use of coke in place of charcoal as is the low rectangular furnace of the Helfenstein, Tinfos, or California types. Pig iron can be produced commercially under the most favorable local conditions in a shaft furnace, but not as economically as in the crucible furnace. The power consumption and the carbon consumption will be higher in the shaft furnace, but technically and commercially under the best conditions, pig iron can be made in this type of furnace using coke as a reducing agent.

There is little agreement as to the cause of the failure of the Hardanger plant, but it cannot be entirely assigned to the use of coke as a reducing agent. The conditions were unfavorable from the start; a poor grade of ore which requires roasting was being smelted; and the type of roaster used was very unsatisfactory both in its mechanical operation and in the product it produced. There appeared to be several things in both the business and technical management of the concern which might have been improved considerably. Apparently in the erection of the works, little allowance was made for the fact that even in the operation of an electric pig-iron furnace using charcoal, the process is very young and comparatively undeveloped; and that with the unknown effect of coke considerable experimental work might be necessary. Judging from the character of the buildings erected, the Company must have had a considerable overhead charge to carry.

During the year it has been established beyond question that better technical results are obtained with coke as a reducing agent, when the low crucible furnace of the Helfenstein or Tinfos type is used rather than a furnace of the Swedish type. This is emphasized by the early experiments with coke at Trollhättan in a furnace of the latter type, the difficulties at Hardanger, and the successful operation of the Helfenstein furnace at Domnarfvet with coke, and the furnace at Tinfos. The difficulties experienced with the so-called shaft furnace are not due to the effect of the shaft resulting in the impossibility of quick removal of gases, or any other effect produced by the shaft itself, but are due to the arrangement of the electrodes in the crucible of the furnace. In the Trollhättan furnace the electrodes are grouped at the base of the shaft around a circular crucible. As there is no bottom electrode of any sort in the furnace and the ends of the electrodes are practically in the same horizontal plane, the current must pass between them in this horizontal zone. When smelting conditions are established in the furnace, the process is advanced to the same point throughout this horizontal zone. As the electrodes are high in the crucible where little reduction has completely taken place, considerable unconsumed carbon accumulates in this zone. Coke has a much greater electrical conductivity than charcoal when hot. Hence, when coke is charged instead of charcoal, the voltage of the furnace gets low, resulting in decreased power factor and a higher power consumption per ton of ore smelted.

The remedy for this difficulty is an arrangement of the electrodes such as to make the current pass through all of the lower smelting zones of the furnace which contain the charge in different stages of reduction. Thus if the current passes through one upper electrode, through the charge and through the furnace bottom, a simple type of such a furnace being the Siemens furnace, it passes from top to bottom through the following smelting zones—a mixture of partly reduced ore and coke; a zone of completed reduction with the metal in a pasty unmelted state; the slag zone; and in the bottom molten metal. The result of an accumulation of coke in one zone of a furnace of this type is not as noticeable as the current has to pass through all of the smelting conditions of the furnace. A furnace of this type in which the current is actually conducted away from the bottom of the furnace with cables or bus-bars, has the disadvantage of a decreasing electrical efficiency and power factor with increase of size so that furnaces of much over 1000 hp. are not economical. That the shaft has nothing to do with the coke problem is further shown by successful smelting with two shafts on the Tinfos furnace, which has a conducting bottom and vertical electrode suspended between the shafts. The results at this place show that the success of the low crucible type has not been due so much to the absence of a shaft in some other cases as to the arrangement of the electrodes in the shaft.

The Helfenstein Furnace

In the Helfenstein furnace the objections to the Tinfos type of furnace are overcome, that is, a limitation of size due to conducting current through the hearth and away from the furnace. The current in the Helfenstein furnace at Domnarfvet passes down through the charge from suspended electrodes, each in its own smelting chamber, and while the furnace bottom acts as a conductor of current between the three smelting chambers of the furnace, it has no cable or bus-bar connections leading to the source of power. By connecting the furnace to a three-phase circuit in this manner, the difficulties of leading large amounts of current from a furnace bottom are not experienced with the consequent limitation in size of furnace, but it has the advantage of passage of current through the whole charge, insuring higher electrical efficiency when smelting with coke than in the furnace with a horizontal arrangement of electrodes.

The rectangular furnace of the Noble Electric Steel

Co has the horizontal arrangement of electrodes. Mr Crawford states that coke if finely ground can be used as a reducing agent with satisfactory results. From this it does not appear that coke would prove as satisfactory as charcoal in the furnace used at Heroult. The fine crushing of coke has not been necessary in the Helfenstein furnace, and this further indicates that the arrangement of the electrodes is the chief factor of the problem. The early experiences in California with coke in a furnace of this type were apparently not successful, for Crawford states that the efficiency of the furnace is decreased when coke is used instead of charcoal. Further evidence of difficulties with coke at Heroult are shown by the decision to use a mixture of half charcoal and half coke in the manufacture of ferromanganese,[7] which was undertaken at this place in the fall.

While coke is being used commercially at Domnarfvet and Tinfos for electric smelting of iron ores, and the possibility of its use in the California furnace has been demonstrated in a trial run, it is best to reserve definite conclusions until more developments occur, but the problem is well on the way to a satisfactory solution, judging from the results of the past year.

The Capacity of Electric Smelting Furnaces

During 1914 information was made public regarding the large Helfenstein furnace which started production of pig iron at Domnarfvet, Sweden, in May 1913. This furnace marks a great advance in the size of electric pig-iron furnaces. Previous to this time the largest pig-iron furnaces were those of the Trollhättan type of 3500 hp. capacity. The Helfenstein furnace at Domnarfvet was built for a power capacity of 10,000 to 12,000 hp., but owing to the high frequency of the electric current produced at Domnarfvet, 62 cycles, the power input was reduced to 6000 to 8000 hp. when smelting with charcoal and 5000 to 5500 hp. when using coke. The power was reduced with this high frequency in order to keep the power factor as high as 0.8 if possible, which under the circumstances was difficult, 25-cycle current being preferable for electric furnace work.

While electric furnaces of as large as 6000 to 10,000 hp. capacity have been operated for the manufacture of ferrosilicon and calcium carbide, the size attained in the Helfenstein furnace is undoubtedly a big advance in electric smelting of iron ores. The furnaces of the Trollhättan type with electrodes grouped around a circular crucible, are limited in size by the difficulty experienced in making carbon electrodes over 30 in. diameter, and also by the fact that the diameter or thickness in case an electrode of square cross-section is employed is limited by the distance between the edge of the crucible and the edge of the shaft. If a furnace of large tonnage of the Trollhättan type is built, the necessary power cannot be introduced into it by simply increasing the size of the electrodes and using built-up electrodes, but it must be done by increasing the number of electrodes suspended around the crucible. This leads to numerous complications resulting in lowering the electrical efficiency of the furnace. The limitation of size of electrode thus limits the power and smelting capacity of the furnace. In the case of a rectangular furnace having the electrodes suspended in the centre of the crucible and feeding shafts on both sides as in the case of the Helfenstein and Tinfos furnaces, there is practically no limitation as to the possible size, because increase in size simply means a longer furnace with electrodes to correspond. It is similar to the increased capacity of the long Mathewson copper blast-furnace over the shorter length furnaces.

The question of increased size of the electric pig iron furnace is very important if the electric furnace is ever to be in the class of the modern blast-furnace in regard to output. An electric furnace with a power input of 3500 hp. should produce per 24 hours on the basis of a power requirement of 2000 kw. hours per ton of pig iron, 30 tons of pig iron, while a 10,000 hp. furnace would produce about 90 tons in the same period. Compared with a blast-furnace output of 400 to 500 tons per day, the electric furnace capacity up to date is small, but the rectangular design of furnace offers greater opportunities of approaching blast-furnace size than does the circular furnace. Although the large electric furnace reduces the cost of production accordingly, the actual thermal efficiency is not much greater than that of a modern 1000-hp. smelting furnace.

Production of Steel Directly from Ore in the Electric Smelting Furnace

Recent experimental work I have conducted[8] has shown the possibility of producing steel of various percentages carbon and low percentages impurities directly from ore in the electric furnace. In a discussion of these results, J. Crawford[9] has summarized his conclusions as a result of experience in the electric furnace manufacture of pig iron at Heroult, California, by stating that although pig steel may have signal advantages over normal low-silicon pig iron for steel making, American steel makers will probably be found 'from Missouri' and will have to be shown. While there is a considerable economy in both carbon and power in making low silicon iron as against high silicon iron, the carbon does not approach in practice the low theoretical consumption. Pig steel of 2.20% maximum carbon when made in either the rectangular furnace or the shaft furnace requires carbon in excess of the theoretical to prevent excessive iron losses in the slag.

E. Humbert[10] and A. Hethey have performed large

[6]Crawford, J., 'Progress of Electric Smelting at Heroult, California.' *Met. & Chem. Eng.*, 1913, p. 383.

[7]*Min. and Scien. Press*, September 5, 1914, Vol. 109, p. 379.

[8]'Pig Steel from Ore in the Electric Furnace,' *Bull.* Amer. Inst. Min. Eng., Feb. 1914, p. 349; 'Fluorspar in Electric Smelting of Iron Ore,' *Min. and Scien. Press*, August 29, 1914, p. 335.

[9]Crawford, J., *Bull.* Amer. Inst. Min. Eng., June 1914, p. 1289.

[10]Humbert, E., and Hethey, A., 'Fabrication direct de l'acier.' *Journal du Four Electrique et de l'Electrolyse*, July 1, 1914, p. 843.

scale experimental work on the direct production of steel from ore, using a single-phase Heroult steel furnace of 6 tons per charge capacity. Several runs were made in the furnace on magnetite and silicious iron ores with coke as a reducing agent. According to the results of this work the authors consider that the direct production of steel in the electric furnace has many advantages over the standard practice of steel manufacture. While the process is simple and produces a high-grade product if desired, it may be expensive—the chief factor in this being the cost of power.

Pig steel for castings is now being manufactured directly from ore in an electric furnace at the foundry of the Moffat-Irving Steel Works, Ltd., of Toronto, Canada. A 300-kw. three-phase furnace is used which has a tilting crucible set under a stationary shaft. The process is intermittent. Fine ore and flue dust are smelted in the furnace.[11]

The cost of production of pig steel from ore in the electric furnace is, of course, the main stumbling block to the success of such a process. As yet not enough practical work has been done to give conclusive figures. All work to date has been almost entirely experimental, and while it has shown that the metallurgical difficulties are not impossible to overcome, few data as to actual cost are available. While there are few districts where pig steel could be produced as cheaply in the electric furnace as steel produced by standard methods, in some places and for foundry work it is probable that steel castings could be made more cheaply directly from ore by this process than in a combustion furnace. At any place where there is a market demand for steel locally, and pig iron can be made in the electric furnace at a profit, the steel ultimately produced would be cheaper, if made by the electric reduction of iron ore to pig steel, followed by refining in another furnace if necessary, than if the product of the electric reduction furnace was pig iron to be subsequently converted to steel in another furnace.

Condensation of Zinc in Electric Zinc Smelting

The most complete statement of the status of electric zinc smelting which was presented during the past year was that of W. R. Ingalls.[12] Ingalls concludes that the difficulty in the efficiency of condensation of the zinc vapors in electric smelting of zinc ore is not due to the condensing apparatus, but that the trouble really originates in the furnace itself, and that given the proper conditions in the furnace, condensation is effected without special difficulty. If electric smelting is made a two-stage process instead of a continuous process, satisfactory condensation as metal instead of blue powder will be obtained. In other words, the high amount of carbon dioxide gas given off as in the ordinary retort during the driving off of hydrocarbons and decomposition of carbonates, must be replaced by a carbon monoxide atmosphere as in the second stage of retort smelting, when reduction and distillation are accomplished. In considering the two kinds of blue powder formed in zinc condensation, Ingalls distinguishes between the meltable blue powder resulting from improper physical conditions, and the non-meltable powder due to improper chemical conditions. The un-meltable blue powder in electric smelting must then be due to the formation of larger amounts of carbon dioxide in the electric furnace than in the retort, which causes oxidation of the zinc in condensation.

The Johnson Furnace

Much publicity has been given to an experimental run on 17 tons of zinc ore in the Johnson electric furnace at Hartford, Connecticut, in January 1914. For some time it has been claimed that the condensation problem is solved in this furnace by the addition of incandescent carbon columns through which the zinc vapors pass before going to the condenser in order to reduce the carbon dioxide present to the monoxide. In this run the amount of blue powder re-smelted was about 20% of the spelter produced, which is a great advance over the most recent report of the work done in the electric zinc smelter at Trollhättan, where in 1912 two tons of blue powder was re-smelted with each ton of ore charged. The results of the trial run of Johnson indicate that he has made considerable progress toward a solution of the condensation problem of electric zinc smelting. While in this furnace the zinc vapors pass through a hot column of carbon before condensation, for the purpose of reducing the carbon dioxide present, it is probable that the good results obtained are largely due to a proper manipulation of the furnace so as to prevent formation of any more carbon dioxide gas than can be helped. As the charge is preheated outside of the furnace, this reduces the time it is in the furnace before losing its zinc. In this way carbon dioxide formation is prevented to a considerable extent. Also if the temperature of the furnace is controlled carefully, it is feasible to decrease the possibility of carbon dioxide formation by not permitting it to smelt so rapidly. If the speed of smelting can be kept down, opportunity is given for the carbon of the charge to reduce some of the carbon dioxide formed in smelting. With electrodes designed to be somewhat larger than actually required for carrying the current load, excessive local heating where the electrode enters the charge is prevented, giving a lower speed of reduction.

The Pato dredge of the Oroville Dredging Co., Columbia, has recovered the following since August 1, 1913: to September 8, 1914, $676,763 from 1,107,490 cu. yd.; from this date to October 1, the boat did not work, as it had capsized, but from October 1 to November 24, 232,350 cu. yd. yielded $108,850.

Rubies valued at $12,000 were recovered from 67,000 'loads' (1600 lb. each) of gravel, by the Burma Ruby Corporation in November.

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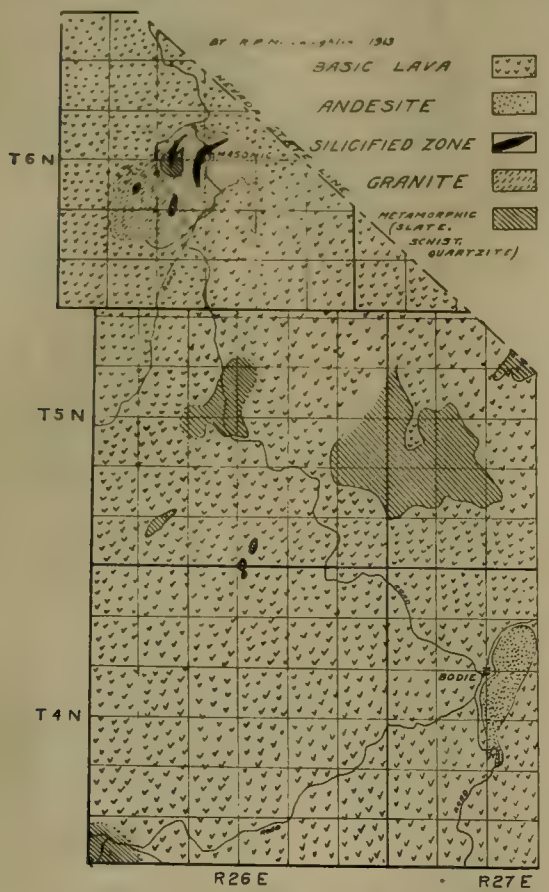
[11] Dalton, A. C., 'Electric Steel Direct from Ore Fines.' *The Iron Age*, Oct. 15, 1914.

[12] Ingalls, W. R., 'Electric Zinc Smelting.' *Trans.* Amer. Electrochemical Soc., Vol. 25, p. 169.

Masonic Mining District, Mono County, California

By R. P. McLAUGHLIN

The Masonic mining district is one which well illustrates the fact that our mineral resources are constantly giving us agreeable surprises. While the district is at present not very active, a description of its history and development may well follow the recent discussions on prospecting, as no extensive descriptions of it have thus far been published and the district is distinctly an asset developed by our old friend and support the prospector. Permission to publish this description is due to the courtesy of State Mineralogist, F. McN. Hamilton, as the information was gathered in course of work now being carried on by the California State Mining Bureau, which is aiming to furnish similar information upon the entire state. The illustrations are reproduced from drawings made for the Bureau.



MAP OF MONO COUNTY.

The district lies about 16 miles, by wagon road, northwest of Bodie and about two miles distant from the California-Nevada boundary line, at an elevation of about 8000 ft. It is the most recently discovered district in Mono county where any considerable amount of work has been done and ore of high grade has been mined.

Masonic and the neighborhood have been known for many years and some slight prospecting had been done, but the discovery of valuable ore was made August 1, 1902, when J. M. Bryan, Kaleb Dorsey, and J. S. Phillips made locations on what has since been called the Pittsburg-Liberty mine. They had followed numerous croppings of white ('bull') quartz veins, in the granite, with out good results and finally panned some of the dark porous croppings prominent in the neighborhood with more encouraging results. The three partners were old time miners who regularly spent a portion of their time working for wages and the remainder in prospecting.

Not until three years after the locations were made was ore in workable quantity or value found, and no considerable production was obtained until 1907 when they shipped to the Selby smelter near San Francisco a carload of ore (17 tons), which netted them $1040 per ton. This was the product of five men's work during the summer and at only a depth of 15 ft. An option was given to George Wingfield and a payment of $47,000 received. The option resulted in sinking a 100-ft. shaft and driving a 47-ft. cross-cut. However, title did not pass from the locators, due to their not consenting to alteration of terms, and they, upon taking charge of the property again, shipped ore to the amount of three carloads, the poorest of which gave them a profit of over $700 per ton. The Pittsburg-Liberty Mining Co. was formed and a 10-stamp steam-power mill was erected about a mile down the cañon.

The mine operated until 1910, the reported production being $600,000 to $700,000, and has since been idle. No large profit is said to have resulted, which is remarkable when it is considered that the maps show only about 6000 ft. of drifts and cross-cuts. Finding a mine and operating it, however, are separate and distinct problems calling for different sorts of ability and training.

Careful inspection of the workings is impossible, as the property is idle. Several veins or zones were stoped, most of them dipping at angles from 70 to 90°. The greatest depth stoped below the croppings was about 150 ft. The lower works being obstructed at the time of my examination, observations could not be made as to the geologic reason for loss of value. Assay plans show orebodies of very irregular shapes and value. Most of the value is in gold, some ore running as high as $300 per ton. From inspection of assay plans it seems probable that the average value was about $20. No machinery was used in the mine. Stopes and drifts were supported by nut pine timber from the surrounding hills. Chutes to the lower adit furnished outlet to the wagon road running to the mill. Timber is cut under permit from the U. S. Forest Service at an average price

of $1.75 per cord. Some of the most noticeable facts indicated by the mine map are: Five veins, striking N.25° W. and dipping to the east, developed upon the upper or 130-ft. level, three of them developed on the second or 172-ft. level; exposure by one cross-cut under the entire group of veins on the third or 271-ft. level; and a lower adit or 413-ft. level which cuts almost all of the mineral zone about 100 ft. south of the most productive portion. An area 300 ft. square covers most of the workings.

The east wall of the silicified zone, according to description by J. M. Bryan, is shown on the map of the 413-ft. level. North of the main adit the general dip is said to be toward the east, while on the south side the dip is westerly. Horses of granite are said to have been common in the mineralized or silicified zone.

Possibility of extension of known orebodies or other discoveries is the most important economic question relating to the district. The geologic features and positions of some of the prospecting works are shown on the accompanying map and a brief description of the geologic conditions may be interesting.

The oldest rock in the region is the metamorphic series which consists of schist, quartzite, altered slate, and similar rocks. It possibly belongs to the same series as the so-called slate extending along the eastern flank of the Sierra Nevada mountains. One of the most prominent exposures of this series is in the vicinity of Rough creek, about four miles north of Bodie, where it consists of some large croppings of chalcedonic quartzite, dark, almost black quartzite showing contorted lines either of bedding or flow under pressure. In other places, as near the state line, T. 5 N., R. 27 E., the quartzite has scarcely lost the appearance of a fine hard sandstone, with gently dipping beds and also varies to the appearance of black flint and white porcelain. Cinnabar in a 2-ft. vein of chalcedony occurs in this vicinity and some work was done many years ago.

That portion of the series near the town of Masonic consists mostly of fine grained mica schist, while that along the wagon road about six miles south of Masonic shows light colored slightly altered shale. Small areas in Sec. 34, T. 5 N., R. 26 E., are interesting on account of their isolation and small extent. Faulting is evidenced by slickensided exposures.

As seen from the above brief notes, the series is complex, probably having originally consisted largely of sediments which have been altered by heat and pressure during the upheaval of the Sierra Nevadas and the accompanying granitic intrusion.

The granite around the town of Masonic varies in different portions of the area, but is usually coarse grained, showing feldspar crystals frequently a half-inch long. It is broken by several series of joint planes. North of town their strike is northeast and southwest, dipping about 60° toward the northwest, while south of town the most prominent fractures strike nearly east and west and dip northward. Probably the entire mass has been subjected to severe strains and movements, causing some of the more prominent jointing planes. Along the southern and eastern borders of the metamorphic area, one-half mile west of Masonic, the relation of the two series is plainly seen.

That the granite is the younger is shown by its intrusion as dikes, several feet wide, for a distance as much as 50 ft. into the schist, which is generally laminated parallel to the contact line between the two formations.

The silicified zones are among the most important features shown on the map, as in them occur most, if not all, of the orebodies of the Masonic district. North of the main road through the district, in section 15, is a bold quartz or quartzite outcrop several hundred feet wide and over one hundred feet high, being one of the

Sections 15, 16, 21, and 22 T. 6 N., R. 26 E., M. D.
1, Pittsburg claim; 2, Liberty claim; 3, Liberty No. 2 claim; 4, Pittsburg No. 2 claim; 5, Hermine claim; 6, Jump Up Joe claim; 7, S. Rough and Ready adits; 9, Home View adit; 10, New York shaft; 11, Serita shaft; 12, Lost Horse shaft; 13, Pittsburg-Liberty adit.

MASONIC MINING DISTRICT; GEOLOGY, PATENTED CLAIMS, AND PORTION OF DEVELOPMENT; FROM CALIFORNIA STATE MINING BUREAU.

most noticeable portions of the silicified areas. These zones doubtless exist in places where considerable fracturing and possibly movement has taken place in the granite country rock. The zones correspond closely with the general direction of the jointing planes in the granite. It is also suggested by some observations, notably about 200 ft. southeast from the Serita shaft, that there may have been intrusions of igneous dikes along some of the fractured areas.

In general the rock in these zones is quartz, but not in the usual vein formation. It is usually dark colored or rusty in appearance and the walls of the zone are not clearly distinguished especially upon the surface of the ground. It is made up of large quartz boulders, silicified granite, breccia, and some clay as from decomposed country rock. The ore of the district has an open or porous appearance consisting of light colored chert and coatings of chalcedonic quartz accompanying breccia of

light colored angular fragments cemented in a dark brown ground mass. Its appearance is unusual as compared with other orebodies of the neighborhood, which doubtless accounts for its comparatively recent discovery. It indicates that after quartz began to be deposited there were many disturbances in the channels opening, closing, and crushing. Irregular shaped orebodies are to be expected.

Ore Treatment and Costs at Stratton's Independence

The following data are from the report of the mill superintendent, W. H. Harrison, for the year ended June 30, 1914:

There was a total of 39 men employed at the plant, consisting of four at the ore dump, four on coarse crushing and sorting, ten on fine crushing and concentrating, ten in the cyanide department, two at the mine breaker, one on the residue dam, and eight on general repairs.

Mill results were as follows:

Details of operation.	1913-14.	1912-13.	1911-12.
Dump ore treated, tons	88,192	104,111	99,372
Mine ore treated, tons	45,683	25,999	13,019
Total	133,875	130,110	112,391
Average gold content, oz. per ton	0.1439	0.1538	0.1550
Value per ton	$2.974	$3.179	$3.204
Concentrate produced:			
First grade, tons	1,598	.....	.....
Second grade, tons	373	.....	.....
Total concentrate, tons	1,971	1,974	.....
Average gold content:			
First grade, oz. per ton	4.358	4.118	4.3425
Second grade, oz. per ton	1.848	1.847	1.3495
Gold recovered:			
In concentrate smelted, oz.	7,655	.....	.....
As bullion in mill, oz.	7,764	.....	.....
Total	15,419	.....	.....
Extraction by years:			
In concentrate, per cent	39.716	34.43	42.19
As bullion, per cent	40.283	44.05	31.44
Total recovery	80.000	78.48	73.63

Costs in 1913-14	Per ton.
Coarse crushing and sorting	$0.156288
Fine crushing, concentrating, and treating concentrate	0.504038
Cyaniding and special chemicals	0.467226
Miscellaneous expense	0.142532
Total milling charge	$1.270084
Mining dump ore	0.111041
Total	$1.381125

The gross profit was $124,760, of which $26,251 was paid to the mine department on the usual scale of treatment charges for low-grade mine ore. This left a net profit to the mill of $98,509. There were no noteworthy changes in treatment methods, the higher recovery being due to the increased tonnage of oxidized ore coming from 'A' level. This is easily cyanided. Less chemicals were used, labor cut to a minimum, and costs were therefore lowered. The plant is in splendid physical condition. The current year will see the end of mill

CONCENTRATOR ROOM IN STRATTON'S INDEPENDENCE MILL.

ing the dump, so costs will increase here, and profits will probably not be as high as previously.

Costs at the Kalgurli Mine and Mill

This property is at Kalgoorlie, Western Australia, and during the past financial year produced 127,870 tons of ore averaging $9.60 per ton. Dividends totaled $461,000.

	Cost per Ton		
Mining:		Ball-milling and conveyors	0.48
Superintendence	$0.04	Roasting furnaces	0.68
Breaking ore	0.55	Separating and settling	0.06
Timbering stopes and passes	0.04	Grinding pans	0.26
Loading and tramming	0.38	Agitating and filter-pressing	0.48
Filling stopes	0.13	Disposal of residue	0.12
Tools	0.04	Water	0.14
Sundries	0.02	Oiling	0.02
Total labor	$1.20	Amalgamation and precipitation	0.08
Total stores	0.28	Clean-up	0.02
Hoisting and drills	0.25	Sampling and assaying	0.02
Proportion of management	0.15	General treatment	0.04
Total mining	$1.88	Proportion of management	0.21
Milling:		Total milling	$2.81
Superintendence	$0.07	All costs	$4.69
Rock-crushers	0.07		
Aerial tramway	0.06		

The average residue was 78 cents per ton.

METAL OUTPUT of the Consolidated Mining & Smelting Co. of Canada from 1894 to date totals 1,462,012 oz. gold, 26,017,332 oz. silver, 333,913,214 lb. lead, and 57,890,794 lb. copper, worth $66,503,334, from the treatment of 3,925,822 tons of ore.

IRON PRODUCTION OF GERMANY naturally shows a large decrease, the output in September being 580,087 tons against 1,564,345 tons in July.

DISCUSSION

Readers of the MINING AND SCIENTIFIC PRESS *are invited to use this depar'ment for the discussion of technical and o'her matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary 'o his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.*

The Gumaos Dredge

The Editor:

Sir—I note in your issue of November 14, among the news items from the Philippine Islands, that you publish the results of the Gumacs company's dredge for August, giving the value of the clean-up at P73,284, equal to $36,642 in U. S. gold.

You also mention that the dredge worked 517 hours and handled 82,000 cu. yd. of gravel during the month—all of which is correct—only, I would like to call the attention of your readers to the fact that the percentage of the running time of this dredge is much greater than the 517 hours would indicate, due to the fact that the Company operates only six days a week, closing down on Sundays. The possible running time for the month of August would therefore be 26 days or 624 hours, instead of 31 days or 744 hours. Hence the percentage of running time is much greater than indicated in your note.

This dredge was built by my company, the New York Engineering Co., and the clean-up of $36,642 together with the large yardage handled by this dredge, certainly affords good evidence of the success of gold dredging in the Philippines when the proper equipment is selected and properly installed.

A. C. LUDLUM.

New York, December 5.

Operation of Oliver Filters

The Editor:

Sir—Supplementing Messrs. Morrison and Thomson's notes on Globe filter practice, printed in the *Press*, October 10, a few words of the experience at the Commonwealth mill at Pearce, Arizona, may be of interest.

As a preliminary let it be stated that the filter unit consists of four Oliver filters, 11.5 by 16 ft., a dry-vacuum system being used working through a receiver, from the bottom of which an elevated goose-neck connects with the vacuum-pump. A duplex vacuum-pump is used, with a rotary for use in emergencies. In the original installation, the goose-neck from the receiver to the vacuum-pump was built to allow a few feet more than the theoretical height necessary at this altitude, but sufficient air was drawn through the filters to form what might be termed an air-lift, and it was necessary to raise the goose-neck an additional 11 ft. to prevent drawing over of filtrate.

In the Commonwealth mill, the arrangement of four Dorr thickeners for counter-current replacement after agitation has caused much of the pregnant solution to be already replaced by the time that the filters are reached, so that the metal content of the filter sludge is small, and the assays of washed and unwashed residues show small loss of 'soluble values.'

The washing arrangement consists of four 1½-in. spray lines, each having nine Vermorel rotary spray tips. In the course of the regular routine, all water entering the mill circuits is added by means of these sprays. Four such spray lines, with nine sprays each, under a head of 25 lb. pressure, give 120 lb. of water per minute, which with a cake of a scant half-inch in thickness, means 120 lb. of water to 340 lb. of dry slime. A cake of one-quarter inch thickness will, of course, double the ratio of wash water to slime, but cakes of a lesser thickness indicate a fouled condition of the filtering medium, and all of the wash water is not drawn through, but runs down the filter into the sludge hopper and dilutes the sludge. The arrangement of the piping does not permit of the substitution of barren solution for wash water, in any of the spray lines. However, in this particular case, the mechanical loss of cyanide by such a substitution would be greater than the gain in the lessening of 'dissolved values.' In passing, it should be mentioned that extraction in the course of the four thickeners being nil, none is looked for during filtration.

The filters are provided with the usual side air-lifts for the circulation of the sludge from the bottom to the top of the hopper, but the foundation arrangement is such that they cannot be readily cleaned, and they are no longer in use. Agitation is secured by means of the mechanical agitator, used for a half hour twice each shift, supplemented by air jets in case the filter is stopped for any reason and the cake dropped. There are eight of these jets arranged along the side of the hopper and extending down into the sludge eight feet. These are used to break up dropped cakes, which tend to pull up and jam on the sides of the hopper, or in case the mechanical agitator does not work.

The filter canvas is scrubbed by means of five stationary brushes fastened to the traveler screw of the winding rig working on the long screw alongside of the filter, acid solution being sprayed upon the canvas from a spray nozzle and garden hose attached to an elevated tank. This, with an occasional hand scrubbing, keeps the canvases in good condition. Were it permissible, an acid treatment by spraying the acid on the

drum from a spray line and drawing it through the canvas by vacuum, would give the best wash. I understand that this is done by having a small auxiliary vacuum line connected to a separate receiver, from which it is pumped back to the spray line. It is not necessary even to drain the sludge hopper, merely draw down the sludge so that it does not touch the drum, close the filtrate vacuum line, and open the auxiliary acid line, then start the acid circulating.

Lately the practice has been adopted of washing the canvas with a fire hose with water under high pressure, the stream being directed on the discharging section of the canvas. As this section is under air pressure from within the drum, the impinging water exerts a kneading action on the canvas which flakes off much of the encrusted lime, and the air assists in forcing out matter in the pores of the fabric.

This pressure water wash has doubled the period of time between acid washes. It might be worth while, if high-pressure water was not otherwise available, to install a pump to give a high pressure to a small volume of water for washing, as the volume of water seems not so essential as the height of the pressure.

As the life of the canvas filter cover seems to have been shortened by rotting underneath the wires, due to the latter rusting, one filter drum has been wound with wire that is coated with P & B paint. This painting of the wire was done by passing the wire over a grooved wheel, the lower edge of which revolved below the surface of the paint in a shallow reservoir. This filter has not been operated long enough to determine whether or not this treatment is beneficial, yet it involves but little additional trouble and while the paint will quickly wear from the outside face of the wire, it is reasonable to expect that the inside, where it rests on the canvas, will retain its coating and lessen the rusting.

If the filter canvas is kept in good shape, the cake kicks off clean, and the discharge apron only serves to divert it into the tailing launder, but if one tries to use this discharge apron as a scraper to remove the cake, he will soon be busy. The saw-toothed edge worn on the discharge apron by the drum wires, is taken care of at the Commonwealth mill by a very simple arrangement. A bolt with a threaded nut on the end of it is substituted for the supporting pin of the discharge apron so that the apron can be shifted lengthwise every day. This, with an occasional filing keeps the edge in good condition.

FLEETING DEVICE, TO PREVENT SAW-TOOTHED EDGES ON DISCHARGE APRON.

D. W. Minter.

Pearce, Arizona, November 17.

Shall the Institute Express Opinions?

Members of the American Institute of Mining Engineers will be asked to vote at the February meeting upon important amendments to the Constitution designed to remove the existing limitations upon any expression of opinion whatever by the Institute. The matter is of first importance and we have received many letters on the subject, but have withheld publication until members should have received the official statement for and against, prepared by a special committee of the Institute. That now being available and the whole matter public, we present below two of the letters at hand and will print others next week.—Editor.]

Reasons for Adopting the Proposed Amendments

It is not generally understood by the membership of the Institute that although its 5000 members include most of the men who are in charge of the mining and metallurgical industries of the world and the organization is therefore one of the greatest dignity and strength, it is at the same time in the singular position of a giant in chains. It is tied down rigidly by constitutional restrictions which permit it to do practically nothing beyond talking and publishing. These restrictions date back to the origin of the Institute when it was feared that special interests might utilize it for their own ends. The Institute and its organization has long since developed to such a point that nothing of this kind is possible now and there is no reason for retaining the restrictions.

It is therefore proposed to remove them and to make it possible for the Institute hereafter to act for its own welfare in any way which it may deem wise. The issue presented to members by this circular therefore is whether or not they wish the Institute to have freedom of action. The restrictions which it is desired to remove illustrate an evil which is found in some form in most constitutions and which is so subtle that it has doubtless crept into ours without any recognition of its true nature by the framers of the constitution.

This is the attempt to tie the hands of our successors in order to make sure that they will always act in accordance with our own views. It is caused by a weakness which is common to us all, the feeling that there will never be any wisdom in the future quite equal to our own and that we should, therefore, endeavor to think of everything that could happen in the future and prescribe to the people who are to run affairs then what they ought or ought not to do in each case. It is not believed that

any set of men are competent to so dictate the policies or the acts of their successors, nor is there any reason why this should be permitted.

The only proper function of a constitution in an Institute like ours is that of formulating the organization and its mode of procedure, and it should stop there. Once organized the Institute is quite competent to convert the will of its members into action at any time and upon any subject. Whether some act in the future will be wise or foolish is the business of the Institute members and officials at that particular date and it is certain that no one else will be in any better position for the exercise of good judgment. If 5000 members, with a complete and modern organization for formulating their will and expressing it in action, cannot be trusted to know what is for their own good at any time, then organization becomes an absurdity.

In short, whenever this Institute wants to do anything it should be free to do it. At present it is tied down in an absurd way by the aforesaid restrictions which limit its activities to social intercourse and professional papers. These narrow limits prevent any development of the general feeling which now prevails that the time has come for the Institute to do something more in this world than mere talk.

The only valid objection which could be raised against freedom of action is that at some time something might be done which in our present opinion might not be wise, and it is easy to conjure up an endless list of such bugaboos. The Institute might take sides upon the tariff question or the European war, upon religion, socialism, or some similar thing. As a matter of fact, common sense will always restrict action to suitable fields, and no board of directors would venture upon any new policy without being well assured either by its general knowledge or a referendum that it represented the will of the majority. To do otherwise would be to commit official suicide. As in any organization, the minority must be overruled, but in the professional spirit which pervades the Institute, good judgment will naturally refrain from policies which are so extreme in any direction as to cause a serious loss of membership. In any case there is no adequate reason why 5000 intelligent men should tie their own hands. The Institute ought to have complete freedom of action.

EDMUND B. KIRBY.

REASONS AGAINST ADOPTING THE PROPOSED AMENDMENTS

The function that the Institute was designed to fill is to offer a field where ideas falling within its province may be placed to the test of examination and discussion. It has admirably filled that function, and because of its success it has been suggested that to its original function of examining and discussing ideas shall be added the function of deciding upon and advocating such ideas or schemes as meet its approval.

The Institute, as at present organized, is specifically prohibited from so deciding upon or advocating any controversial matter. The Institute, as at present organized, cannot take sides. The proposed changes in the Constitution would do away with this prohibition and allow the directors practically unlimited scope to commit the Institute to take sides on any question.

The first effect of the removal of this prohibition will be the earnest, continued, and subtle solicitation of the directors to throw the influence of the Institute on the side of the financial or political interests of a certain number of members, who naturally desire to get all the available support to their propaganda. While I am heartily in favor of having the interests of the mining industry adequately presented before the country and Congress, the Institute does not seem the best means for making this presentation. It has no means for quickly and accurately ascertaining the wishes of its members who, being of many nationalities, have naturally and inevitably clashing interests. It would be unjust to decide, merely by the vote of the directors, a question which vitally affects even a small integral minority of the members.

I have seen no means suggested by which the questions that will be submitted to the Board of Directors can be classified so as to determine certainly and with accuracy whether they may or may not be decided by the board. None of the schemes so far suggested for ascertaining the wishes of the members, or for weighing the strength of the opposition to any project, seems competent to attain with speed and certainty the desired result.

While undoubtedly a certain amount of chafing against restrictions imposed by the Constitution has taken place, I do not think that the Institute has really suffered. I feel sure that if the restrictions were entirely removed and the proposed unlimited latitude allowed directors, they would be the first to rebel at the greatly increased responsibilities they would have to assume, the increased amount of time they would have to give the affairs of the Institute, not only to promote ideas they were interested in, but to prevent the adoption of schemes they thought harmful.

The proposed entire removal of restriction on the taking of sides, seems to me unwise. I have heard no definition of any new limitation that is sufficiently helpful to warrant a change in the Constitution. Without some limitation, I feel that the probabilities are great that sides may be taken on some question that will not add to the prestige of the Institute or aid its usefulness, and I am therefore not in favor of the proposed changes to the Constitution as they now stand.

SIDNEY J. JENNINGS.

FRENCH iron mines and mills at Longwy and Bruges have been placed under management of the German civil authorities. The significance of this fact will be understood when it is remembered that the district furnishes approximately 85% of the entire French iron ore production.—*Weekly Report*, American Association Commerce & Trade, Berlin.

CONCENTRATES

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

TUBE-MILL crushing capacity at the Consolidated Gold Fields plants on the Rand has been increased by means of a scoop discharge at the outlet end, which lowers the level of the pulp in the mill.

SHAFT-SINKING at the Nevada Wonder mine, Nevada, cost from $30.80 to $38.53 per foot in the past financial year of the Company. These costs are for two and three-compartment shafts respectively.

AN 8-INCH PIPE-LINE is said to be capable of delivering 30,000 bbl. of California oil per day. This is probably with light oils heated considerably, but is ordinarily in excess of the possibilities.

APPROPRIATIONS for the U. S. Geological Survey for a systematic study of the water resources of the country have totaled $12,500 to $200,000 during the past 18 years. From 1903 to 1906 it was $200,000 per year, and since 1911, $150,000.

LAMPBLACK RESIDUE from the manufacture of gas from crude oil makes a useful fuel when briquetted. It needs no binder. Analyses show the following composition: moisture, 3.04%; volatile matter, 27.32%; fixed carbon, 69.06%; ash, 0.58%; and heat value, 15,105 B.t.u. per pound. The latter is about 1000 B.t.u. more than the best anthracite coal.

A VERTICAL TRIPLE-EXPANSION WATER PUMP, with a capacity of 30,000,000 gal. per day, of Allis-Chalmers make, was recently installed at the Broadway pumping station of the Toledo Water Works, Ohio. It is far more efficient than the old pumps. Insulation of the steam cylinders and pipes is by Johns-Manville magnesia covering. The pump cost $83,000.

ADVANTAGES have been claimed from the storage of coal in water. In the annual report of Admiral R. S. Griffin, chief of the Bureau of Engineers of the Navy Engineers, he says the Bureau has not yet been able to determine the advantage to be derived from the storage of coal under water, although tests have been going on for three years at New London without so far developing any marked difference in value between coal in the open, under cover, and under water.

STATES which have taken legislative action in the mine-rescue and first-aid movement are as follows: Illinois, Oklahoma, Nevada, Colorado, Tennessee, Ohio, Kentucky, and New Mexico, according to J. W. Paul of the U. S. Bureau of Mines. Mention only is made of the states which have taken some action in promoting rescue work and training. Some of the states named have appropriated funds for the purchase of breathing apparatus only; some have required the mine operators to procure a certain number of sets of such apparatus, some have authorized co-operative training; and others have provided stations, cars, and a permanent organization for the conduct of the instruction and training of miners in modern equipment and methods.

THALLIUM is a rare metal with a specific gravity of 11.81 to 11.91, and a melting point of 303°. It occurs in certain pyrites and in mineral waters. Physically and mechanically it is like lead, but chemically it also resembles the alkali metals in many respects. It is so soft that it can be cut with the finger nail. A freshly cut surface is lustrous, but rapidly becomes dull. The metal volatilizes a little above the melting point, and when heated before a blowpipe gives a reddish vapor having a peculiar smell. Hydrochloric acid attacks thallium slowly, while other acids dissolve it rapidly. The metal is generally extracted from the flue dust of furnaces in which pyrite containing the element is burned. This dust is treated with dilute sulphuric acid, and the thallium precipitated in a crystalline form by means of zinc. The chief use of the metal is in the manufacture of optical glass of high refractive power. Thallium is worth about $11 per pound.

LIME exhibits some peculiar chemical reactions. It consists of 5 parts of calcium and 2 parts of oxygen, having the formula CaO. Owing to its chemical activity, it is not found native, but mostly as the carbonate $CaCO_3$. If this be heated, the following reaction takes place:

$$CaCO_3 = CaO + CO_2$$

If the lime produced is exposed to the air, it absorbs moisture, forming calcium hydroxide. This absorbs carbon dioxide from the air, resulting in calcium carbonate and water. Therefore, if exposed to the air, lime will gradually revert to a substance having the same chemical composition as that from which it was derived. Reactions are as follows:

$$CaO + H_2O = Ca(OH)_2$$
$$Ca(OH)_2 + CO_2 = CaCO_3 + H_2O$$

These reactions form the basis for manufacture of lime products and its various uses. The chemical uses are numerous in the agricultural, bleaching, caustic alkali, chemical gas, glass, grain milling, oil, fat and soap, ore treatment, paint and varnish, paper, preserving, sanitation, smelting, sugar, tanning, and water softening and purifying industries.

MINING IN THE FAR NORTH*

Placer Mining in the Fairbanks District—Continued

By EMIL EDWARD HURJA

Placer mining on Fairbanks creeks has undergone considerable change from the earlier days of the creek, when hundreds of thousands were taken out with a few men working in a single season. There are a number of large concerns which are making a business of mining, systematizing the work, and cutting down expenses wherever possible, in order to permit the low-grade ground to be worked as economically as possible.

Two plants are at work on No. 1 Below, creek claim, one of Rogge, Grill & Griffin and the other of Jacobson & Pearson. The operations of the latter plant are at the mouth of Alder creek, on ground owned by L. C. Hess. A slip scraper was used early in the season, but was replaced by a bottomless Bagley scraper later. A 40-hp. boiler and a 6¼ by 10 double-drum American hoist comprise the equipment. It was planned to work 25,000 sq. ft. of bedrock during the summer season. Ten men were employed. The ground prospected $1.25 per square foot. The Rogge, Grill & Griffin plant was on ground owned by Meehan & Larson. Fifteen men were employed. A slip scraper, operated by a 50-hp. plant was used to work the 'pay' from the bottom of the cut. The ground is 20 ft. deep. A second cut was started late in the summer.

Above Discovery claim, Lappi & Holkie worked on No. 2 Above. They had a 25-hp. boiler and had six men working. The depth to bedrock was 22 ft. Fred Parker's open-cut work on No. 3 Above is the most important work in the creek, so far as size of plant and output is concerned. The summers' output was nearly 50,000 sq. ft. of bedrock, and the plans for next year provided for an increased output in 1915. A 3½-ft. Bagley scraper was operated by a 7 by 10 American three-drum hoist. The boiler capacity of the plant was 50-hp. Ten men worked each shift during the summer. Pole riffles and one box of Hungarian riffles served to catch the gold. Two plants worked on No. 4 Above, one, a small one owned by Charles Felton and the other by Frank Mueller. On 16 Above, Charles Schafer operated a small placer plant. Huddleston Brothers and Henry Pate worked on 16 Above, near the head of Fairbanks creek, driving into the hill for a bench run of 'pay.' On No. 8 Above, creek claim, the Alaska Exploration Co. is conducting dredging operations. The Company was financed by English capitalists and the work was in charge of G. Aarons during the past season. Because of the age of the dredge, numerous breakdowns greatly reduced the operating length of the season. The dredge has 3½-cu. ft. buckets in a close-connected line and a 40-ft. ladder. Steam is the motive power. Wood is used for fuel. The depth of the ground is from 10 to 12 ft. Due to an error in judgment, the dredge during 1912 and part of 1913 worked through a pile of tailing made by itself in order to work back to virgin ground that had been overlooked. The operation during the present season was reported to be successful. A Keystone No. 3 drill was used on the Company's holdings on upper Fairbanks creek during the summer in prospecting work.

The productive area of the Goldstream basin extends from the Goldstream flats, two miles or more below the town of Fox, upstream to the confluence of Pedro and Gilmore creeks, and both of those streams to the near headwaters. The Engineer Creek valley is producing a little. It is tributary to lower Goldstream. It was on Pedro creek that the first discovery of gold in the Fairbanks district was made, the creek getting its name from the discoverer.

*[Previous articles in this series by Mr. Hurja on mining in Alaska and the Yukon have been 'Mining Revival in the Ketchikan District, Alaska,' July 4; 'Wrangell, Alaska,' special correspondence, July 11; 'Developments of the Alaska Gold Mines Co.,' July 18; 'Juneau, Alaska,' special correspondence, July 25; 'Cordova, Alaska,' special correspondence, August 8; 'Valdez and Prince William Sound,' August 15; 'Seward and the Kenai Peninsula,' August 29; 'The Koyukuk Mining District,' September 12; 'Operations of the Yukon Gold Co.,' October 10; 'Skagway-White Horse Mining District,' October 17; 'Operations of the Canadian-Klondyke G. M. Co.,' November 14; 'The Klondike, the Treadgold Placers, and Outlying Districts,' November 28; 'The Upper Yukon: Circle City, Eagle, and Woodchopper,' December 5; 'Placer Mining in the Fairbanks District,' December 19.—EDITOR.]

OPEN-CUT WORK ON NO. 8, BELOW, PEDRO CREEK, FAIRBANKS DISTRICT.

Aside from a little unimportant mining on Twin creek the placer mining activity in the Pedro valley may be said to start at the mouth of Twin creek. There Gustafson & Carlson are operating an open-cut plant. Charles Gius is mining with another big open-cut plant below them, below him is Julius Gius and then in order going downstream, Mudge & Co., Morgan & Co., Harry Atwood, C. A. DeRuchia, and McPike & Gilmore, all on Pedro creek. Then on Goldstream, Koch, Kerrigan & Cullinane operate on No. 2 Below, F. C. Bleeker on No. 5 Below, and Henry Wagner on No. 6 Below, each have open cutting operations in full swing.

All of the Pedro creek open-cutting plants are of the same type, double or triple-drum hoisting engines controlling buttomless scrapers with cable through blocks set at different points along the bank of the cut, scraping directly into the boxes. Mudge & Co., Gustafson & Carlson, and Mogan & Co. started their operations last season, and were fortunate in having good water conditions to help them along in the initial stages of the work. Atwood has been operating on Pedro creek for a number of years, in fact, he was one of the first men to stake on the creek. He was a member of the Parnette trading expedition which established Fairbanks in 1902.

The DeRuchia outfit's work on No. 8 Below, Pedro, for 1914 provided for cleaning up 75,000 sq. ft. of bedrock. A wheel scraper of 16-cu. ft. capacity was drawn 46 ft. up an incline to a dump-box 27 ft. above the ground by an American double-drum hoist. Two 35-hp. boilers furnished power for the work. A bedrock drain was cut before the work was attempted. The dump-box has block riffles followed by Hungarian riffles. The plant operated night and day, with 20 men employed.

On No. 9 and No. 10 Below, Pedro, James McPike, and Thomas Gilmore have a battery of boilers aggregating 90 hp. operating a 50-hp. American triple-drum hoist in an open-cut that promises to yield for four years more. One Bagley No. 3 and one No. 4 scraper are used. The dirt from the cut is scraped directly into the dump-box, which has a length of 80 ft., a width of four feet, and is underlaid with 5 and 6-in. block riffles. The sluice-boxes have a width of 20 in. Iron-shod pole riffles are used in the string. The work last summer cleaned up two blocks of ground, aggregating over 70,000 sq. ft. A big block was opened up for operations in the spring of 1915 as soon as water starts to run.

Koch, Kerrigan & Cullinane are operating on No. 2 Below, Goldstream, with a 70-hp. plant. An American hoist, $8\frac{1}{4}$ by 10, operates a yard slip scraper. After the ground, which is 17 ft. from surface to bedrock, is stripped of 'muck' and waste, the last six feet is scraped into the sluice-boxes. Part of the 'pay' occurs in bedrock. The dump-box is 60 ft. long, 40 in. wide, and contains block riffles. Hungarian riffles are used in the sluice-boxes.

On No. 5, Goldstream, creek and right limit bench claims, F. C. Bleeker operates two plants about 1500 ft. apart. One has a 70-hp. locomotive type boiler, with an $8\frac{1}{4}$ by 10-in. American hoist; the other has a 90-hp. boiler with a similar hoisting engine. The first plant had as its season's work, a block of 80,000 sq. ft. of bedrock to scrape. The other had a block of 55,000 sq. ft. The average depth of the ground is 18 ft., with a minimum of 12 and a maximum of 30 ft. The 'muck' ranges from 6 to 15 ft. deep, with an average of 9 ft. Some of the 'muck' is ground-sluiced off, but because of the absence of perceptible grade, most of it has to be scraped. Water is pumped 15 ft. to the flumeway by two pumps, a Crow and a Morris. Six hundred feet of flume carries the water to the dump-box. Two slip scrapers are used, each with a capacity of 30 cu. ft. Two and one-half feet of bedrock is taken up. The dump-box is 54 ft. long. Iron-shod pole riffles are used in the upper end of the dump-box, with perforated metal riffles and cocoa matting below. The cost of operation is 25c. per square foot of ground worked. Henry Wagner has one scraper of the Bagley type at work on No. 6.

TYPICAL PLACER PLANT, FAIRBANKS DISTRICT

On No. 8, Goldstream, Martin & Co. had 12 men at work in drifts. The depth to bedrock is 28 ft. A 50-hp. plant furnishes power. Visaco & Co. have a crew of ten men working on No. 9. The ground is 35 ft. deep. Vicaire & Co., with a 30-hp. plant and 10 men employed, have started driving operations on No. 10. The ground is 40 ft. deep. They expect to take out a dump during the winter. Genoss & Co., on No. 11 Goldstream, have two 25-hp. boilers to furnish power for hoisting. Ten men are employed. Mogstad & Co. have a crew at work on No. 12. Casalegno & Dunn finished their work on No. 14 early in the fall. They had a crew of 14 men working for several months during the summer sluicing season.

Peterson & Co. are preparing to open up a new block of ground on No. 17, Goldstream, a claim which probably has produced more gold than any other in Goldstream and more than many others in the district. It formerly was owned by L. L. James, now of San Francisco. The depth to bedrock on the upper end of the claim is 95 feet.

James Russell and Huddleston Brothers are working on 22, Goldstream, taking out a little gold. The depth to bedrock is 50 ft. On the Perlenda ground on 23, Goldstream, Brown & Co., and Leaf & Carroll are working. They sluiced a little during the summer. E. A. Williams, on the lower end of the Owl Association claim on Engineer creek, had a crew of 30 men working during the summer. He has a 70-hp. plant on the ground, which is of low-grade and has to be worked on a large scale to be profitable. The ground is 60 ft. deep. Herbert Williams is prospecting on the upper end of the Owl Association. O. W. Fisher also is prospecting on upper Engineer. DeWree & Co., at the mouth of Blanche gulch, an Engineer tributary, had 10 men working for a time during the summer, using a 25-hp. plant in the work.

The Ester Creek district continues to be profitable, although the richer placers have been worked out. The rich tributaries of Ready Bullion and Eva creeks are still yielding some gold, although the richer parts of the streaks have been taken out long ago. Prospecting is expected to demonstrate unworked parts of the streaks.

On Eva creek, Charles Lind & Co. are prospecting the Minnesota Association claim, owned by Harry Wallace. Drill work done there two years ago showed up good ground, which was not worked because of the presence of 'live' water. Charles Pyne & Co. are working on the upper end of the Happy Home Association claim, sinking a prospect shaft. The Happy Home has produced between $400,000 and $425,000. McIntosh & Co. have a small crew at work on the Daly bench, taking out side 'pay.'

The Mihalcik bench yielded between $60,000 and $70,000 during the past year on Ready Bullion creek, tributary to Ester creek. There is no more work in progress on Ready Bullion, with the exception of desultory prospecting for a side streak on some of the worked-out claims.

Tom Isaacson & Co. are working on No. 3 Above, with a small crew of men. A new side streak was recently found, and a 30-hp. plant was erected. The depth of the ground is 80 ft. The season's probable output of the claim was 10,000 sq. ft. of bedrock. Olson & Sullivan, working on the upper end of No. 1 Above, erected a battery of boilers, one 40-hp. and the other 35-hp. and started to open up for the winter. They expect to open 60,000 sq. ft. of bedrock in readiness for the beginning of sluicing next spring. Thirty-five men are employed. On No. 1 Above, George Rey is prospecting the Haskell claim. Sandstrum & Co. have a lay on the upper end of No. 1 Above and recently erected a 30-hp. plant. They have a crew of six men working. Keith & Co. have a 25-hp. plant on No. 3 Above, with six men employed. On Gold Hill, the left limit bench of Cripple creek, three plants worked almost continuously during the summer. The Gold Hill Mining Co. employed 15 men until the first of August. Beck & Co. had 12 men working until the end of the sluicing season. Alm Brothers employed eight men for a greater part of the summer. On Happy creek there is one plant at work.

Little Eldorado is a tributary to the Chatanika, a few miles below the mouth of Cleary creek. Several small plants worked on the upper end of the creek during the summer, but their total production probably did not amount to more than $10,000. Jess Noble, on No. 5 Above, first tier, right limit, bench, was drowned out early in the summer and was forced to sink another shaft. The depth to bedrock is 110 ft. Eight men were employed in the fall. The 'pay' is said to be rich. Howser & Co., working on No. 2 Above, recently erected a 30-hp. plant after finding 'pay' and made considerable profit during the summer. Erickson & Anderson, on No. 2 Below, Little Eldorado, had a 30-hp. plant on their ground, which is 100 ft. deep and contains a pay-streak 120 ft. wide. The gold is in the gravel for four feet above bedrock. Sixteen men were employed through the summer. Whaley & Co. had six men working during the summer on No. 6, first tier bench, right limit, where the ground is 150 ft. deep.

On the Eldorado Association, opposite No. 8 on the first tier of left limit benches, Hearn & Rundlund have a 40-hp. plant and have 18 men working. The depth of the ground is 150 ft. Hess & Erickson, on No. 9 Below, had 20 men working during the summer. They took out 50,000 sq. ft. of bedrock. W. T. Burns, who recently was interested in the Chatham Mining Co. on Chatham creek, has started to prospect his holdings on the Oregon Association at the mouth of Little Eldorado.

On Vault creek, most of the mining was being done at the mouth of the stream, where it emptied into the Chatanika. The Cook interests operated on the Sarah Association near the mouth of Vault for most of the summer. The plant is 50-hp., with a 5½ by 8-in. American hoist. The ground is 200 ft. deep, of which 100 ft. is 'muck.' The 'pay' is in gravel almost entirely, a distance of 2½ ft. above bedrock. The pay-streak is 80 ft. wide. Ten men worked during the summer, after the blocking out operations had been completed during the spring. Water is obtained by gravity through ditching.

The bulk of Dome creek's placer mining this year was done near the mouth of the creek. The richer placers farther upstream which were the cause of so much strife and squabble in Fairbanks' early life, have been depleted. Quartz mining is taking the place of the placer mining at the head of the creek

Chester Johnson had 14 men working most of the summer on lower Dome. Victor Kleinschmidt had a crew of 18 men working during the season on the upper end of the Niggerhead Association claim, in which he holds an interest. Peter Letender worked on the Shakespeare claim for a short time during the summer, but closed down about August 1. Gust Dourell and partners are prospecting on the Day Dawn claim, in the flats of the Chatanika.

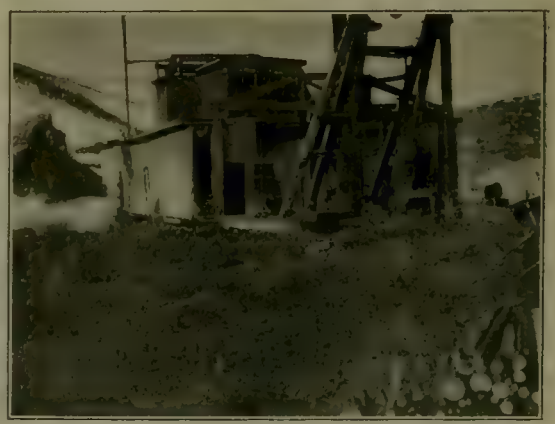
S. P. Magnusson operated the lower lay on the Niggerhead claim all summer long. The boiler capacity of his plant was 110 hp., with a single drum 7 by 10 American hoist. A 120-light dynamo plant also is included. The depth of the ground is 170 ft., 18 ft. of it 'muck.' Four feet of dirt was taken out as 'pay,' almost all of it in bedrock. The streak is 276 ft. wide. Magnusson has cleaned up 550 ft. of the streak up and downstream. Thirty-eight men are employed. The ground averages 90c. per square foot.

The gold placer area known to miners as the Tenderfoot district is about 60 miles southeast of Fairbanks and embraces the watersheds of several small streams flowing into the Tanana from the north. Richardson, on the Tanana river, is the supply centre for the district. Gold was first found there in 1905 and up to 1909 the gold production was about $400,000 yearly. Since that time it has been decreasing steadily. The Tenderfoot gold assays $12.25 per ounce, lower than any other gold in the interior of Alaska.

Lawrence Albrecht is working on No. 16 Tenderfoot creek. The streak, where he is mining, has a width of 50 ft. The depth to bedrock is 170 ft. Between $50,000 and $70,000 will be taken out by him this year. Thirty-five men are working. E. Hearn has 12 men working on No. 5 and No. 6 Tenderfoot, where the ground is 90 ft. deep. He is doing well. Lenot, Chinquist & Rearden are employing ten men on No. 4, Tenderfoot. Melvin, Pohl & L'Kievicz are open-cutting on Democrat Pup, a tributary of Banner creek. Jacob Samuelson is working at the head of Democrat Pup. He made his first clean-up recently, taking out from $800 to $1000 by ground-sluicing.

Open-cut work will be conducted on Portage creek, a tributary to the Little Delta river, 100 miles from Fairbanks, next year. The mining work on Portage consists largely of ditch building and preparatory work on unwatering ground for open-cutting. Val Diebold, J. A. Gustafson, and Emil Johnson are interested in a group of five claims, and they expect to do their first work on No. 1 Below. The ground is 10 ft. deep, of which two feet is 'muck.' A 200-ft. bedrock drain is under way, which will make it possible to work the ground. The ground was thoroughly prospected last winter. Kelly & McDermott have completed a 4½-mile ditch which will supply them with water for ground-sluicing operations on Discovery claim.

Placer mining is being carried on in many other parts of the district tributary to Fairbanks. Miners are working in the Salchaket, Big Chena, Kantishna, Nenana, Totalaniska, Tolovana, and other areas in the Fairbanks region. The Kantishna is the only district of these which has a steady production.



DREDGE ON FAIRBANKS CREEK.

MINERAL PRODUCTION IN 1914

Preliminary figures of production for a number of the states and for Ontario are given below. Additional figures will be printed from week to week as they become available.

U. S. Geological Survey Estimates

Wyoming's Small Metal Yield

With final figures for 11 months and an estimate for December, the total for last year was $2850 gold, 100 oz. silver, and 17,000 lb. copper, which is a decrease for all metals compared with 1913. Considerable development and construction work was done in the Atlantic City district.

South Dakota Gold and Silver Output

The production of gold, according to preliminary estimates, was $7,270,000, compared with $7,319,294 in 1913, and that of silver was approximately 174,000 oz., compared with 172,702 oz. in 1913. A nominal quantity of lead was produced. From 1876 to the end of 1914 South Dakota has produced $185,224,000 in gold and 5,830,000 oz. of silver. The mines of the various districts have been covered in the *Press* by our regular correspondent.

Metal Output of New Mexico

The output of New Mexican mines for 11 months of 1914, with an estimate for December, indicate a yield of $1,172,000 gold, 1,720,000 oz. silver, 1,340,000 lb. lead, 65,600,000 lb. copper, and 18,300,000 lb. zinc (in terms of spelter and zinc in zinc oxide). These figures show increases of $290,000 gold, 90,000 oz. silver, 9,300,000 lb. copper, and 1,800,000 lb. zinc, and a decrease of 2,600,000 lb. lead. Despite lower prices for metals, the total value was $12,070,000 in 1914, against $11,694,002 in 1913, an increase of $376,000.

Texas' Metal Production

The output of Texas mines for eleven months of 1914 with an estimate for December, according to preliminary figures compiled by Charles W. Henderson, amounted to $9302 gold, 581,000 oz. silver, 190,000 lb. lead, 30,000 lb. copper, and 190,000 lb. zinc. These figures show a considerable increase for gold and silver, a large decrease for zinc, and smaller decreases for copper and lead. The greater part of the output of silver came from the Presidio mine, in the Shafter district. Some silver and copper was produced at Van Horn, Culberson county, and some lead and zinc in the Sierra Blanca district, El Paso county.

Metal Production of Colorado

The output for 11 months, with an estimate for December, indicates a yield of $19,860,000 gold, 8,742,000 oz. silver, 75,550,000 lb. lead, 6,677,000 lb. copper, and 96,000,000 lb. zinc (in terms of spelter and zinc in zinc oxide), with a total value of $33,300,000, compared with $18,146,916 gold, 9,325,255 oz. silver, 87,897,773 lb. lead, 7,227,826 lb. copper, and 119,346,429 lb. zinc, with a total value of $35,450,585, in 1913.

In addition to the decrease in quantities of silver and the base metals, the falling off in average value for these metals caused a decrease in value of $833,000 for silver, $921,000 for lead, and $1,890,000 for zinc.

The tonnage treated by the Globe, Leadville, Pueblo, and Salida smelters was approximately the same as in 1913. Copper ore from Rico and copper matte from Ouray were shipped to plants in Utah. Cyanide precipitate and copper ore were shipped to Omaha. The copper-matting plant at Ouray was operated steadily during the year, and a 200-ton increase was made in its capacity, construction work being completed by the end of the year 1914. The tonnage treated at the United States Zinc Co.'s magnetic plant and smelter at Pueblo was less than in 1913.

Mining in Alaska in 1914

Complete statistics of the mineral production of the territory can not be collected within less than four or five months after the close of the year, but meanwhile it appears advisable to give prompt publication to preliminary estimates, which are believed to vary not over 5% from the actual figures, according to Alfred H. Brooks, who has charge of this compilation.

It is estimated that the value of the total mineral output in 1914 is $19,248,000, compared with $19,416,000 for 1913. The preliminary figures on gold output show $15,900,000, against $16,626,813. Silver was $191,000 and $218,988, respectively. Though the low price of copper since midsummer greatly curtailed the output of that metal, about 20,850,000 lb., valued at about $2,872,000, was produced in 1914, against 21,659,958 lb., worth $3,357,293 in 1913. The output of the other minerals, including tin, marble, gypsum, quicksilver, coal, and petroleum, in 1914 had a value of about $285,000, compared with $272,242 for 1913.

Had it not been for the depression in the copper market, the value of Alaska's mineral product would have been considerably greater in 1914 than in 1913. The gold-mining industry of the territory as a whole was prosperous during the year, as is made directly evident by the figures on output, but a more important item of progress is the extensive dead work accomplished on large plants that have not yet reached a productive stage. No progress was made in coal mining, there being in 1914 only one small productive mine in the territory, and that in one of the lignite fields. It is expected that the new law providing for leasing of coal lands in Alaska will lead to the exploitation of the fields containing high-grade coal. The tin, gypsum, marble, and petroleum mining industries of Alaska had a successful year.

The certainty of railway connection with the Yukon basin has greatly stimulated both prospecting and mining development. There was a noticeable increase in investigation of large mining enterprises in 1914 compared with previous years. This was due solely to the expectation of cheaper transportation.

The data on hand indicate that the value of the placer gold produced in 1914 was about $10,700,000, or practically the same as that of 1913, which was $10,680,000. The distribution of this output is, however, not the same in the two years. Some increases in the output of the Ruby, Seward Peninsula, Iditarod, and Hot Springs districts were made, but on the other hand, there was a marked decline in the placer-gold output from Fairbanks and lesser decreases in some of the smaller camps. The abundant rainfall which occurred in most of the Yukon and Seward Peninsula districts during the mining season of 1914 greatly favored placer operations.

The Chisana district is the only new placer camp developed in 1914. Promising discoveries are reported in the Healy River region of the middle Tanana, and also a find of placer gold in the upper Tolovana basin, between Fairbanks and Rampart.

About 44 gold dredges were operated in Alaska for the whole or part of the open season of 1914. Preliminary estimates show that they produced gold worth between $2,050,000 and $2,300,000. In 1913, 39 dredges were operated, recovering $2,200,000. The decreased output per dredge in 1914 is accounted for by the facts that in 1913 several of them were working in rich ground, and that several of the new boats were not completed in time to operate for more than a

brief period in 1914. A further handicap this year was the fact that the dredging season at Nome opened later than usual. In addition to the 44 dredges operated, there were about half a dozen under construction.

About 25 gold-lode mines were operated in 1914, and produced gold valued at about $5,100,000. In 1913, 30 mines produced $4,854,813. The decrease in the number of mines is due to the fact that several which were operated in the Fairbanks district in 1913 were idle in 1914. Juneau is and will continue to be by far the most important Alaska lode district. Important progress was made during the year in the Willow Creek district. The Port Wells district was added to the gold-lode producers.

Developments made up to midsummer gave promise that 1914 would be the most profitable year in the history of Alaska copper mining. The financial stringency and collapse of the copper market that followed the European war not only closed down some of the producing mines, but also put a stop to some very important developments. Up to about the first of August seven copper mines were in operation, but at the close of the year only three were still working. Had it not been for the war, at least nine copper mines would have been ready to ship ore before the end of the year. Probably the most important events of the year to the copper industry of Alaska were the reopening of the Mamie mine, in the Ketchikan district; the installation of a shipping plant and the opening of the Midas mine, near Valdez; and the completion of aerial trams at the Jumbo and Mother Lode mines, in the Chitina district.

The report then covers the various districts in detail. These have also been dealt with in recent issues of the *Press* in the articles by Emil Edward Hurja.

Ontario Dividends for the Year

Dividends paid by Cobalt, Porcupine, and other mining companies in 1914 were as follows, according to *The Daily Nugget*:

Company.	Total 1914	Per cent.	Total amount.
Beaver	.....	20½	$ 410,000
Buffalo	280,000	284	2,807,000
City of Cobalt	.....	23	139,321
Cobalt Central	.....	4	192,845
Cobalt Silver Queen	.....	21	315,000
Coniagas	1,320,000	181	7,240,000
Crown Reserve	424,479	337	5,960,858
Cobalt Townsite	200,000	110	1,042,260
Casey-Cobalt	93,750	...	203,249
Cobalt Lake	150,000	15½	465,090
Caribou-Cobalt	50,000	7½	75,000
Foster	.....	5	45,774
Kerr Lake	600,000	184	5,520,000
La Rose	899,176	69	4,974,998
McKinley-Darragh	472,015	193	4,337,028
Nipissing	1,350,000	204	12,240,000
Mining Corp. of Canada	259,375	12½	259,375
Right of Way	16,850	78	543,754
Peterson Lake	129,096	5¼	129,096
Seneca-Superior	335,218	135	645,993
T. & H. B.	69,849	25,000	1,940,250
Temiskaming	.....	56	1,384,156
Trethewey	50,000	108	1,061,999
Wettlaufer	.....	45	637,465
Hollinger	1,170,000	87	2,610,000
Porcupine Crown	180,000	9	180,000
La Rose shared privately prior to May 1908	.....	...	1,204,862
Private corporations (est.)	300,000	...	3,800,000
	$8,349,808		$60,364,473

The silver market affected operations to some extent.

Utah Mines and Dividends

In reviewing the past year's mining industry of the state, the *Deseret Evening News*, of Salt Lake City, makes the following comments: Dividends totaled $6,996,118, against $7,678,516 in 1913, as follows:

	Dividends in 1914.	Dividends in 1913.	Total to date.
Bingham-New Haven	$ 68,607	$ 45,728	$ 548,856
Buffalo Con.	2,346	.....	2,346
Centennial Eureka	150,000	300,000	1,050,000
Chief Consolidated	87,645	175,290	262,935
Cliff	.....	30,000	90,000
Consolidated Mercur	20,000	30,000	3,470,312
Daly-Judge	180,000	180,000	855,000
Daly West	.....	27,000	6,282,000
*Duluth & Utah	10,000	.....	6,000
Eagle & Blue Bell	178,629	178,629	357,258
Gemini	50,000	100,000	2,280,000
Gethin Le Roy	.....	7,500	7,500
Gold Chain	.....	60,000	130,000
Grand Central	75,000	75,000	1,602,750
Ingot Gold	.....	750	750
Iron Blossom	400,000	400,000	2,270,000
Mammoth	.....	20,000	2,300,000
May Day	24,000	24,000	156,000
Moscow	.....	24,528	40,880
Opohongo	.....	8,989	71,918
Silver King Coalition	.....	375,000	13,397,385
Silver King Consolidated	246,706	308,382	555,088
United States Mines, Bingham	†75,000	†100,000	.....
Utah Consolidated	600,000	450,000	9,660,000
Utah Copper	4,828,185	4,747,710	26,649,006
Yankee Consolidated	.....	10,000	192,000
Totals	$6,996,118	$7,678,516	$75,237,984

*Proceeds from sale of property. †Estimated.

The total dividends during 50 years amount to $118,818,208.

The Bingham district produced approximately 8,077,856 tons of ore yielding $1,476,315 gold, 1,978,603 oz. silver, 69,520 tons copper, 31,876 tons lead, and 1503 tons zinc, valued at $22,980,688, compared with 9,190,374 tons of ore, $1,774,815, 2,408,692 oz., 72,460 tons, 35,500 tons, and 1711 tons respectively, worth $29,008,007. The war and low metal prices are the causes of the decrease.

The Alta district in 11 months produced 14,112 tons of ore worth $221,906. The tonnage in 1913 was only 5608. With the new development in the Cardiff, the current year promises well.

The American Fork district six mines yielded 197 tons of ore.

Park City, with 21 mines, showed a decrease of 10,563 tons for 11 months of 1914, the total being 64,541, against 75,104 in 1913.

Tintic, with 41 producers, shipped 300,640 tons of ore, a decrease of about 75,000 tons.

The Ophir, Santaquin, and Beaver districts developed in a promising way.

The smelters near Salt Lake City yielded the following:

Metal.	1914.	1913.
Gold, ounces	160,863	172,711
Silver, ounces	12,821,378	13,084,835
Copper, pounds	157,162,611	161,445,962
Lead, pounds	190,245,670	166,126,790
Zinc, pounds	23,349,295	18,857,827
Arsenic, pounds	2,051,940	1,288,815
Total value	$40,258,487	$44,974,203

These values are based on the following average prices: silver, 54.69c. per oz.; copper, 13.15c.; lead, 3.82c.; zinc, 5.15c.; and arsenic, 9c. per pound.

There were 198 producing mines in the state yielding 8,618,832 tons of ore, against 10,202,566 tons in 1913.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

NEW YORK

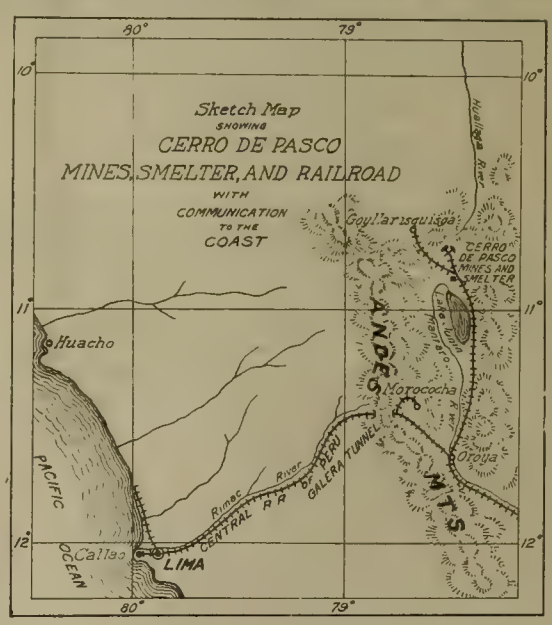
ZINC SMELTER FOR FOREIGN ORE AND CONCENTRATE—GERMANY AND AUSTRALIAN ZINC ORES—ANACONDA AFFAIRS—COPPER MINING NOTES—CERRO DE PASCO PUBLISHES YIELDS—BURMA CORPORATION

The report which was circulated around New York a while ago that the American Smelting & Refining Co would build a zinc-smelting plant on the Atlantic seaboard to handle the ore and concentrate shipped from Australia, has reached England and does not seem to be greeted with any enthusiasm there. There is no doubt that the Company was considering the matter of building a plant, but the question was put on the scheme by the decision in the friendly suit by the Zinc Corporation against Skipworth and others. The first decision was appealed to the Court of Appeal in London and was sustained, the court holding that the contract of the Zinc Corporation with Aron Hirsch & Sohn, by which the latter is to take the whole of the concentrate output of the Zinc Corporation up to 1919, was not abrogated by the war. The directors of the Zinc Corporation had proposed to abrogate the contract and to enter a new contract with the A. S. & R. Co., or else to erect a plant in England and treat the concentrate there itself. In the face of this decision, no American company would be willing to go ahead and spend the large sum required to construct a modern zinc smelter, with the prospect of having the concentrate supply cut off at the end of the war in Europe. This matter is also discussed in the London letter of this issue.

It is interesting now to note that the companies in Australia have been under suspicion because of their German affiliations, and offices of some of them have been raided. The attorney-general of the Commonwealth recently made the public statement that the investigation regarding the Broken Hill Proprietary and other metal companies had not disclosed any offense against the law, but the facts showed beyond all question that German capital and German influences exercised a monopoly over the civilized world's base-metal industry. The monopoly is so complete that it excludes effective competition. Peace holds out no prospects satisfactory or even tolerable to the British and Australian interests, since it will surely involve resumption of complete German domination of the industry. There seem to be grounds for the attorney-general's forebodings, for it seems scarcely probable that even if the Zinc Corporation attempts to proceed with its effort to abrogate the contract with the German smelters, that a zinc smelter in England would be a profitable venture. One of the critical factors in establishing such a plant is the labor supply, and the labor situation in England is not such as to cause an experienced zinc smelter to think that a smelting plant built there would be a financial success. The same is true, only more so, as regards the labor situation in Australia, and it indeed would appear as though the Australian zinc producers will have no option but to resume their German affiliations at the close of the war.

The Anaconda Copper Co. is making plans for changes in its practice after normal conditions are restored. It was some time ago decided to give up the hauling of ore from Butte to the Great Falls plant for concentration, as the extra freight cost as compared with concentration at Anaconda made this disadvantageous. Doing away with the concentrating renders available the hydroelectric power formerly used in the ore concentrating plant, and as he terms on which the Company leases the water power of Black Eagle falls gives it very cheap power, it was good economy to find some possible way of utilizing this. It is now announced that this will be done by constructing a new electrolytic refinery to have a capacity equal to the present one at Great Falls. This will raise the capacity of the Great Falls refinery to 240,000,000 lb. of copper per year. Most of this refined copper will, of course, have to go East, as the market for refined copper in the western states, and in the countries bordering on the Pacific, is rather limited, but as the new plant will have the advantage of cheap electric power and will furnish work for the old staff at Great Falls, it has obvious economic advantages. The smelting plant at Great Falls will be kept in operation, and the reconstruction which has been in progress for some time will be carried on to completion. The improvements in processes which have been devised by Anaconda officials in the last year or two will give a considerably greater copper output; and it is officially stated that when all these plants are in regular operation the Company will produce 50,000,000 lb. more copper per year than formerly from the same tonnage of ore. The Anaconda has declared a dividend of 25c. per share, payable on January 20.

The report that the North Butte and East Butte mining companies would be consolidated is officially denied.——The United States Smelting, Refining & Mining Co. has declared a quarterly dividend of 87½c. on the preferred stock, payable January 15, but no action was taken on the common



shares. The Mohawk Mining Co. is 'making hay while the sun is under a cloud.' Its recovery of copper from the ore milled reached 20½ lb. per ton, or over 2 lb. better than its best previous record. If it maintains its present rate of operation the output of copper this year will be almost equal to the best previous year.——The Wolverine made a recovery

of 19½ lb. of copper per ton of ore, but this is likely to steadily decrease, as it is estimated that the Wolverine has only about seven more years of life.

The Cerro de Pasco Mining Co., which has for years maintained a profound secrecy in regard to its operations in Peru, has recently made a statement to the *Boston News Bureau* of the amount of copper produced during the past three years. This is as follows: during 1912, 45,272,000 lb. refined copper; 1913, 43,865,000 lb.; and for 1914, 42,000,000 lb. is estimated. At present the smelter is operated at 40% capacity. No obvious purpose was served by the former policy of secrecy, since anyone who could materially profit by knowing what the production was could obtain the official records of imports, and it is not improbable that from henceforth the Cerro de Pasco will fall in line with the other copper companies and give out the figures as to its production and operations. It is reported here that the Copper Producers' Association will never resume the publication of its statistics, which were stopped at the outbreak of the war. The persistent reiteration of this probably indicates that some one would prefer not to have the figures continue to be given out.

The mines of the Burma Corporation at Bawdwin, on the border line between Burma and China, are of much importance and interest to producers of lead and zinc because of the unusual character of the ore. A recent report given out by the Company says that development work has proved the existence of about 500,000 tons of ore, and indicates 1,000,000 tons more of reasonably assured ore, the latter being of higher grade than the former. A recent cablegram says that at a depth of 168 ft., in a winze sunk from the 170-ft. level, the orebody averages 35 oz. silver, 36% lead, and 20% zinc. Diamond-drilling has, however, indicated that the orebody extends to at least 300 ft. below the 170-ft. level, and is even higher grade than the ore below. Present smelting operations are confined to the old slags left by the Chinese workers years ago. The problem how to smelt these ores at a profit is an interesting one, and while contracts have been made with Belgian firms to treat the material, it is hoped that some method can be devised which will permit smelting the ores at a larger profit.

WASHINGTON, D. C.

Leasing Oil, Gas, and Coal Lands.—Water-Power Bill.—Revision of Mining Laws Still Delayed.

The Senate Committee on Public Lands is giving hearings on the Administration's conservation measures which have already passed the House, and there is to be a thorough hearing on the so-called leaseholding bill, to which there is greater opposition than to any other measure of its kind in Congress. This provides for the exploration of oil, gas, and coal lands, but its essential principle is leaseholding, and the introduction of it is feared by many in the mining world. It is the plan of the committee to hold protracted hearings on this measure with the beginning of the new year, and western mining men should be represented if they wish to make a considerable showing against the proposal. It is, however, forecasted by western senators that Congress will take no action on the bill at this session, which has only two months more to sit. They plan to obstruct the progress of the measure so that it will fail, but nothing can be taken for granted. Those who are behind the measure, in the main the administration, through the able activity of Franklin K. Lane of the Department of the Interior, will try with great patience again in the next Congress. The representations before the Senate in this session will have no mean effect *pro* or *con* in the work on the legislation in the next session, should it remain unfinished business.

Western senators have been busy in hearings over the so-called water-power bill, which, while it does not affect mining directly, does so in an indirect manner. The mining and the water-power interests, through the state issues involved, are sailing in the same boat. A safe journey is likely to mean finished legislation provocative of more. In the matter of water-power, those who are opposing the federal legislation now before Congress are saying that nowhere is water-power now needed in the West, all states having a surplus of it. The legislation is therefore unnecessary, and will serve no other purpose than to project a principle of uneasy dimensions. In the public hearings, John Ryan, president of the Montana Power Co., declared it was folly to talk of the possibility of acquiring water-power sites for speculative purposes, holding them undeveloped. G. M. Dahl, director in the General Electric group, said that any monopoly in water-power, developed or undeveloped, was impossible. General Electric interests, he said, controlled 28,000 hp., and had less than 30% stock interest in the other companies named in the General Electric group; there is no concentration in the hands of a few interests as has been claimed.

Governor Ammons and Governor-elect Carlson of Colorado appeared before the committee. The former attacked the principle of leaseholding, on waterways as well as on coal, oil, gas, and precious metal lands. He declared that such a policy would deprive the public land states of the West of the taxes with which to build themselves up. Large areas of those states were held by the government, and, under a leasing system, only the federal government would profit by their development. Mr. Carlson said that experience has shown that private ownership was the only system under which the resources of the West could be developed.

The legislation in the House to create a commission to codify the mining laws of the land lies as dormant as ever. There is a mysterious influence at work to kill the proposal. Many promises are made only to be broken. Presently an effort will be made to smoke out the opposing forces.

HOUGHTON, MICHIGAN

Fires and Explosion at Copper Mines.—Mohawk Output.

The third recent disaster in the Michigan copper district occurred early Christmas morning when the stamp-mill of the Isle Royale Mining Co. on Portage lake, one mile east of Houghton, was completely destroyed by fire. It is believed that the fire started in the office on the floor of the mill, and in spite of the efforts of the mill hands and the Houghton fire department, the whole plant, with the exception of the carpenter shop, boiler house, and office, was burned to the ground. The loss is estimated at $250,000. The mill contained three Nordberg steam stamps, 72 roughing jigs, 30 finishing jigs, circular slime tables, and Bartlett and Wilfley tables. The mill is now a skeleton mass of twisted pipe and machinery. Men are now engaged in taking down dangerous pieces of framework, and saving as much as possible from the ruins. The 'rock' from the Isle Royale mine will probably be sent to the Centennial-Allouez stamp-mill at Point Mills.

On December 18 one of the boilers at the No. 3 shaft of the North Kearsarge mine of the Osceola Consolidated Mining Co. exploded. The boiler house was almost completely wrecked and the firemen killed. No. 3 shaft was put out of commission temporarily, and in the meantime the men employed at this shaft are getting No. 1 shaft into shape for operation.

Several weeks ago the boiler house and compressor plant at the Superior mine were destroyed by fire. This mine, however, is now back to normal production with a daily tonnage of 600 tons.

A new record was made during the month of November by the Mohawk Mining Co. The production of 1,262,864 lb. was lower than the production for October, but the yield of 20.45 lb. of refined copper per ton of rock exceeded the October record by more than two pounds.

LONDON

DEVELOPMENT RESULTS AND ORE TREATMENT PROPOSALS OF THE RUSSO-ASIATIC CORPORATION — SMELTING AUSTRALIAN ZINC ORES IN AUSTRALIA

In January last, discussion of the Russo-Asiatic Corporation and of the zinc-lead-silver-gold properties acquired by it in Siberia was published in the *Press*. The deposit receiving first attention was the Ridder, which is situated in the Altai territory not far from the Irtish river. The Company belongs to the group identified with the Kyshtim Corporation. Leslie Urquhart, the managing director, is an engineer of long residence in the Russian empire, while Herbert G. Hoover has lent his technological skill and financial resources. The

MAP SHOWING RUSSO-ASIATIC PROPERTIES.

to water concentration, flotation, and smelting. In the first place, ordinary flotation is not necessary, as the mineral does not slime badly and no heavy gangue is present. It was found that, though fine-grained, the constituent sulphides can be fairly well segregated on tables and differential flotation for the treatment of slime need not be considered at present. The plan therefore is to remove as much zinc as possible by water concentration, this concentrate to be roasted and smelted in retorts, while the lead-copper concentrate will be smelted for metallic lead and copper matte. The development of the orebody is in the hands of R. Gilman Brown, and an independent geological report has been made by H. H. Knox. The orebody has been traced along the strike for 750 ft. It is nearly vertical at the outcrop, and the dip soon flattens with depth. In order to test the ore at a lower point, two rows of five boreholes 125 ft. apart have been sunk, one row 400 ft. from the outcrop and the other 170 ft. farther away, both at an inclination of 63°. All these holes have passed through ore, and the assays of the cores are fairly uniform. The width of the solid sulphide portion varies from 20 to 90 ft., and that of the disseminated up to 200 ft. The results of the borings are such as to warrant an estimation of available ore. Down to 700 ft. on the dip it is calculated that there is 883,000 long tons of sulphide averaging 30.9% lead, 14.9% zinc, 1.37% copper, $8.60 gold, and 10 oz. silver, and 1,565,000 tons of disseminated, averaging 2.89% lead, 5.6% zinc, 0.3% copper, $12 gold, and 1.29 oz. silver. It will be seen that the gold content is high, and judging by the relative figures in the rich and disseminated ores, it would appear that gold is in the gangue as well as in the sulphide, though I am told that this is not the case, and that the gold is in the sulphides. It is intended to erect a concentrator of 200-ton daily capacity, to treat rich sulphide, and subsequently another plant of 400-ton capacity

Ridder property has been a hard nut to crack for years, and many have been the English, French, and American engineers who have had a look at it, and held up their hands in despair. The lode is wide, being as wide as 250 ft. in places, and containing zones of varying richness between the foot and hanging walls. The minerals are galena, blende, and chalcopyrite, with gold and silver. In the richer parts the gangue is quartz and calcite, the proportion of gangue being so low as to justify the use of the term of 'solid sulphides' by the directors. Beneath this zone is another containing sulphide in patches, and called 'disseminated ore,' the gangue being hornstone, which was probably originally a shale, but much silicified and brecciated. The oxidized zone extends to a depth of 140 ft. or so, and has been worked for the gold and silver by previous owners. To Mr. Hoover and his associated engineers, W. T. Madge and Deane P. Mitchell, the sulphides presented no terrors, for they have been highly successful in the treatment of Broken Hill ores. The study to ascertain the best way of dealing with the Ridder ore required the consideration of questions relating

to treat disseminated ore. It is estimated that a profit of $35,000,000 will be made from the treatment of the ore mentioned above. Of course, the whole of the output is readily marketable within the Russian empire. The development of this mine has been handed over this week to a subsidiary called the Irtysh Corporation. The Russo-Asiatic takes £1,100,000 in ordinary shares as purchase price. The capital required for development is being raised by the issue of £500,000 debentures carrying 6% interest, and subsequently exchangeable into shares. The Ridder is not the only property acquired by the Company, as the Ekibastus coalfield is included in the transfer. One of the seams is of excellent quality and will make suitable coke for smelting purposes. The smelter will be erected on the spot, and the concentrate shipped from the Ridder. Readers of the *Press* will be interested to observe that all the engineers whose names have been mentioned are, with the exception of Mr. Urquhart, Americans.

On several occasions I have referred to plans for erecting lead and zinc smelters in England, to treat the Broken Hill concentrate hitherto shipped to Germany. A serious snag in the path of the companies desiring to rearrange their policy in this connection promises to be the interpretation by the English courts of justice of the contracts under which the concentrate is sold. A case before the courts at present is that of the Zinc Corporation, in which judgment is desired as to the construction of the contract made in 1908 with Aron Hirsch & Sohn. This contract contains a clause to the effect that, in the event of anything happening beyond the control of the vendors and buyers, preventing the sale and delivery, the contract should be suspended during the cause of the disability. The judge in the first court gave it as his opinion that the clause covered the present position created by the war; knowing that the government and the parties involved desired the opinion of the highest court, refrained from giving any elaborate judgment. With unprecedented rapidity, the case came before the appeal court during the week ended December 12, before six judges. This court held the opinion that the matter could not be discussed in the absence of some representative of Aron Hirsch & Sohn, and dismissed the case. At the time of writing, I am not informed of the future intentions of the directors of the Zinc Corporation. As things stand at present, the matter is in exactly the same position of doubt as it was before it went to the court. As readers will remember, the Zinc Corporation was one of the first in the field at Broken Hill with a project for the treatment of zinciferous tailing by means of the flotation process. The Company has not only beneficiated enormous heaps of zinc tailing, but three years ago acquired a mine for itself on the Barrier range, the South Blocks, and has under option the South Blocks Extended. Thus it is a producer of lead concentrate as well as zinc concentrate. Active steps have been taken during the past three months with a view to establishing metallurgical works, and thus freeing Australia and England from German domination.

BUTTE, MONTANA

ANACONDA COMPANY'S EXTENSIONS, AND SAFETY FIRST WORK.—ELM ORLU AND BLACK ROCK ZINC MINES.—NORTH BUTTE AND EAST BUTTE COMPANIES.

Despite the low price of copper and the gloomy outlook caused by England's placing copper on the contraband list, the mining situation in Montana is good. The president of the Anaconda Copper Mining Co., B. B. Thayer, together with the president of Amalgamated Copper Co., John D. Ryan, recently completed a tour of inspection of the various interests of the Anaconda company throughout Montana. These gentlemen spoke optimistically of the future and outlined improvements, extensions, and enlargements, which will involve the expenditure of large sums in Montana, forthwith. One of the most important of these undertakings is the enlargement of the electrolytic refinery at Great Falls. It would appear that the cheap electric power at Great Falls justifies the local refining of the copper, and it is the apparent intention of the Anaconda in the near future to do much of its refining at Great Falls instead of in the east, as at present. The New York correspondent also discusses this subject in this issue. At the Anaconda works the sulphuric acid plant is being pushed rapidly to completion, and the new leaching process will soon be in operation. Significant experimenting is under way along other lines also at this plant. At Butte, the Anaconda company has manifested faith in the future of the copper industry by taking an option on the property of the Butte-Duluth Mining Co. at a price given out as over $2,000,000. It may not be the intention of the Company to continue the leaching methods now practised at Butte-Duluth, but the disseminated orebodies which are claimed to be extensive will be proved by thorough drilling.

The Anaconda company is giving a lot of serious attention to the 'safety first' movement. C. W. Goodale, manager of the Boston and Montana department, has been made chairman of the general committee having the work in charge, and the results are beginning to show for his careful and systematic direction. 'Safety first' committees have been organized throughout the mining and metallurgical works, and they have regular meetings. The latest innovation is a monthly publication called *The Anode*, which is to be devoted entirely to matters pertaining to the prevention of accidents. It is to be made readable and entertaining so that the employees will read it and profit by it.

Butte's two zinc mines are now at work full blast, treating about 1500 tons of ore per day. The Elm Orlu mine, belonging to the W. A. Clark interests, is shipping about 500 tons per day to the new mill of the Timber Butte Milling Co., and the Black Rock mine of the Butte & Superior Copper Co. has started again with its normal production of about 1000 tons per day. The success of these zinc mines is very significant here. It is well known that some of the mines of the Anaconda company contain large quantities of zinc ores, mineralogically not unlike the Elm Orlu. It is not improbable that Anaconda will be taking its zinc resources seriously before long and endeavor to prepare a commercial zinc product.

Rumor is persistent that the North Butte Mining Co. has bought the property of the East Butte Copper Mining Co. This is important news if true (according to our New York correspondent it has been officially denied.—EDITOR), as it indicates a further pulling apart of the Cole-Ryan interests formerly so closely linked. The North Butte company would thus become the chief competitor of Anaconda in the Butte field. What with its former holdings, its recent acquisition east of the Pittsmont, and now the acquisition of the Pittsmont itself, North Butte will become an important factor in Butte's mineral production. Incidentally, Anaconda will lose some custom ore, as North Butte is shipping to the Anaconda works at present. East Butte has a mill and smelter which North Butte will surely make use of. North Butte will also make use of the Pittsmont workings of East Butte to explore some of its own ground to the east. This consolidation should be of benefit to Butte, as it makes two strong independent copper companies, with the resultant activity in the purchase and development of new ground. The North Butte has taken the lead in this prospecting by the organization of the Rainbow Lode Development Co. for prospecting for zinc east of the Black Rock. Likewise the Anaconda takes a hand by prospecting the Nettie mine west of Butte. If these two Companies get in the habit of watching what the other is doing the district as a whole should profit thereby.

Butte interests are drilling for oil near Ryegate, in Musselshell county. The rig has 4000-ft. capacity.

THE MINING SUMMARY

The news of the week as told by our special correspondents and collected by the local press

ALASKA

Mining began in Alaska in 1880, and since that time the territory has produced mineral products to the value of $268,000,000. Of this, $244,300,000 has been in gold, $19,800,000 in copper, $2,251,000 in silver, $170,000 in coal, and the rest in tin, lead, quicksilver, marble, gypsum, petroleum, etc. Copper mining began in Alaska in 1901, and the total production is about 133,000,000 lb., according to Alfred H. Brooks, of the U. S. Geological Survey.

The total production of Alaskan tin mines since the industry started in 1902 is about 550 tons of metallic tin, valued at $432,000. In 1914 one dredge was operated on the Buck Creek placer tin deposits throughout the open season. Two others were operated for a part of the season on Anikovik river, working on deposits containing both gold and tin. Operations were also continued and some tin was produced at the Lost River lode tin mine. All these localities are on Seward Peninsula. Tin was also produced from several deep placer mines in the Hot Springs district, operated chiefly for the recovery of gold. It is estimated that nearly 50 tons of stream tin was recovered from these placers in 1914. This output could be considerably increased, for only a few of the miners make a systematic attempt to recover the tin.

ARIZONA

A week's heavy rain has resulted in flooding the country between Phoenix and the Mexican border. Several lives were lost, stock drowned, railways washed out, and an immense amount of damage has been done. Thirty miles south of Tucson the Santa Cruz valley suffered greatly. The Tucson Farms Co. lost 19 centrifugal pumps and other machinery worth $500,000. At Bisbee, floods flowed through the cañons between the hills and business area. The San Pedro river west of Bisbee was a mile wide. At Douglas the railroads were badly damaged. Nogales was surrounded by water.

Gila County

Minority shareholders in the Keystone property, which has been acquired by the Inspiration Consolidated, are to protest against its transfer, on the ground that enough is not being paid for it.

Greenlee County

The Arizona Copper Co.'s output in November was 2,670,240 lb. of copper.

Mohave County

Engineers representing San Diego people have sampled the Enterprise mine, 18 miles east of Kingman. The ores contain lead, gold, and silver.

Pima County

The Gold Nugget Placer Mining Co., holding dry placer deposits 47 miles from Tucson, has been absorbed by the Greaterville Dredge Gold Mining Co., which owns adjoining property. J. West, president of the latter Company, states that the purchase price was $75,000 and that 960 acres of ground was included in the transfer, this making the total holdings of his Company 1980 acres, which is being developed as rapidly as possible. A well, which is to furnish water sufficient for the dredge, has been practically completed and actual gold recovery is expected to start within the next six months.

Yavapai County

(Special Correspondence.)—An option has been given on the Gladstone McCabe claims at McCabe to J. C. Rankin, acting for an English company that is at present operating the Henrietta mine, according to John L. Davis, the manager. These three mines are practically together, and the intention of the Company is to connect them underground and hoist the ore through one well equipped working shaft. It is reported that a new modern reduction plant will be constructed if the option is taken up, as is expected. These are among the best known of the old producers of this district, as they have been worked continuously for a number of years and contain ore reserves for many more years of profitable extraction.

Prescott, December 28.

CALIFORNIA

Oil production of the state in November was 259,771 bbl. per day, shipments from the fields being 6,746,952 bbl. Stocks amount to 57,071,088 bbl. There were 6123 producing wells.

Fresno County

The geology and oil prospects in Waltham, Priest, Bitterwater, and Peachtree valleys are discussed by Robert W. Pack and Walter A. English in *Bulletin* 581-D of the U. S. Geological Survey. This area is part of the Coalinga field, but situated in the hilly region to the west, and was examined in the summer and fall of 1913. The immediate reason for the investigation was the need of geologic data for the classification of the public land in the area that had been withdrawn from all forms of entry, because of its possible value as oil land. As a result of the examination, large areas of unappropriated public land have been restored to entry. The chief conclusion reached regarding the occurrence of oil is that most of the region does not offer reasonable promise of yielding petroleum, and that much of it is certainly barren of oil. Coal occurs in the Tertiary beds in the Priest valley syncline and at several places in the hills on the south side of Waltham valley. Coal has been extracted from the Stone Canyon mine for many years.

Kern County

(Special Correspondence.)—At Randsburg the Consolidated Mines Co. is reported to have cut 4 ft. of $25 ore. For over a year the Company's mill has been crushing ore averaging $7 per ton.——Rumors connected with the Yellow Aster speak of a sale and a large stamp-mill to be built.——A flow of water from 10,000 to 15,000 gal. per day has been cut in an old shaft of the Good Hope and Wedge mines, right in town, and supplies the Consolidated mill.——Lessees are busy at several claims

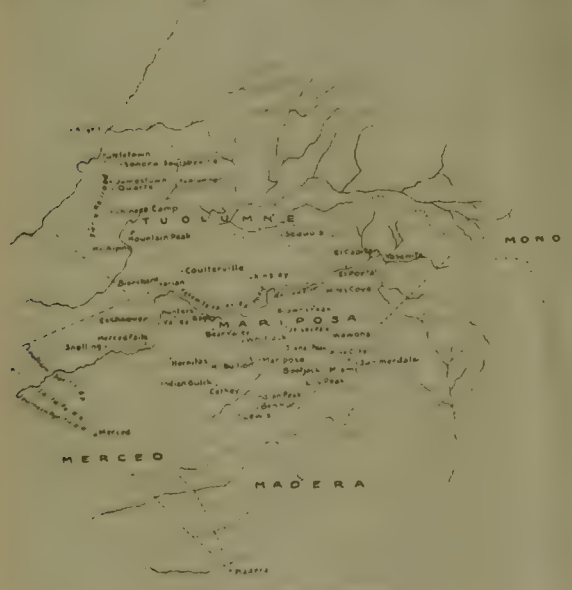
At Jawbone the wolfram claims of T. Whalley and F. Fellman are being leased, and work is to start soon. Low-grade tungsten veins have been found on these properties.

Randsburg, December 27.

Mariposa County

(Special Correspondence.)—The following notes cover this county's latest developments. A. G. Huberty, of Jackson, Amador county, has been in Mariposa for several days examining the Herman, Barbara, and Charles H mines, located 1½ miles west of Bear valley, owned by C. A. Schlagerter of Mariposa. The bond on this group is to be $12,500, due in 6, 12, and 18 months. There is a 210-ft. shaft on the property, about 100

ft. of adits, a lot of open-cut work, and 300 tons of ore on the dump which it is said will assay $12 per ton.——A bond has been taken by Frank X. Egenhof on the Little Wonder, owned by Mr. Keilburg and others, but Mr. Egenhof's sudden death last week will delay the development of this property.——A contract for driving on the 100-ft. level of the Sunshine mine has been let by Mrs. J. E. Divens to F. T. Schlagerter and partner. The second round of holes broke into high-grade ore which it is estimated will plate $100 per ton. The property is equipped with gasoline hoists and other good machinery. This mine produced 200 tons of ore last summer, averaging $12.50 per ton.——James C. Yancey, of Portland, Oregon, who recently bonded the Sweetwater and Revel mines and mills, has men under C. H. Wedekind building a dam to supply water for the Sweetwater mill and other improvements for economical work so much needed in Mari-



MAP OF MARIPOSA COUNTY.

posa mine development.——Schroeder brothers and Judkins, of Colorado, Mariposa county, will start a 5-ft. Huntington mill on the old Schroeder mine above Merced river, south of Saxon creek. The surface of this mine was rich, and as the ore is a soft decomposed material, this machine is adapted to the ore.——The Colorado Quartz mine, owned by Judkins, Weston, and Dearborn, has a new hoisting plant, and sinking on the vein is under way. It is predicted that this mine will become one of the steady producers of Mariposa county. ——The Mountain King Mining Co., on the Merced river, east of Bagby, has opened high-grade ore and is actively developing its property. The Company is installing some new machinery, and a mile of iron pipe for a new water-power plant. ——The Clearing House Mining Co. has started its mill, which has been closed down on account of low water. George W. Egenhof, manager, will install a power drill-sharpener in the near future.——The Malone mine, now owned by the Golden Reath Mining Co., will be sold under judgment of $1900 at Mariposa on December 21. Thomas Gordon is the principal creditor.——The Monte Cristo claims of Robert Weilman and associates, situated in Devil's gulch, are being developed and an engineer has been sent to New York expecting to place this property with New York and Canadian people.——The Comet mine is closed down, and probably will not resume operations before next spring on account of the snow.——The Silver-Lead mine is being developed by the new owners, who have erected a 10-stamp mill.——No. 5 mine is having a reduction plant installed by Mr. Parker of Chicago. This is a new style of ball-mill, first of the kind that has ever been used in California, and its operation will be watched with considerable interest.——The Mariposa Commercial Mining Co. has been repairing its power dam at Bagby, and has been making plans and surveying for a large dam between Mt. Bullion and Mariposa. This dam will be used for irrigation and power purposes.——There is little question but that Mariposa mines will be developed more in 1915 than they have been in the past five years. What is needed is to have intelligent and economical management, and with that the properties will soon resume their former production.—— The county commissioners are planning on installing a specimen case in each of the hotels of the Yosemite valley to show the minerals produced by the county.

Mariposa, December 20.

Nevada County

The regular quarterly dividend of the North Star company, of $50,000, has been paid, making $200,000 for 1914, and $4,186,989 to date. The dispute between the You Bet Mining Co. and the Goodwin estate has been settled, the former being in possession again. The Jerry Goodwin property is to be reworked at once.

Plumas County

Work has been stopped for the winter at the Haskell Peak mine near Clio. There is 54 in. of snow on the ground there. Good progress was made in the lower workings, which will open the gravel channel. J. J. Snyder is superintendent.—— The same channel is to be prospected by G. W. Wilson and others some distance away.

San Bernardino County

(Special Correspondence.)—All leases on the tungsten deposits at Atolia terminate on January 1. Only a few miners made any profit during the season, and not many, it is reported, are anxious to renew leases under present conditions, which are really only working contracts.

Atolia, December 27.

Shasta County

This county's mineral exhibit for the Exposition at San Francisco weighs over 50 tons, and is ready to be shipped from Redding. Large blocks of ores have been given by various mining companies.——The smelter fume case will be continued on February 23.

The Mammoth Copper Co. has bought the Friday-Lowdon 13 copper claims, near Kennett, for $5000. About 1000 ft. of development and considerable diamond-drilling, costing $50,000, has been done. Owing to the zinc in the Company's ore, a sorting plant is being built. The product containing an excess percentage of zinc will be sent to Oklahoma smelters.

Sierra County

At the Kate Hardy, at Forest, the mill is working 24 hours daily. According to the superintendent, A. D. Grant, the lower adit is in 600 ft., and six veins have been cut.——The vein has been found again in the North Fork at Forest. It consists of quartz and talc, the former containing considerable pyrite.——A fire at the Plumbago destroyed the 'dry' house and stable.——A fire at Pike City destroyed several buildings last week, including the Alaska Mining Co.'s hotel of 100 rooms, occupied by its miners.——Gravel has been opened by a rise in the Cold Spring claim near Mt. Vernon. Los Angeles people are interested.

Tuolumne County

It is reported that work is to be resumed at the old Soulsby mine, which has been a large gold producer from down to 800 ft. depth. Pumps are to be installed to cope with the water.

Lessees in the New Albany mine in the east belt of this county have opened rich ore at 700 ft. During 10 months they have not extracted much ore, but now they expect to keep the 20-stamp mill going.

Tulare County

The Woody, Eclipse, Ball Mountain, Josephine, and other claims of the Adams Corporation, in the White Pine district near Porterville, have been acquired by W. T. Young of Mississippi. The Ball Mountain was then leased to other people. A hoist and 15-ton mill on the Eclipse are to be moved to the Ball Mountain. There is said to be a good tonnage of ore in the claims.

COLORADO

Production figures for 1914, December being estimated, from the U. S. Geological Survey, are quoted under various counties.

Boulder County

This county's production in 1914 was $97,000 gold, 207,000 oz. silver, 450,000 lb. of lead, and 48,000 lb. of copper, an increase of $28,000 gold, 45,000 oz. silver, 40,000 lb. lead, and 22,000 lb. copper.

The new cyanide plant, situated at Caribou, 35 miles west of Boulder, built by H. P. Lowe and others at a cost of $60,000, to treat ore from the Caribou, Poorman, and No Name silver mines, is in operation. The mill is producing three carloads of concentrate per week. These mines have yielded a large quantity of silver, but have been idle for over 20 years. About $50,000 has been spent in unwatering them to 1000 ft., retimbering, and equipment. Over 50 men are employed at 800, 900, and 1000 ft. stoping ore. Dumps contain good ore also. An adit is in 1500 ft. in the Caribou, and is to be driven about 4500 ft. in all, to work the properties, which cannot be done profitably by the shafts.

Chaffee County

This county produced $480,000 gold, 260,000 oz. silver, 3,600,000 lb. lead, 300,000 lb. copper, and 2,000,000 lb. zinc in 1914, a considerable increase for all the metals except zinc, which equaled the 1913 yield.

Clear Creek County

The output of this county in 1914 was $540,000 gold, 432,964 oz. silver, 2,700,000 lb. lead, 450,000 lb. copper, and 1,000,000 lb. zinc, an increase of $70,000 gold, and small increases for silver and copper, but a considerable decrease for lead and an appreciable decrease for zinc.

Eagle County

Eagle county's output in 1914 came chiefly from Red Cliff, but included a small quantity of silver ore from the Lady Belle and North Dakota mines, in the Brush Creek district. The total yield was $45,000 gold, 116,000 oz. silver, 1,100,000 lb. lead, 30,000 lb. copper, and 7,664,000 lb. zinc, a small increase for gold, decreases for silver, lead, and copper, and 1,000,000 lb. increase for zinc.

Gilpin County

Last year's output was $500,000 gold, 150,000 oz. silver, 500,000 lb. lead, and 600,000 lb. copper, including ore mined through the Newhouse tunnel.

Gunnison County

Owing to increased shipments of lead ore from Italian Mountain, and of lead-zinc from Whitepine, there was an increase for lead and zinc in this county in 1914.

Lake County (Leadville)

Lake county, chiefly from Leadville, but also from the Lackawanna gulch and St. Kevin districts, produced $1,554,000 gold, 3,860,000 oz. silver, 27,000,000 lb. lead, 2,470,000 lb. copper, and 79,000,000 lb. zinc, with a total value of $9,000,000, against $1,023,631 gold, 3,400,318 oz. silver, 29,286,183 lb. lead, 1,923,987 lb. copper, and 93,842,857 lb. zinc, with a total value of $7,219,443. In 1913 the output of zinc carbonate was 111,000 tons of 24% zinc against 135,760 tons of 27.4% in 1913. The zinc sulphide smelting ore and concentrating ore combined increased from 97,704 tons of 23% zinc in 1913 to 114,000 tons of 22% zinc in 1914.

Leadville men are organizing a syndicate to tunnel and prove the area under Canterbury and Prospect mountain. The ore-shoots from Fryer and Breece hills dip north toward this ground. Cold weather has interfered with work on Breece hill and other parts of the Big Evans district. Lessees at the Jonny and the Ibex are steadily producing a heavy tonnage of gold, silver, copper, and zinc ores. At the Lapplander in Lake Park, W. H. Upton and others have opened 6 to 7 ft. of $18 to $24 ore in an adit 740 ft. long. Gold predominates in the ore. According to G. W. Buehler of the Miller mine in Lackawanna gulch, the property is looking better than at any previous time. Bad roads work against development in this area.

Mineral County

Creede produced $18,500 gold, 643,000 oz. silver, 1,450,000 lb. lead, and 36,000 lb. copper, but no zinc last year, an appreciable decrease for gold, silver, lead, and zinc.

Pitkin County

The Pitkin County (Aspen) yield last year was 354,000 oz. silver and 22,200,000 lb. lead, a decrease of 200,000 oz. silver, but an increase of 5,000,000 lb. lead. But for the fire in the Smuggler workings the output would have been even larger.

Summit County

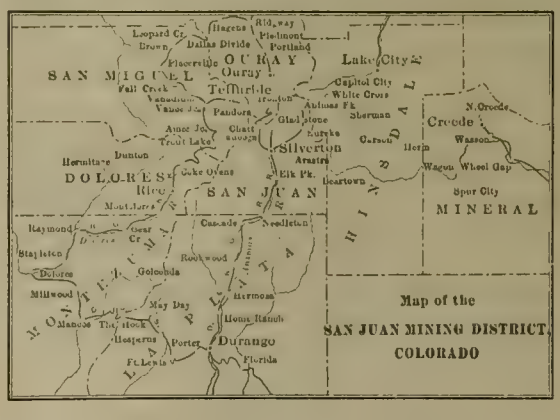
The output of gold from dredges and pocket mines at Breckenridge was $665,000 in 1914, an increase of $230,000. The total output of the county was $700,000 gold, 63,000 oz. silver, 1,300,000 lb. lead, and 5,000,000 lb. zinc.

(Teller County) Cripple Creek

According to the U. S. Geological Survey, the gold output of Cripple Creek was $12,048,000, an increase of $1,143,000. This is the largest production for any one year since 1908. Cripple Creek to the end of 1914 has produced $259,000,000 in gold.

The San Juan

The San Juan region of Dolores, La Plata, Ouray, San Juan, and San Miguel counties produced $3,721,000 gold, 2,470,000 oz. silver, 12,820,000 lb. lead, 2,490,000 lb. copper, and approximately 1,400,000 lb. zinc, compared with $4,071,683 gold, 2,769,077 oz. silver, 21,740,502 lb. lead, 3,373,935 lb. copper, and



6,867,410 lb. zinc in 1913. There were increases for gold of $30,000 in Ouray county and of $10,000 in Dolores, but decreases of $159,000 in San Juan, $42,000 in San Miguel, and of $192,000 in La Plata. There were increases for silver of 137,000 oz. in San Miguel and 90,000 in Ouray, but decreases

of 386,000 oz. in San Juan, 60,000 oz. in La Plata, and 80,000 in Dolores. Dolores county (Rico), San Juan county, and San Miguel county all showed heavy decreases in lead, copper, and zinc. The Tomboy company produced no zinc concentrate, as the Montana vein contains little or no zinc. Ouray county, because of increased production at the Camp Bird, the steady production of the Wanakah mill and copper matting plant, and the successful application of flotation to the Atlas ores, showed appreciable increases for gold, silver, and copper output, and a small increase for lead.——The boarding and bunk house of the Gold Lion mine, 10 miles south of Ouray, has been burned. The loss is about $15,000. It was one of the best in Colorado. John Davey is manager for the Company.

IDAHO

Blaine County

Ore averaging 10 oz. silver and 55% lead is being mined from the 500-ft. level of the Wilbert, 25 miles east of Arco. The mill, which is temporarily shut down, has had a Symons disc crusher added.——At 750 ft. in the Nau Aug. 12 miles from Hailey, two new ore-shoots are being opened. Ore being shipped assays 80 oz. silver and 62% lead. Concentrate is produced by the new mill. Dumps on the surface contain 12,000 tons of $14 ore. K. C. Wooley is in charge.

Shoshone County (Coeur d'Alene)

The Caledonia Mining Co. has distributed a dividend amounting to $36,079. Another of 2c. per share will be paid on January 5, making a total of $218,429 since October 5. A flotation process is now operating in the mill and adding considerably to the profits. Only 30 miners are employed extracting the rich ore.——The Hecla Mining Co. paid $220,000 in 1914, and $3,190,000 to date. A large tonnage of ore is available for the mill. ——According to the manager of the Laclede mine, F. Cushing Moore, in the Mullan district, development is promising for the 200-ft. level.——In the suit of the Marsh Mining Co. *v.* the Washington Water Power Co., the latter has compromised with the former over power rates.——In the suit of the Marsh Mining Co. *v.* the Inland Empire Mining & Milling Co., involving the right of the former to appropriate part of the surface ground of the Never Sweat claim, about 3.3 acres, to be used as a terminal for a tramway, ore-bins, etc., Judge John M. Flynn decided in favor of the plaintiff.——Developments in the Interstate-Callahan are most encouraging. On No. 4 level the ore-shoot is 1200 ft. long, and from 20 to 50 ft. wide, assaying up to 60% zinc. A shaft was sunk 450 ft. from this level and a cross-cut has opened 8 ft. of good grade ore.——The Pine Creek district is showing several interesting developments.

MONTANA

Silverbow County

The Anaconda Copper Mining Co. will pay a dividend of 25c. per share on January 20. At 1600 ft. in the Butte-Ballaklava, the Jessie vein shows 30 in. of glance. The 1600-ft. level is considerably better than at 1400 ft., the shoot being 200 ft. long on the former, and 140 ft. on the latter, copper content being about the same. Ore shipments of 50 tons per day are being made. Charles W. Newton was superintendent, but has gone to another property.——Directors of the North Butte company recently met at Duluth, Minnesota, and decided not to pay the quarterly dividend on account of large expenditure at the mine. Sinking the Granite Mountain shaft to 3100 ft., etc., cost $220,477 to December 1. The new hoist and other equipment will cost $246,956.

NEVADA

During 1914, 804 persons sent in 1631 samples from 248 localities, and the State Mining Laboratory made 6533 determinations on these samples. This is an increase of almost 50% over the number of persons and samples for 1913. Those sending samples would derive much greater benefit from its work, if they all took large samples and crushed them down and quartered them and finally sent a considerable quantity to the laboratory, than if, as is commonly the case, they sent only a few fragments.

Elko County

The Dexter mill and cyanide plant at Tuscarora has been destroyed by fire, the loss being estimated at $150,000. It has not been operated for several months, and arson is suspected.

The *Nevada Mining Journal*, devoted exclusively to mining in Nevada, is being published weekly at Elko. A preliminary issue has been made.

Esmeralda County

Drifts from the station at the top of rise 503-C, above the 1017-ft level of the Velvet claim of the Jumbo Extension are out 50 and 60 ft. respectively, showing 5 ft. of $50 and $60 ore. Daily shipments are 100 tons assaying $55 to $60 per ton. A stope above 921 ft. is opening 4 ft. of $25 ore.——The Jumbo Junior Mining Co. has been organized to work the Spearhead Fraction claim. A shaft was sunk 300 ft. several years ago. Sinking will be resumed to the latite-shale contact. The property is well situated.——The Kenanas winze is 75 ft. below the 700-ft. level.——The Black Butte shaft is being unwatered.

Nye County

Six mines at Tonopah produced 10,565 tons valued at $216,130 during the week ended December 26.——The Belmont company paid each employee $5 as a Christmas present. Likewise the Jim Butler men, under the same management.—— Six feet of $15 ore, with a 2-ft. vein of rich ore on the hanging wall, has been opened at 500 ft. in the West End. This discovery is in a little prospected portion of the property.—— All testimony has been taken in the Jim Butler-West End suit. Argument will be started on January 25.——Water in the Cash Boy shaft is down to 65 ft. below the 1100-ft. level, and should soon be all out. Sinking is then to be resumed to 1400 ft.——The North Star sent 100 tons to the West End mill last week.

At the Round Mountain mine a station has been cut at 1000 ft. A drift on the foot-wall of the new shaft vein has opened $51 to $281 ore. At 950 ft. this shoot was 30 ft. wide, the foot-wall portion assaying $80 per ton. Good results are coming from the Sphinx claim, especially at 800 and 900 ft. The pipe from Jett cañon, 8½ miles long, should be delivering water in May. It will carry 400 in. for the gravel deposit.

White Pine County

The Ely-Gibraltar Mining Co., operating 2½ miles north of McGill, has shipped ore worth $5000 to Salt Lake City. The last carload averaged 79% lead, 3 oz. silver, and 40c. gold per ton. An adit is in 950 ft. in tough ground. A mill is proposed for second-grade ore. C. E. Street, of Salt Lake City, is manager.

NEW MEXICO

Socorro County

The Socorro Mining & Milling Co., on application to the state engineer's office, has obtained an extension of two years for the completion of its hydro-electric plant, work on which has been in progress about three years. The Company has already expended $90,000, and the total cost will be at least double that amount. The plant will have an initial capacity of 1000 hp., and is designed to furnish power for the operation of the Company's mine and mill, and other mines and mills in the Mogollon district of this county. Oil-engines now are being used in that district, but the operating cost is high, due to the necessity of transporting oil overland from Silver City, a distance of 90 miles.

The Mogollon district, which in 1913 yielded $619,886 gold and 1,306,766 oz. silver, showed a small increase for 1914.

UTAH

Juab County

The annual report of the Colorado Mining Co., for the year ended November 1, 1914, shows that under the leasing system 2947 tons of dry ore was shipped containing 0.116 oz. gold and 33.106 oz. silver per ton, also 17.93% lead and a little copper. The gross value was $28.56 and net return $21.09 per ton. Royalties payable are from 20 to 50%, according to the value of the ore, from $10 to $30 and over per ton. Lessees received $28,274. The Company's revenue from all sources was $153,619 and at the end of the year had $84,624 on hand. E. F. Birch is assistant general manager for the Company.

Lead-silver concentrate is being shipped by the Utah Minerals Concentrating Co., which has a new plant treating dump material at the Chief Consolidated mine at Eureka. A crusher, rolls, tube-mills, and tables have a capacity of 100 tons per day. George W. Parshall is mill superintendent. ——The zinc orebody at 1200 ft. and the lead-silver shoot on the same level are developing well in the Tintic Standard at Tintic. E. J. Raddatz is manager.——Four feet of 125-oz. silver ore has been opened in the May Day. J. C. Dick is manager.

Salt Lake County

The Columbus Extension company is now controlled by A. O. Jacobson and associates. Miners are driving an adit to cut the same contact rocks in which the Cardiff ore occurs, about 4000 ft. away. Machine-drills are used.——Smelter returns from ore sent by the Wasatch Mines Co.'s Columbus Consolidated, in the Alta district, yielded $75 per ton net.

Tooele County

At the Buffalo Consolidated, in the Ophir district, ore assaying 150 oz. silver, 0.21 oz. gold, and 10.8% lead is being blocked out. Two shipments sent out by a lessee contained 136.8 and 164.1 oz. silver, 0.21 and 0.20 oz. gold, and 10.4 and 11.5% lead respectively.

WASHINGTON

Okanogan County

A new furnace to treat antimony ore from the Lucky Knock mine, near Whitestone mountain, is to be installed, according to advice from Tonasket. The deposit is considerable, and near a railway.

CANADA

British Columbia

The steamer *Amur* recently arrived at Seattle from Granby bay with 550 tons (1,100,000 lb.) of copper from the Granby company's smelter at Anyox. This is the first shipment for some time.

Ontario

The Beaver Consolidated shaft is down 920 ft. The rich shoot cut at 530 ft. has been proved at 460 ft. also.——The Nipissing company will pay a 5% dividend on January 20, amounting to $300,000. On December 19 the financial position was as follows: cash in bank, $401,410; bullion in transit, $420,937; ore on hand and in process, and bullion ready for shipment, $467,206; total, $1,289,553. About 600,000 oz. silver has since been sent to England.——During the year ended October 31 the Coniagas mine produced 2,497,395 oz. silver, about 1,000,000 oz. less than the previous year. The output to date is 20,160,389 oz. Dividends amounted to $1,320,000, making $7,000,000 since November 1906. Ore reserves are estimated to contain 11,904,000 oz. Cost of mining and concentrating was 12.444c. per oz., including all general charges and royalty, but not shipping, smelting, refining, and marketing, which totaled 3.585c. per ounce.

The Dome Lake, at Porcupine, has shipped its first bars of gold.

PERSONAL

Noel Cunningham is in Arizona.

A. C. Lawson has returned from Tonopah.

E. H. Lysle was in Los Angeles this week.

William H. L. Benedict is in San Francisco this week.

S. J. Kinnon is manager for the Ernestine company at Mogollon, New Mexico.

C. W. Purington has returned from the Lenskoi mines and left London for Boston, December 15.

Howland Bancroft has gone to British Columbia, expecting to return to Denver about the middle of January.

Albert Burch has resigned as manager for the Goldfield Consolidated Mines Co., retaining his position as a director and consulting engineer. J. W. Hutchinson has been made general manager and K. M. Simpson assistant general manager.

Obituary

Hugo DuBois, secretary for the Roessler & Hasslacher Chemical Co., a member of the American Electrochemical Society since March 27, 1909, died August 13, 1914.

A. K. Beatson, who died December 16 at Los Angeles, was most generally known as the discoverer and long time manager of the Bonanza copper mine on La Touche island, near Valdez, Alaska. He was one of the older generation of Pacific coast mining men, and prior to going to Alaska had been actively connected with various mining enterprises in California. One of the tunnels now used by the Great Western Power Co. was driven by him originally in connection with mining. He was long superintendent for the Big Bend T. & M. Co. In 1901 he was one of the original locators of the claims on La Touche with which his name is especially connected, and he managed the property up to 1910, when control was purchased by the Guggenheims, Beatson remaining a director. Since 1910 he has lived in California. The La Touche, Bonanza, which is often confused with the other Bonanza mine owned by the Alaska syndicate at Kennicott, stands as a monument to his insight and persistence in the face of many difficulties and discouragements.

SCHOOLS AND SOCIETIES

The annual meeting of the American Institute of Mining Engineers will be held in New York February 15 to 18 inclusive.

The annual meeting of the Mining and Metallurgical Society of America will be held at the Engineers Club, New York, January 12.

The American Institute of Electrical Engineers held its 302nd meeting in New York on December 11. Two papers discussed the subject of insulators.

The Utah branch of the A. I. M. E. will hold an executive meeting at Salt Lake City on January 15. The necessary committees and program will be arranged for 1915.

The Geological Society of America will meet at San Francisco the first week in August in connection with the meeting of the American Association for the Advancement of Science. The Cordilleran section of the Society will act as host.

The Faraday Society held its annual meeting in London on November 23. Sir Robert Hadfield, of steel fame, was elected president for 1914-15. Several interesting papers were read.

THE MARKET PLACE

Weekly Summary of Prices of Shares and Metals

Metal Prices

San Francisco, December 31.

Antimony	15 —15¾
Electrolytic copper	13½—14
Pig lead	4.05—5.00
Quicksilver (flask)	$52.50
Spelter	7 — 7¼
Tin	34½—36
Zinc dust, 100-kg. zinc-lined cases	9

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, December 31.—Copper is quiet at 12.75c., lead dull at 3.80c., and spelter steady at 5.40c. per pound. November outputs of Chino, Nevada Consolidated, Ray, and Utah Copper were 3,047,694, 2,612,071, 3,196,457, and 6,668,040 lb. respectively. Inspiration balance sheet as at October 31 shows $2,195,231 cash.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending		
Dec.	24	12.75	Nov. 18	11.75
"	25 Holiday		" 25	12 25 to 12.50
"	26 Holiday		Dec. 2	12.62
"	27 Sunday		" 9	12.73
"	28	12.75	" 16	12.70
"	29	12 75	" 23	12.84
"	30	12.75	" 30	12.75

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	16 54	11.21	July	14.21	13 26
Feb	14.93	14.46	Aug.	15.12	12.34
Mch.	14.72	14.11	Sept.	16.23	12.02
Apr	15.22	14 19	Oct.	16.31	11.10
May	15.42	13.97	Nov.	15.08	11.75
June	14.71	13.60	Dec.	14.25	....

The copper market held steady last week, which was satisfactory, as present domestic consumption is not much over 50% of normal. There has been talk of the possibility of increasing the output if the price continues to rise, but this can hardly happen, as refineries undoubtedly have large stocks, with no immediate prospect of reducing them.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending		
Dec.	24	3.80	Nov. 18	3 70
"	25 Holiday		" 25	3.90
"	26 Holiday		Dec. 2	3.80
"	27 Sunday		" 9	3.80
"	28	3.80	" 16	3.80
"	29	3.80	" 23	3.80
"	30	3.80	" 30	3.80

Monthly averages.

	1913.	1914.		1913.	1914
Jan	4.28	4.11	July	4.35	3.80
Feb.	4.33	4.02	Aug.	4.60	3.86
Mch.	4.32	3.94	Sept.	4.70	3.82
Apr	4.36	3.86	Oct.	4.37	3.60
May	4.34	3.90	Nov.	4.16	3.68
June	4.33	3.90	Dec.	4.02	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound

Date.		Average week ending		
Dec.	24	5.40	Nov. 18	5.00
"	25 Holiday		" 25	5.10
"	26 Holiday		Dec. 2	5.20
"	27 Sunday		" 9	5.50
"	28	5.40	" 16	5.50
"	29	5.40	" 23	5.37
"	30	5.40	" 30	5.40

Monthly averages.

	1913.	1914.		1913.	1914.
Jan	6.88	5.14	July	5.11	4.75
Feb	6.13	5.22	Aug.	5.51	5.45
Mch.	5 94	5.12	Sept.	5.55	5.16
Apr.	5.52	4.98	Oct.	5.22	4.75
May	5 23	4.91	Nov.	5.09	5.01
June	5.00	4.84	Dec.	5.07	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Dec. 3	55.00	Dec. 17	52.50
" 10	52.50	" 24	53.00
		" 31	52 50

Monthly averages.

	1913.	1914.		1913.	1914
Jan.	39.37	39.25	July	41.00	37.50
Feb.	41.00	39.00	Aug.	40.50	80.00
Mar.	40.20	39.00	Sept.	39.70	76.25
Apr.	41.00	38.90	Oct.	39.37	53.00
May	40.25	39.00	Nov.	39.40	55.00
June	41.00	38.60	Dec.	40.00	53.10

Imports into England in November totaled 632, and exports 1217 flasks. For 10 months the totals were 37,325 and 19,776 flasks respectively. The average in November was £11 2s.6d., or $53.10 per flask.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	50.45	37.85	July	40.70	31.60
Feb.	43.07	39.76	Aug.	41.75	50.20
Mch.	46.95	38.10	Sept.	42.45	33.10
Apr.	43.00	36.10	Oct.	40.61	30.40
May	43 10	33.29	Nov.	39.77	33.51
June	45.10	30.72	Dec.	37.57	....

Tin is dull at 32.75 to 33 50c. The market in December is discussed on the following page of this issue.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.		Average week ending		
Dec.	24	48.37	Dec. 2	49 33
"	25 Holiday		" 9	49.93
"	26 Holiday		" 16	49.83
"	27 Sunday		" 23	48.66
"	28	48.75	" 30	48.65
"	29	48.75		
"	30	48.87		

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	63.01	57.58	July	58.70	54.90
Feb.	61.25	57.53	Aug.	59 32	54 35
Mch.	57.87	58.01	Sept.	60.53	53.75
Apr.	59.26	58 52	Oct.	60.88	51.12
May	60.21	58.21	Nov.	58.76	49.12
June	59.03	56.43	Dec.	57.73	....

The market is somewhat weak and erratic. Cobalt mines are sending large quantities to England. In the week ended December 19, exports totaled 320,377 oz., and during half of the next week the total was 375,519 oz. The Beaver Consolidated has 200,000 oz. at the mine. The tone in England has been fairly good, according to Samuel Montagu & Co. Purchases on account of China have afforded some competition, and have put a little animation into the market. The demand for this quarter arises from the approach of the Chinese New Year, which commences on February 14, 1915.

The recurrence of this festival each year is accompanied with a settlement of outstanding accounts between the Chinese. They are keen speculators, and holders of cash naturally attempt to tighten rates at this period, and silver has to be bought in this market as a counter stroke. The silver may or may not be shipped actually to China. In any case, buying goes on more or less until the contending parties come to terms. For this reason any hardening effect upon prices from these purchases, made just before the Chinese New Year, may prove but temporary, for the silver thus acquired, or a portion of it, may be re-sold when the cash holder has lost his power to squeeze. The amount of supplies each day during the second week of December in London has been singularly unequal, and as demand also has been erratic, the result was curious. The price has risen when supplies have been large and fallen when they were exceptionally small.

Exports of silver from London to the Orient to December 10 totaled £5,099,500, or say 51,000,000 oz., less than in the same period of 1913.

Current Prices for Oils and Candles

(Corrected monthly by Standard Oil Co. California.)

All prices are f.o.b. San Francisco except where otherwise specified, and are subject to change without notice.

Granite Mining Candles	Per set, cents	Granite Mining Candles	Per set, cents
6s-12 oz.-10s	8¾	6s-14 oz.-20s	9½
6s-12 oz.-20s	9	6s-16 oz.-10s	10
6s-14 oz.-10s	9¾	6s-16 oz.-20s	10¾

Extra hard 1c per set higher than the above.

The following prices are for oils (Calol) in wood barrels, cases (2-5 gal.) 3c per gallon higher.

	Per gal., cents.		Per gal., cents.
Compressor oil	40	Light gas engine oil	28
Amber gas engine oil	40	Red compressor oil	26
Castor machine oil	20	Red engine oil	17
Dynamo and motor oil	24	Turbine oil	35
Engine oil	24	Turbine oil, heavy	35
Gas engine oil	26	Diesel engine oil	40
Heavy gas engine oil	45	Cylinder oil	37
Heavy red engine oil	19	High-pressure cylinder oil	50
Heavy red journal oil	21	Low-pressure cylinder oil	37
Ice machine oil	28	Valve oil	44

The following prices are for oils in iron barrels, cases (2-5 gal.) 7c per gallon higher, except on Eocene, which is 8c. per gallon higher.

	Per gal., cents.		Per gal., cents.
Pearl oil	9	Engine distillate	7
Headlight oil	10	Vrotums	15
Eocene oil	11	V. M. and P. naptha	11½
Red Crown gasoline	12½		

	Per bbl.
Star fuel oil, f.o.b. Richmond Refinery	$0.85

	Per ton.
Petrolastic cement X	$13.00
Petrolastic cement XX	12.00
Asphaltum	$5.50 to 12.50

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted, except as noted, f.o.b. San Francisco. Buying prices marked *.

	Min.	Max.
Antimony ore, 45 to 55%, per ton	$27.00	$33.00
Arsenic, white, refined, per lb.	0.05	0.06
Arsenic, red, refined, per lb.	0.12	0.15
Asbestos, chrysotile	100.00	350.00
Asbestos, amphibole	5.00	7.50
Asphaltum, refined, per ton	11.50	20.00
Barium chloride, commercial, per ton	50.00	60.00
Barium sulphate (barytes), prepared, per ton.	20.00	30.00
Bismuth ore, 15%, per ton	*250.00	upward
China clay, English, levigated, per ton	15.00	20.00
Chrome ore, according to quality, per ton	7.50	10.00
Cobalt metal, refined, f.o.b. London, per lb.	1.90	....
Coke, foundry, per 2240 lb.	12.00	15.00
Diamonds (according to size and quality):		
Borts, per carat	2.00	15.00
Carbons, per carat	55.00	80.00
Feldspar, per ton	5.00	25.00
Firebrick:		
Silica, per M.	50.00	55.00
Snowball, per M.	40.00	45.00
Flint pebbles for tube-mills, Danish, per 2240 lb	24.00	28.00
Fluorspar, per ton	10.00	15.00
Fuller's earth, according to quality, per ton	20.00	30.00
Gilsonite, per ton	35.00	40.00
Graphite:		
Amorphous, per lb.	0.01	0.02½
Crystalline, per lb.	0.04	0.13
Gypsum, per ton	5.00	7.50
Infusorial earth, per ton	10.00	15.00
Iridium	55.00	....
Magnesite, crude, per ton	5.00	7.50
Magnesite, dead calcined, per ton	20.00	25.00
Manganese ore, oxide, crude, per ton	10.00	15.00
Manganese, prepared, according to quality, per ton	30.00	70.00
Mica, according to size and quality, per lb.	$0.05	$1.00
Mercury, 76 lbs.	100.00	110.00
Molybdenite, 85% MoS2 per ton	100.00	200.00
Monazite sand (6% thorium) per ton	150.00	200.00
Nickel metal, refined, per lb.	0.45	0.60
Oxide, extra strength, levigated, per 100 lb.	2.00	....
Oxide, precipitated, per oz.	50.00	60.00
Platinum, native, crude, per oz.	40.00	45.00
Selex lining for tube mills, per 2240 lb.	15.00	17.50
Sulphur, crude, per ton	25.00	30.00
Talc, prepared according to quality, per ton	20.00	30.00
Tin ore, 60%, per ton	425.00	450.00
Tungsten ore, 65%	400.00	425.00
Uranium ore, 10% min.	25.00 per unit	
Vanadium ore, 15% V2O5 per ton	150.00	180.00
Wolframite (see tungsten ore).		
Zinc ore, 50% up, per ton	*15.00	20.00

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Heimann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are f.o.b. San Francisco and subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66°, drums, per 100 lb.	$ 0.80	$ 1.10
Acid, sulphuric, com'l, 66°, carboy, per 100 lb.	1.25	2.00
Acid, sulphuric, C. P., 9-lb. bottle, bbl., per lb.	0.13	0.18
Acid, sulphuric, C. P., bulk, carboy, per lb.	0.09½	0.12
Acid, muriatic, com'l, carboy, per 100 lb.	1.60	3.00
Acid, muriatic, C. P., 6-lb. bottle, bbl., per lb.	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, per lb.	0.10½	0.15
Acid, nitric, com'l, carboy, per 100 lb.	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., per lb.	0.16	0.22
Acid, nitric, C. P., bulk, carboy, per lb*	0.12½	0.15
Argols, ground, bbl., per lb.	0.10	0.20
Borax, cryst. and conc., bags, per 100 lb.	3.00	4.35
Borax, powdered, bbl., per 100 lb.	3.38	4.50
Borax glass, gd. 30 mesh, cases, tin lined, per 100 lb.	10.50	14.00
Bone ash, 60 to 80 mesh, bbl., per 100 lb.	0.50	6.50
Bromine, 1-lb. bottle, per lb.	0.55	0.65
Clay, domestic fire, sack, per 100 lb.	1.50	2.00
Cyanide, 98 to 100%, 100-lb. case, per lb.	No quotes	
Cyanide, 98 to 100%, 200-lb. case, per lb.	"	"
Cyanide, 129%, 100-lb. case, per lb.	"	"
Cyanide, 129%, 200-lb. case, per lb.	"	"
Lead acetate, brown broken, casks, per 100 lb.	9.00	10.50
Lead acetate, white broken, casks, per 100 lb.	10.50	10.75
Lead acetate, brown broken, casks, per 100 lb.	9.00	10.50
Lead acetate, white, crystals, per 100 lb.	12.50	13.25
Lead, C. P., test, gran., per 100 lb.	13.00	15.00
Lead, C. P., sheet, per 100 lb.	15.00	18.00
Litharge, C. P., silver free, per 100 lb.	11.50	13.50
Litharge, com'l, per 100 lb.	8.00	9.50
Manganese ox., blk., dom. in bags, per ton.	20.00	25.00
Manganese ox., blk., Caucasian, in casks, per ton (85% MnO_2—¾% Fe)	65.00	120.00
Nitre, double ref'd., small cryst., bbl., per 100 lb.	9.00	11.00
Nitre, double ref'd., granular, bbl., per 100 lb.	8.50	10.50
Nitre, double ref'd., powdered, bbl., per 100 lb.	9.25	11.25
Potassium bicarbonate, cryst., per 100 lb.	14.00	16.00
Potassium carbonate, calcined, per 100 lb.	18.00	30.00
Potassium permanganate, drum, per lb.	0.20	0.30
Silica, powdered, bags, per lb.	0.03	0.05
	Min.	Max.
Soda, carbonate (ash), bbl., per 100 lb.	1.45	1.75
Soda, bicarbonate, bbl., per 100 lb.	2.00	2.50
Soda, caustic, ground, 98%, bbl., per 100 lb.	2.75	3.25
Soda, caustic, solid, 98%, drums, per 100 lb.	2.50	2.75
Zinc shavings, 850 fine, bbl., per 100 lb.	12.00	14.00
Zinc sheet, No. 9—18 by 84, drum, per 100 lb.	No quotes	

*Extra charge for packing nitric acid for shipment to conform to regulations.

Roessler & Hasslacher quoted as follows on December 15:

Ammonia, anhydrous, in 50-lb. cylinders, per lb.	$0.27
Arsenic, white powder, in 500-lb. bbl., per lb.	0.06
Cobalt oxide, black, in 10-lb. tins, per lb.	1.05
Cyanide, potassium, 38.4% cyanogen, per lb.	0.25
Cyanide, sodium, 51% cyanogen, per lb.	0.25
Sodium, metallic, in 1-lb. tins, per lb.	0.40

Further progress has been made in re-establishing general normal prices.

New York Metal Review

The last month of 1914 was a quiet one in all the metals so far as domestic demand went, but the situation was helped out by sports of buying for export or for the manufacture of goods which are to be exported. This was notably so in copper, lead, and spelter. The tone of the market is more cheerful than it has been, and it is believed that domestic consumers of copper will enter the market strong in January. The decision of the Interstate Commerce Commission, granting to Eastern railroads an increase in freight rates, has had a good effect, although the companies have not yet released on board-cars requisitions. Their needs are known to be great, but while this is so, it is thought they will proceed conservatively, despite the favorable decision. But no one denies that they will be a more nearly normal factor in the market. In iron and steel lines there was better buying, especially for first-quarter delivery in December, but it was done at rock-bottom prices, which the market already is showing a tendency to leave. The heavy buying of various kinds of machinery for export has continued, and the total of sales runs into millions. The United States Steel Corporation announced that it would not cut wages, a proposition which had been discussed, and Mr. Gary, the chairman, made the statement that there are evidences of a change for the better. Wall Street houses are restoring their employees to three-quarters or full pay, money is easier, and the Christmas retail trade in New York city was better than merchants had expected it would be. Copper advanced, and lost but little after the rise. Exports of lead and spelter had been heavy, and the latter advanced in price. The tin market was quiet, and prices were fairly even, despite a scarcity of spot metal. Antimony declined in a dull market.

COPPER

December opened and finished quietly, though events of the month caused prices to rise, and the advance was held fairly well. In the first eight days, the quotation for electrolytic was 12.75c. cash, New York but on December 9 there was an advance to 12.87½c. Then came frequent advances until December 15, when the New York quotation was 13.37½c. cash, a level which was maintained until December 21, when there was a drop to 13.25c. Up to the time 12.75c. cash, or 12.87½c. 30 days, delivered, was reached, a large business was done, but consumers refused to follow the market up. In the first week of December the larger selling agencies made an effort to establish 13c., full terms, as the market, but the buyers would have none of it, and 12.75c. cash was adhered to for the time. It should be noted that at this time future deliveries were commanding an advance of about ½c. over prompt copper. The cause for the advances which started December 9 was heavy purchasing on the part of Europe. At no time was domestic demand for electrolytic anywhere near normal, and the trade does not expect much activity on the part of home consumers until about the middle of January. Lake copper, on the other hand, has sold well as a direct or indirect result of the war. Certain brands of some producers of Lake are understood to be practically exhausted. The quotation for prime Lake on December 1 was 13c. cash New York, but on December 11 it started upward, advancing ½c. per day, until 13.62½c. was reached December 15. The following day the price declined to 13.50c., where it was December 24. Good business was done at 13.50c., and still more could have been done had sellers been willing to grant concessions. Special brands of Lake commanded premiums. According to statistics prepared by the Department of Commerce at Washington, the copper exports to Europe in the first three weeks of December reached a total of 30,724,367 lb. Of this amount, nearly half, or 14,862,158 lb., was exported in the week ended December 19. France took 6,976,996 lb., Italy 3,457,042 lb., and England 3,209,461 lb. in that week. Henry R. Merton & Co., London, reported the stock of copper in Europe, November 30, to be about 31,749 tons, against 31,565 tons November 14, and 19,757 tons November 13, 1913. On December 1 the quotation for hot-rolled sheet copper was advanced ½c. to 18c., and again on December 15 to 18½ cents.

LEAD

The trade was greatly surprised when the largest producer announced a reduction of 10 points, November 28, making the New York price 3.80c. and that at St. Louis 3.67½c., quotations which held until late in December, although the St. Louis market showed weakness. Prior to the drop, the metal was regarded as strong. The most plausible reason for the cut was that outside sellers had been cutting 3.90c. While the domestic demand was poor, exports were good. The largest consignment of pig lead which ever left this country was aboard the steamer *Indrakuala*, which cleared for Vladivostok in November. On the steamer *Kursk*, which cleared for Archangel, November 20, was 1300 tons. In England metal for early delivery was reported as scarce on December 11.

SPELTER

Heavy buying of spelter for foreign consumption sent quotations up in December, after which came a decline, but not all of the advance was lost. The New York prices were as follows: December 1, 5.35c.; 8, 5.65c.; 15, 5.80c.; and 22, 5.65c. Russia has been a heavy buyer of spelter. In England the imports totaled 6432 tons in November, only half of what they were in the same month a year ago. A factor in sustaining the market is the fact that the supply of ore is not over plentiful.

TIN

Throughout December the spot supply of tin was short, and had there been any big demand prices would have soared. Up to December 24, only 650 tons had arrived, though on that day there was 2585 tons afloat. Nearly all of the latter, however, was due to arrive December 31 or early in January, and consequently could not be used to make December deliveries. The quotation December 1 was 33.15c. New York; 8th, 32.50c.; 15th, 34.75c.; and 22nd, 33.30c. Buying was spotty and mostly for future delivery. A curious circumstance was the buying of about 200 tons of tin in the New York market for export to Russia. This the trade could not understand, as London would seem to be the natural market for Russia. The announcement of the freight rate advance granted to Eastern railroads tended to stimulate the market, but the effect was not great. The stock of unsold Banca tin in Holland, November 30, was 3944 tons, against 160 tons on the same date in 1913. The deliveries in November totaled 2600 tons, of which 400 tons came from Pacific ports.

ANTIMONY

The market was dull and prices were weak throughout the month. The quotations December 1 were 17 to 18c. for Cookson's, 15 to 16c. for Hallett's, and 13.50 to 14.50c. for Chinese. December 24, prices quoted were 14.50 to 15c., 13.50 to 14c., and 12.50 to 13c., respectively.

ALUMINUM

Spot aluminum in ton lots was nominally quoted at 18 50 to 19.50c. at the end of December.

JOPLIN ore prices the last week of 1914 were the highest they attained in 1914, the basis range being from $50 to $52, basis of 60% metallic zinc. Few producers accepted as low as $50, base, while, on the other hand, not a great many carload lots brought as high as $52. An average settlement of $51.50 was made, with the buying extremely heavy, with the exception of one high-grade ore buyer.

COMPANY REPORTS

GREAT FOULDER PERSEVERANCE GOLD MINING CO. LIMITED

During the quarter ended September 30 1914, this Kalgoorlie company did 1,429 ft. of development. Work on the lode near the main shaft at 2200 ft. promises to yield profitable ore. The stock of broken ore in stopes is 233,440 ons, assaying $5.76 per ton. The mill treated 67,097 tons, yielding 16,258 oz. gold and 3155 oz. silver worth $326,000. Working costs totaled $4.25 per ton, and the profit above operation and capital expenditure was $44,000.

KALGURLI GOLD MINES, LTD.

The report of this Kalgoorlie company covers the year ended July 31 1914. Development footage totaled 2665 ft. also 427' ft. of diamond-drilling and 2638 ft. of sample holes. The drill was used extensively for testing the deeper ground, but nothing encouraging was discovered. On or below 1850 ft., 2778 ft. of drilling has been done in calc-schist, the ore-bodies on the east and west on reaching the contact between this rock and quartz-diabase split up and apparently gradually cut out. The opinion of J. Malcolm Maclaren, as published in the *Press* of November 8, 1913, has been confirmed in this work. Reserves, although difficult to estimate, are placed at 200,000 tons, according to the general manager, R. S. Black.

The mill treated 127,870 tons of ore with 92.43% extraction. The income was £256,185, of which the profit was £101,330. Adding £11,121 from the previous year, there was available £112,451, of which £96,000 was paid in dividends, leaving a balance of £16,451.

The output to date is as follows: 1,348,290 tons, £3,604,692 gold, and £1,444,500 in dividends.

STRATTON'S INDEPENDENCE, LTD.

The report of this well known Colorado company deals with the year ended June 30, 1914. The report of the consulting engineers and acting managers, Philip Argall & Sons; the mine superintendent, Erick Johnson; and mill superintendent, W. H. Harrison, contains the following notes:

Development totaled 2311 ft. on Company and lessee account. There were 66 men employed by the Company, of whom 33 were mining on the surface, and 44 lessees' men. Development was mainly directed to proving the mill veins at greater depth, and following them south into the granite area. This resulted in opening new ore, as over 93% of the shipping ore on Company account came from these veins. They are the sole source of shipping ore mined by the Company, and have yielded $237,992 to date. The estimated output for the current year is 60,000 tons. The grade is low, having averaged $2.84 per ton during the year under review. Work on the southern spurs of the Bobtail vein on No. 2 and 4 levels was not satisfactory. Lessees' operations in the Independence claim did not yield anything important. The Washington claim is still worked under lease. The vein at 1150 ft. is worthless. The claim produced $25,258 net, yielding a royalty of $7935. As the mill veins may pass into this area, the output may increase this year. The output of the Company and lessees in the whole property showed a decrease of $29,277 and $53,832 respectively, compared with last year. The dumps are now scattered and are costly to remove, but there should be enough for the mill for two years.

Lessees shipped 7783 tons of sorted ore valued at $158,173, against 10,314 tons and $229,528 in the previous year. Freight and treatment cost $48,744, while the royalty, etc., to the Company was $34,992, or 31.97%, leaving $74,437 net. The mill treated 369 tons of lessees' ore, giving $1068 net and $[illegible] to the Company. Sorted ore shipped amounted to [illegible] tons, worth $[illegible], against 420 tons and $[illegible] last year. After paying freight and treatment there was a net return of $[illegible]. Company ore to the mill was [illegible] tons, averaging $[illegible] per ton, yielding a profit of $[illegible], compared with [illegible] tons, $[illegible] and $[illegible] in the previous term.

The mill treated a total of 133,875 tons of mixed ores, and made a profit of $[illegible]. Details of costs, etc., will be given in another issue of this journal.

The revenue account of the Company shows a net total of $[illegible], of which $[illegible] was net profit. Adding the previous balance of $[illegible] there was $95,000 available. A dividend of [illegible] was paid on December 10, amounting to $29,800. Cash on hand and in banks in London and Cripple Creek totaled $98,000.

ASHANTI GOLDFIELDS CORPORATION, LTD.

This Company is the most important in West Africa, and the report of the consulting engineer, W. R. Feldtmann, covers the year ended June 30, 1914. The ramifications of the Company are somewhat of a wide scope, and cover operations at several mines outside prospects, power-plant, and three

MAP OF WEST AFRICAN GOLDFIELDS.

treatment plants. The manager at the mines is John Swan Watkins. The native labor situation was good, and owing to the cocoa industry being somewhat depressed, there is a surplus of natives available.

Prospecting and development work amounted to 18,278 ft., at a cost of £55,493, or $14.50 per foot. Ore reserves are as follows:

Mine.	Tons.	Assay value.
Ashanti main workings	34,100	$21.08
Ashanti Obuasi shoot	213,400	27.30
Ayeinm	120,000	10.00
Justice's	65,000	11.00
Total and average	432,500	$19.56

This is an increase of 67,200 tons. The gross value is £1,797,000, of which there would be £653,100 profit.

The Central treatment plant, using roasting and direct cyanidation, dealt with 97,293 tons of ore yielding $20 per ton, with 93.2% extraction. The Côte d'Or filter-press plant treated 16,915 tons yielding $9.40 per ton, with 80.1% recovery. The Côte d'Or plant also treated 15,501 tons of tailing giving $2.70 per ton.

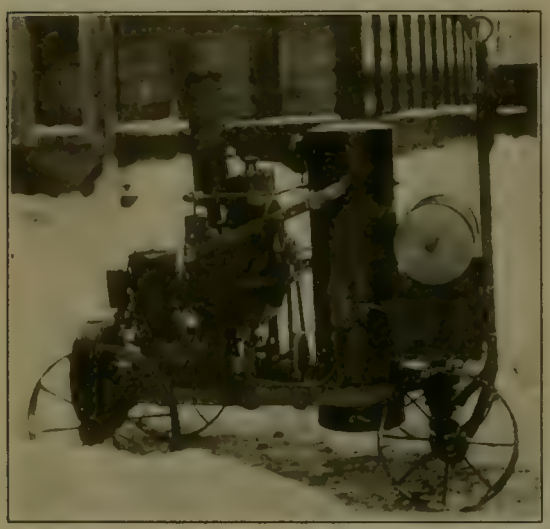
Revenue for the year totaled £441,653, of which £145,731 was profit. The balance of £63,809 from 1912-13 made £209,540 available, of which £147,327 was paid in dividends, making £1,245,864 to date. Construction and equipment expenditure was £30,040.

New Machines and Devices

A Small Portable Air-Compressor

The small gasoline engine driven air-compressor shown in the accompanying illustration has recently been placed on the market by the Ingersoll-Rand Co., of New York. This small compressor has been designed to meet the requirements of small operations and those of a temporary character where air tools of various types are used. The compressor has been found particularly adapted to rock cutting, calking joints, drilling, riveting, tamping, and other purposes. As is well known, compressed air tools have proved their merit on this class of work, and have effected a saving of time and labor over hand methods.

The compressor being portable and self-contained, is well



Portable Compressor

adapted to this work. It is operated by a single-cylinder gasoline engine which is coupled directly to the compressor, both pistons working on the same crank-shaft. The engine is of the single-action two-cycle type. The air-compressor is one of the Company's standard types, known as 'Imperial XII,' has a capacity of 45 cu. ft. per minute at a pressure of 90 lb. Cooling is provided for by a gear-driven pump and an automobile type radiator with large tank capacity, serving both the compressor and engine. The radiator is assisted by a large fan.

The frame, axles, and wheels are of steel and the front axle is arranged with a swivel connection to the frame, permitting horizontal rotation for turning corners and sufficient vertical movement to accommodate the wheels to the inequalities in the road without strain on the frame. An air receiver tested to 300 lb. water pressure and fitted with safety valve and pressure gage is at one end of the frame. The equipment also includes a gasoline tank of 15-gal. capacity which is supported on a large tool-box. The complete outfit weighs 1500 lb. and is designed for transportation by hand, but can be fitted with tongue and singletree if desired. The compactness of the plant is evidenced by the accompanying illustration.

Commercial Paragraphs

Wood Drill Works, Paterson, N. J., has issued an interesting folder entitled 'Talks by the Drill Master.' Told in narrative form, the old driller relates the story of his experience with Wood rock drills.

A. M. Byers Co., Pittsburgh, Pa., has for distribution a circular entitled 'Meeting the Mine Owner's Demands,' which is devoted to the application of wrought iron pipe to the severe usage of mining operations.

The Denver Fire Clay Co., Denver, Colo., in Bulletin No. 50 discusses the Case muffle type oil-fired assay furnace. The bulletin shows two views of the battery of muffle furnaces in operation at the property of the Consolidated Mining & Smelting Co., of Canada.

The Lunkenheimer Co., Cincinnati, Ohio, is distributing two booklets devoted to 'Ferrenewo' and 'Clip' valves. The 'Ferrenewo' valve is made in globe, angle, and cross patterns, all parts of which are replaceable. The 'Clip' type of gate valve has been manufactured by the Company for a number of years.

C. L. Berger & Sons, Boston, Mass., general catalogue of engineering, surveying, and mining instruments is one of the most complete that has been brought to our attention. Published in book form, this catalogue is complete in every detail, replete with illustrations and containing a large amount of data on the subject of surveying instruments and their application.

The Dodge Manufacturing Co., Mishawaka, Ind., through its New York branch, has received an order from the Alaska Gastineau Mining Co., Seattle, Wash., for 20 sets of special floor stands and worm-geared shafts complete. An order has also been received from the Inspiration Consolidated Copper Co. for $7300 worth of equipment covering shafting and about 25 split clutches for the crushing plant.

The Johns-Manville Co. is the manufacturer of J-M asbestos-sponge felted pipe covering, a product made up of laminations of felt composed of asbestos and finely ground sponge. The materials being naturally cellular, they form the basis of the claim that this covering confines more dead air cells than any other covering and therefore possesses higher heat-insulating value. The Company has recently contracted to equip the high-pressure pipes in the new Utah state capitol with this material.

The Western Electric Co., New York, begins the new year by distributing the first edition of its 1915 Electrical Supply Year Book. This catalogue is a marked departure from the regular publicity literature in the electrical supply field. In place of the manufacturer's list prices which catalogues of this kind have usually carried in the past, this new book announces a complete series of Western Electric list prices upon which a uniform basic discount applies, such a discount indicating to the holder of the catalogue his approximate price on all of the articles listed. Although containing over 1200 pages besides an alphabetical index, it probably weighs less than any general catalogue of this nature which has heretofore been issued. One feature of the book is an advertising bulletin embracing examples of advertising and selling helps which the Company furnishes to its agents in connection with the sale of goods manufactured by the Western Electric Company.

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Engineering and Mining Journal in review of "Metallurgy of Copper," October 17, 1914:

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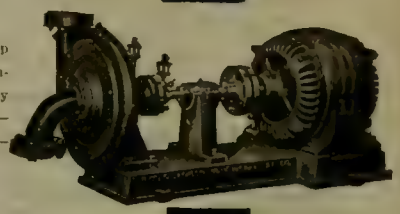

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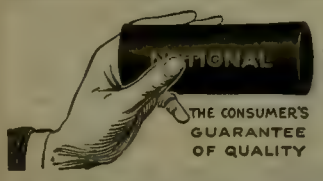

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Page.

Acetylene Lamps
Justrite Mfg. Co.....42

Agitators
Dorr Cyanide Machy. Co.....8
Traylor Eng. & Mfg. Co.....38

Air Brakes
Allis-Chalmers Mfg. Co.....5

Amalgamated Plates
San Francisco Plating Wks.—

Assayers' and Chemists' Directory
See page 22.

Assayers' and Chemists' Supplies
Braun Corporation, The.....25
Braun-Knecht-Heimann Co.25
Denver Fire Clay Co.....33
Mine & Smelter Supply Co..—

Balances and Weights
Ainsworth & Sons, Wm.....37
Braun Corporation, The.....25
Braun-Knecht-Heimann Co.25
Denver Fire Clay Co.....33
Kohlbusch, Herman, Sr.....37
Mine & Smelter Supply Co..—
Salt Lake Hardware Co.....37
Thompson Balance Co.....37
Troemner, Henry 37

Ball Mills
Allis-Chalmers Mfg. Co.....5
Chalmers & Williams.....28
Hardinge Conical Mill Co...28
Traylor Eng. & Mfg. Co.....38

Bearings
Meese & Gottfried Co.....
Back Cover

Belting
Diamond Rubber Co., The..—
Goodrich Co., B. F.....—
Johns-Manville Co., H. W..—
Meese & Gottfried Co.....
Back Cover
Robins Conveying Belt Co..28

Blowers
Allis-Chalmers Mfg. Co.....5
General Electric Co.....13
Hendrie & Bolthoff Mfg. & Supply Co. 2
Worthington, Henry R.....—

Boiler Graphite
Dixon Crucible Co., Joseph.33

Boilers
Allis-Chalmers Mfg. Co.....5
Harron, Rickard & McCone.
Back Cover
Hendrie & Bolthoff Mfg. & Sup. Co. 2
Hendy Iron Works, Joshua. 9
Power & Mining Machy. Co.—
Union Iron Works Co.....—

Books
Mining Press 15, 23, 25, 35 38, 40
Wiley & Sons, John.....—

Boots and Shoes
Putman Boot & Shoe Co....29

Brick, Fire
Atkins, Kroll & Co.....26
Braun Corporation, The.....25
Braun-Knecht-Heimann Co.25
Denver Fire Clay Co.....33

Briquetting Machinery
Braun Corporation, The.....25
Braun-Knecht-Heimann Co.25
Traylor Eng. & Mfg. Co.....38

Buckets
Allis-Chalmers Mfg. Co.....5
Broderick & Bascom Rope Co. 47
Harron, Rickard & McCone.
Back Cover
Hendrie & Bolthoff Mfg. & Sup. Co. 2
Hendy Iron Works, Joshua. 9
Leschen & Sons Rope Co., A.29

Page.

Meese & Gottfried Co.....
Back Cover
Robins Conveying Belt Co..28
Watt Mining Car Wheel Co.27
Wellman-Seaver-Morgan Co.45

Burners, Oil
Braun Corporation, The.....25
Braun-Knecht-Heimann Co.25
Denver Fire Clay Co.....33
Harron, Rickard & McCone.
Back Cover

Cableways, Suspension
Broderick & Bascom Rope Co. 47
Flory Mfg. Co., S.....29
Leschen & Sons Rope Co., A.29
Painter Tramway Co.....28
U. S. Steel Products Co.....41

Cages
Chalmers & Williams.....28
Hendrie & Bolthoff Mfg. & Sup. Co. 2
Hendy Iron Works, Joshua. 9
Traylor Eng. & Mfg. Co.....38
Union Iron Works Co.....—
Wellman-Seaver-Morgan Co.45

Carbone, Borts, and Diamonds
Atkins, Kroll & Co.....26

Cars
Allis-Chalmers Mfg. Co.....5
Atlas Car & Mfg. Co.....28
Demarest Co., D. D.....29
Harron, Rickard & McCone.
Back Cover
Hendrie & Bolthoff Mfg. & Sup. Co. 2
Hendy Iron Works, Joshua. 9
Mine & Smelter Supply Co..—
Traylor Eng. & Mfg. Co.....38
Watt Mining Car Wheel Co.27
Wellman-Seaver-Morgan Co.45

Castings
Lunkenheimer Co. 39
Taylor-Wharton Iron & Steel Co. 28
Yuba Construction Co.....28

Chain
Harron, Rickard & McCone.
Back Cover
Meese & Gottfried Co.....
Back Cover
Robins Conveying Belt Co..28
Taylor-Wharton Iron & Steel Co. 28

Chemicals
Atkins, Kroll & Co.....26
Braun Corporation, The.....25
Braun-Knecht-Heimann Co.25
Denver Fire Clay Co.....33
Mine & Smelter Supply Co..—
Roessler & Hasslacher Chemical Co. 33

Chemists
See page 20.

Chilean Mills
Allis-Chalmers Mfg. Co.....5
Chalmers & Williams.....28
Colorado Iron Works Co....47
Lane Mill & Machy. Co.....8
Power & Mining Machy. Co.—
Traylor Eng. & Mfg. Co.....38

Classifiers
Allis-Chalmers Mfg. Co.....5
Chalmers & Williams.....28
Colorado Iron Works Co....47
Dorr Cyanide Machy. Co....8
Power & Mining Machy. Co.—
Traylor Eng. & Mfg. Co.....38

Clutches, Friction
Harron, Rickard & McCone.
Back Cover
Meese & Gottfried Co.....
Back Cover
Wellman-Seaver-Morgan Co.45

Coal Cutters
Allis-Chalmers Mfg. Co.....5
Ingersoll-Rand Co....**Bulletin**
McKiernan-Terry Drill Co..28
Power & Mining Machy. Co.—
Sullivan Machinery Co.....7

Page.

Coal Handling Machinery
Bartlett & Snow Co., C. O..41

Compressors, Air
Allis-Chalmers Mfg. Co.....5
Chalmers & Williams.....28
Demarest Co., D. D.....29
General Electric Co.....13
Harron, Rickard & McCone.
Back Cover
Hendrie & Bolthoff Mfg. & Sup. Co. 2
Hendy Iron Works, Joshua. 9
Ingersoll-Rand Co....**Bulletin**
Laidlaw-Dunn-Gordon Co...—
McKiernan-Terry Drill Co..28
Nordberg Mfg. Co.....27
Sullivan Machinery Co.....7
Union Iron Works Co.....—

Concentrator Belts
Diamond Rubber Co., The..—
Goodrich Co., B. F.....—

Concentrators
Allis-Chalmers Mfg. Co.....5
Chalmers & Williams.....28
Colorado Iron Works Co....47
Deister Concentrator Co....30
Demarest Co., D. D.....29
Hendrie & Bolthoff Mfg. & Sup. Co. 2
Hendy Iron Works, Joshua. 9
Mine & Smelter Supply Co..—
Power & Mining Machy. Co.—
Senn Concentrator Co.....12
Traylor Eng. & Mfg. Co....38
Union Iron Works Co.....—

Concrete Mixers
Harron, Rickard & McCone.
Back Cover
Power & Mining Machy. Co.—

Condensers
Alberger Pump & Con. Co..28
Allis-Chalmers Mfg. Co.....5
Cameron Steam Pump Wks.35
Prescott Steam Pump Co., Fred M. 40

Contract, Drilling
Longyear Co., E. J.....14

Conveyors, Belt
Allis-Chalmers Mfg. Co.....5
Meese & Gottfried Co.....
Back Cover
Robins Conveying Belt Co..28

Conveyors, Screw
Meese & Gottfried Co.....
Back Cover

Converters
Allis-Chalmers Mfg. Co.....5
Hendrie & Bolthoff Mfg. & Sup. Co. 2
Power & Mining Machy. Co.—
Traylor Eng. & Mfg. Co....38
Union Iron Works Co.....—

Cranes
Wellman-Seaver-Morgan Co.45

Crucibles
Braun Corporation, The.....24
Braun-Knecht-Heimann Co.24
Denver Fire Clay Co.....33
Dixon Crucible Co., Joseph.33
Mine & Smelter Supply Co..—

Crushers
Allis-Chalmers Mfg. Co.....5
Bacon, Earle C. 28
Braun Corporation, The.....25
Braun-Knecht-Heimann Co.25
Chalmers & Williams.....28
Colorado Iron Works Co....47
Denver Fire Clay Co.....33
Denver Quartz Mill & Crusher Co. 29
Harron, Rickard & McCone
Back Cover
Hendrie & Bolthoff Mfg. & Sup. Co. 2
Hendy Iron Works, Joshua. 9
Power & Mining Machy. Co.—
Traylor Eng. & Mfg. Co....38

Page.

Union Iron Works Co.....—
Vulcan Iron Works.....28

Cupels
Braun Corporation, The.....25
Braun-Knecht-Heimann Co.25
Denver Fire Clay Co.....33
Mine & Smelter Supply Co..—

Cyanide Plants and Machinery
Allis-Chalmers Mfg. Co.....5
Chalmers & Williams.....28
Colorado Iron Works Co....47
Demarest Co., D. D.....29
Dorr Cyanide Machy. Co....8
Hammond Iron Works.....33
Hendrie & Bolthoff Mfg. & Sup. Co. 2
Hendy Iron Works, Joshua. 9
Kelly Filter Press Co.....27
Meese & Gottfried Co.....
Back Cover
Mine & Smelter Supply Co..—
Moore Filter Co.....27
Pacific Tank & Pipe Co....46
Power & Mining Machy. Co.—
Redwood Manufacturers Co.38
Traylor Eng. & Mfg. Co....38
Union Iron Works Co.....—

Dewaterers
Colorado Iron Works Co....47
Dorr Cyanide Machy. Co.....8

Distributers
Colorado Iron Works Co....47

Drafting Material
Ainsworth & Sons, Wm.....37
Buff & Buff Mfg. Co.....37
Leitz Co., A. 37

Dredges
Bucyrus Company 15
Marion Steam Shovel Co...—
New York Engineering Co. 10, 11
Union Construction Co.....28
Union Iron Works Co.....—
Yuba Construction Co.....28

Dredging Machinery
American Locomotive Co....44
Bucyrus Company 15
Hendrie & Bolthoff Mfg. & Sup. Co. 2
Marion Steam Shovel Co....—
New York Engineering Co. 10, 11
Robins Conveying Belt Co..28
Seattle Machine Works....41
Taylor-Wharton Iron & Steel Co. 28
Union Construction Co.....28
Union Iron Works Co.....—
Wellman-Seaver-Morgan Co.45
Yuba Construction Co.....28

Drill Makers and Sharpeners
Ingersoll-Rand Co....**Bulletin**

Drilling, Contract
Longyear Co., E. J.....14

Drills, Air and Steam
Demarest Co., D. D.....29
Harron, Rickard & McCone.
Back Cover
Hendrie & Bolthoff Mfg. & Sup. Co. .....
Ingersoll-Rand Co....**Bulletin**
McKiernan-Terry Drill Co..28
Mine & Smelter Supply Co..
Sullivan Machinery Co.....7
Wood Drill Works.....42

Drills, Core
Ingersoll-Rand Co....**Bulletin**
Longyear Co., E. J.....14
McKiernan-Terry Drill Co..28
Sullivan Machinery Co.....7
Union Construction Co.....28

Drills, Electric
Harron, Rickard & McCone.
Back Cover
Ingersoll-Rand Co....**Bulletin**

Drills, Prospecting
Harron, Rickard & McCone
Back Cover

(Continued on page 34).

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WHERE TO BUY

Page.

Ingersoll-Rand Co....**Bulletin**
McKiernan-Terry Drill Co..28
Longyear Co., E. J.....14
New York Engineering Co. 10, 11
Sullivan Machinery Co..... 7

Dynamos

Allis-Chalmers Mfg. Co..... 5
General Electric Co.....13
Hendrie & Bolthoff Mfg. & Sup. Co. 2
Western Electric Co.....—
Westinghouse Electric & Mfg. Co. .....—

Engines, Gas and Gasoline

Allis-Chalmers Mfg. Co..... 5
Hendrie & Bolthoff Mfg. & Sup. Co. 2
Hendy Iron Works, Joshua. 9
Power & Mining Machy. Co.—

Engines, Oil

Allis-Chalmers Mfg. Co..... 5
Busch-Sulzer Bros.-Diesel Engine Co. 30
Snow Steam Pump Works..—

Engines, Steam

Allis-Chalmers Mfg. Co..... 5
Harron, Rickard & McCone. Back Cover
Hendy Iron Works, Joshua. 9
Nordberg Mfg. Co.....27
Traylor Eng. & Mfg. Co....38
Union Iron Works Co.....—
Wellman-Seaver-Morgan Co.45

Explosives

Du Pont Powder Co.....38

Fans, Ventilating

Allis-Chalmers Mfg. Co..... 5
General Electric Co.....13
Harron, Rickard & McCone. Back Cover
Hendrie & Bolthoff Mfg. & Sup. Co. 2
Sullivan Machinery Co..... 7

Filter Presses

Kelly Filter Press Co.....27
Traylor Eng. & Mfg. Co....38

Filters

Chalmers & Williams.....28
Colorado Iron Works Co...47
General Filtration Co.....40
Moore Filter Co.....27
Traylor Eng. & Mfg. Co....38

Fire Brick

Atkins, Kroll & Co.....26
Braun Corporation, The....25
Braun-Knecht-Heimann Co.25
Denver Fire Clay Co.....33

Fittings, Malleable and Cast Iron

National Tube Co.....28

Flanges

American Spiral Pipe Wks..30
Lunkenheimer Co. 39
National Tube Co.....28

Foundry Equipment

Ingersoll-Rand Co....**Bulletin**
Sullivan Machinery Co..... 7
Wellman-Seaver-Morgan Co.45

Frogs and Switches

Johns-Manville Co., H. W..41
U. S. Steel Products Co.....41
Watt Mining Car Wheel Co.27

Furnaces, Assay

Braun Corporation, The....25
Braun-Knecht-Heimann Co.25
Denver Fire Clay Co.....33
Mine & Smelter Supply Co..—

Furnaces, Roasting and Smelting

Allis-Chalmers Mfg. Co..... 5
Colorado Iron Works Co...47
Hendrie & Bolthoff Mfg. & Sup. Co. 2
Power & Mining Machy. Co.—
Traylor Eng. & Mfg. Co....38
Wedge Mechanical Furnace Co. 6

Gas Producers

Power & Mining Machy. Co.—
Wellman-Seaver-Morgan Co.45

Gaskets

American Spiral Pipe Wks..30
Diamond Rubber Co., The..—

Page.

Johns-Manville Co., H. W..41
Smooth-On Mfg. Co.....39

Gears

General Electric Co.....13
Meese & Gottfried Co..... Back Cover
Pacific Gear & Tool Co....29

Generators

Allis-Chalmers Mfg. Co..... 5
General Electric Co.....13
Hendrie & Bolthoff Mfg. & Sup. Co. 2
Western Electric Co.....—
Westinghouse Electric & Mfg. Co. .....—

Giants, Hydraulic

See Hydraulic Mining Machinery.

Graphite Products

Dixon Crucible Co., Joseph.33

Heaters, Feed Water

Alberger Pump & Con. Co..28
Allis-Chalmers Mfg. Co..... 5
Hendrie & Bolthoff Mfg. & Sup. Co. 2
Union Iron Works Co.....—

Hoists, Air

Hendrie & Bolthoff Mfg. & Sup. Co. 2
Mine & Smelter Supply Co..—

Hoists, Electric

Allis-Chalmers Mfg. Co..... 5
Demarest Co., D. D.....29
General Electric Co.....13
Harron, Rickard & McCone. Back Cover
Hendrie & Bolthoff Mfg. & Sup. Co. 2
Hendy Iron Works, Joshua. 9
Lidgerwood Mfg. Co.....43
Nordberg Mfg. Co.....27
Power & Mining Machy. Co.—
Sullivan Machinery Co..... 7
Union Iron Works Co.....—
Wellman-Seaver-Morgan Co.45
Westinghouse Electric & Mfg. Co. .....—

Hoists, Steam

Allis-Chalmers Mfg. Co..... 5
Demarest Co., D. D.....29
Flory Mfg. Co., S.....29
Harron, Rickard & McCone. Back Cover
Hendrie & Bolthoff Mfg. & Sup. Co. 2
Hendy Iron Works, Joshua. 9
Lidgerwood Mfg. Co.....43
Nordberg Mfg. Co.....27
Power & Mining Machy. Co.—
Sullivan Machinery Co..... 7
Union Iron Works Co.....—
Wellman-Seaver-Morgan Co.45

Hose

Diamond Rubber Co.....—
Goodrich Co., B. F.....—
Ingersoll-Rand Co....**Bulletin**
Johns-Manville Co., H. W..41

Hydraulic Mining Machinery

American Spiral Pipe Wks..30
Hendy Iron Works, Joshua. 9
Pelton Water Wheel Co....39
Union Iron Works Co.....—

Injectors

Lunkenheimer Co. 39

Iron Cements

Johns-Manville Co., H. W..41
Smooth-On Mfg. Co.....39

Jaw Plates

Taylor-Wharton Iron & Steel Co. 28

Jigs

Allis-Chalmers Mfg. Co..... 5
Chalmers & Williams.....28
Colorado Iron Works Co...47

Laboratory Supplies

See Assayers' and Chemists' Supplies.

Lamps, Arc and Incandescent

General Electric Co.....13
Johns-Manville Co., H. W..41
Western Electric Co.....—
Westinghouse Electric & Mfg. Co. .....—

Lamps, Miners

Justrite Mfg. Co.....42

Page.

Lead Joint Pipe

National Tube Co.....28

Locomotives, Electric

Atlas Car & Mfg. Co.....28
General Electric Co.....13
Westinghouse Electric & Mfg. Co. .....—

Locomotives, Steam

American Locomotive Co...44
Lima Locomotive Corp.....27

Lubricants

Dixon Crucible Co., Joseph.33

Lubricators

Lunkenheimer Co. 39

Magnesite

Atkins, Kroll & Co.....26

Metal Buyers and Dealers

American Metal Co., Ltd....26
Atkins, Kroll & Co.....26
Beer, Sondheimer & Co.....26
Consolidated Min. & Smelting Co. of Canada, Ltd..26
Empire Zinc Co.....33
International Smelting & Refining Co. 26
Selby Smelting & Lead Co..26
U. S. Smelting, Refining & Mining Co. 26
Vogelstein & Co., L.....26
Wildberg Bros. 26

Mills, Ball and Pebble

Allis-Chalmers Mfg. Co..... 5
Chalmers & Williams.....28
Colorado Iron Works Co....47
Hardinge Conical Mill Co...28
Traylor Eng. & Mfg. Co....38

Mills, Chilean

Allis-Chalmers Mfg. Co..... 5
Chalmers & Williams.....28
Colorado Iron Works Co....47
Lane Mill & Machy. Co....38
Power & Mining Machy. Co.—
Traylor Eng. & Mfg. Co....38
Union Iron Works Co.....—

Motors

Allis-Chalmers Mfg. Co..... 5
General Electric Co.....13
Hendrie & Bolthoff Mfg. & Sup. Co. 2
Hendy Iron Works, Joshua. 9
Mine & Smelter Supply Co..—
Western Electric Co.....—
Westinghouse Electric & Mfg. Co. .....—

Oil, Wood Creosote

Pensacola Tar & Turpentine Co. 29

Oil and Grease Cups

Lunkenheimer Co. 39

Oil Well Supplies

Broderick & Bascom Rope Co. 47
Diamond Rubber Co.....—
Harron, Rickard & McCone. Back Cover
Hendy Iron Works, Joshua. 9
National Tube Co.....28
Union Iron Works Co.....—
U. S. Steel Products Co.....41

Ore Buyers

See Metal Buyers and Dealers
Also see page 22.

Packing

Diamond Rubber Co.....—
Johns-Manville Co., H. W..41

Paper

Blake, Moffit & Towne.....29

Patent Attorneys

Dewey, Strong & Co.....31

Pebbles

Atkins, Kroll & Co.....26
Grace & Co., W. R.....33

Perforated Metals

Allis-Chalmers Mfg. Co..... 5
Ludlow-Saylor Wire Co....45

Pipe Covering

Johns-Manville Co., H. W..41

Page.

Pipe, Riveted

American Spiral Pipe Wks..30
Sacramento Pipe Wks.....—

Pipe, Wood

Pacific Tank & Pipe Co....46
Redwood Manufacturers Co.30

Pipe, Steel

National Tube Co.....30
Sacramento Pipe Works....—

Pipe Threading Machines

Merrell Mfg. Co.....29

Powder

Du Pont Powder Co.....38

Producer, Gas

Power & Mining Machy. Co.—
Wellman-Seaver-Morgan Co.45

Pulleys, Shafting and Hangers

Harron, Rickard & McCone. Back Cover
Hendy Iron Works, Joshua. 9
Meese & Gottfried Co..... Back Cover
Robins Conveying Belt Co..28
Wellman-Seaver-Morgan Co.45

Pulverizers

Allis-Chalmers Mfg. Co..... 5
Braun Corporation, The....25
Braun-Knecht-Heimann Co.25
Chalmers & Williams.....28
Colorado Iron Works Co....47
Denver Fire Clay Co.....33
Denver Quartz Mill & Crusher Co. 29
Hardinge Conical Mill Co...28
Hendy Iron Works, Joshua. 9
Mine & Smelter Supply Co..—
Power & Mining Machy. Co.—
Traylor Eng. & Mfg. Co....38
Wellman-Seaver-Morgan Co.45

Pumps

Alberger Pump & Con. Co..28
Allis-Chalmers Mfg. Co..... 5
Cameron Steam Pump Wks., A. S. 35
Deane Steam Pump Co.....—
Demarest Co., D. D.....29
Deming Co., The.....33
Frenier & Sons.....28
General Electric Co.....13
Harron, Rickard & McCone. Back Cover
Hendrie & Bolthoff Mfg. & Sup. Co. 2
Hendy Iron Works, Joshua. 9
Jackson Iron Works, Byron.27
Jeanesville Iron Works.....—
Krogh Pump Co.....—
Meese & Gottfried Co..... Back Cover
Mine & Smelter Supply Co..—
Prescott Steam Pump Co., Fred M. 40
Union Iron Works Co.....—
Yuba Construction Co.....28

Quicksilver

Atkins, Kroll & Co.....26
Braun-Knecht-Heimann Co.25
Mine & Smelter Supply Co..—

Railway Supplies and Equipment

American Locomotive Co...44
Atlas Car & Mfg. Co.....28
Lima Locomotive Corp.....27
U. S. Steel Products Co....41
Watt Mining Car Wheel Co.27

Rings and Dies

See Jaw Plates.

Rolls, Crushing

Allis-Chalmers Mfg. Co..... 5
Bacon, Earle C.....28
Chalmers & Williams.....28
Colorado Iron Works Co...47
Hendrie & Bolthoff Mfg. & Sup. Co. 2
Hendy Iron Works, Joshua. 9
Lane Mill & Machy. Co....38
Power & Mining Machy. Co.—
Taylor-Wharton Iron & Steel Co. 28
Traylor Eng. & Mfg. Co....38

Roofing

Johns-Manville Co., H. W..41

Rope, Manila and Jute

Broderick & Bascom Rope Co. 47
Leschen & Sons Rope Co., A.29
Meese & Gottfried Co..... Back Cover

(Continued on page 38)

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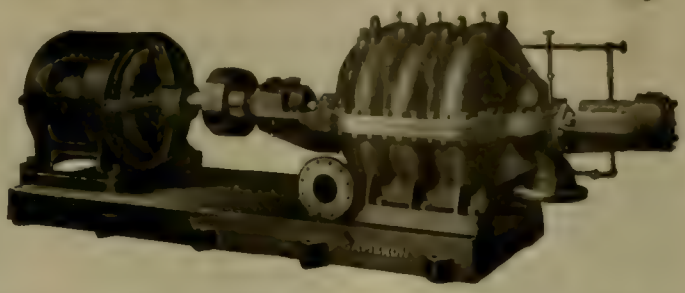

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U. S. Steel Products Co.....41

Samplers
Braun Corporation, The....25
Braun-Knecht-Heimann Co.25
Colorado Iron Works Co....47
Denver Fire Clay Co.....33
Mine & Smelter Supply Co..—
Traylor Eng. & Mfg. Co....38

Saw Mill Machinery
Hendy Iron Works, Joshua. 9

Schools and Colleges
Heald's School of Mines....23
Vander Naillen School, A...23

Screens
Allis-Chalmers Mfg. Co..... 5
Chalmers & Williams.....28
Colorado Iron Works Co....47
Ludlow-Saylor Wire Co....45
Meese & Gottfried Co..... Back Cover
Power & Mining Machy. Co.—
Traylor Eng. & Mfg. Co....38

Second-Hand Machinery
McMaster, D. J.....44
Hallidie Machy. Co.....31

Shafting
See Pulleys, Shafting and Hangers.

Shells and Rings
See Jaw Plates.

Shoes and Dies
Hendy Iron Works, Joshua. 9
Union Iron Works Co.....—

Shovels, Electric and Steam
American Locomotive Co...44
Bucyrus Co., The.....15
Marion Steam Shovel Co....—

Silex
Atkins, Kroll & Co.....26

Smelters and Refiners
Beer, Sondheimer & Co.....26
Consolidated Smelting & Ref. Co. of Canada, Ltd.....26
Empire Zinc Co.....33
International Smelting Co..26
Selby Smelting & Lead Co..26

Page.

U. S. Smelting, Refining & Mining Co.....26
Vogelstein & Co., L.....26

Smelting Machinery
Allis-Chalmers Mfg. Co..... 5
Colorado Iron Works Co....47
Hendrie & Bolthoff Mfg. & Supply Co..... 2
Power & Mining Machy. Co.—
Traylor Eng. & Mfg. Co....38
Union Iron Works Co.....—
Wedge Mechanical Furnace Co. 6

Springs
American Steel & Wire Co..41
Cary Spring Works.....37
U. S. Steel Products Co.....41

Stamp Mills
Allis-Chalmers Mfg. Co..... 5
Chalmers & Williams.....28
Colorado Iron Works Co....47
Demarest Co., D. D.....29
Hendrie & Bolthoff Mfg. & Supply Co..... 2
Hendy Iron Works, Joshua. 9
Moyle Eng. & Equip. Co., E. H. 27
Nordberg Mfg. Co.....27
Power & Mining Machy. Co.—
Traylor Eng. & Mfg. Co....38
Union Iron Works Co.....—
Wellman-Seaver-Morgan Co.45

Stamp Stem Guides
Demarest Co., D. D.....29

Steel, Drill
Harron, Rickard & McCone. Back Cover

Steel, Manganese
Taylor-Wharton Iron & Steel Co. 28

Suction Dredges
Yuba Construction Co.....28

Tanks, Cyanide
Hammond Iron Works Co..33
National Tube Co.....28
Pacific Tank & Pipe Co....46
Power & Mining Machy. Co.—
Redwood Manufacturers Co.28
Traylor Eng. & Mfg. Co....38

Tapes, Measuring
Lufkin Rule Co.....37

Telephones, Mine
Western Electric Co.....—

Thickeners, Slime
Colorado Iron Works Co....47

Page

Dorr Cyanide Machy. Co.... 8
Traylor Eng. & Mfg. Co....38

Tramways, Aerial
Broderick & Bascom Rope Co. 47
Leschen & Sons Rope Co., A.29
Painter Tramway Co.....28
Roebling's Sons Co., John A.27
U. S. Steel Products Co.....41

Transits
Ainsworth & Sons, Wm.....37
Bausch & Lomb Optical Co..—
Buff & Buff Mfg. Co.....37
Leitz Co., A.....37

Transmission Machinery
Allis-Chalmers Mfg. Co..... 5
General Electric Co.....13
Harron, Rickard & McCone. Back Cover
Hendy Iron Works, Joshua. 9
Meese & Gottfried Co..... Back Cover
Robins Conveying Belt Co..28
Taylor-Wharton Iron & Steel Co. 28

Tube Mills
Allis-Chalmers Mfg. Co..... 5
Chalmers & Williams.....28
Colorado Iron Works Co....47
Hardinge Conical Mill Co,..28
Power & Mining Machy. Co.—
Traylor Eng. & Mfg. Co....38
Union Iron Works Co.....—

Tubes
National Tube Co.....28

Turbines, Hydraulic
Allis-Chalmers Mfg. Co..... 5
Hendy Iron Works, Joshua. 9
Pelton Water Wheel Co....39
Wellman-Seaver-Morgan Co.45

Turbines, Steam
Alberger Pump & Con. Co..28
Allis-Chalmers Mfg. Co..... 5
General Electric Co.....13

Unions
Lunkenheimer Co. 39
National Tube Co. 28

Valves
Lunkenheimer Co. 39
National Tube Co. 28
Pelton Water Wheel Co....39

Water Wheels
Hendy Iron Works, Joshua. 9
Pelton Water Wheel Co....39

Page.

Union Iron Works Co.....—
Wellman-Seaver-Morgan Co.45

Waterproof Coating
Johns-Manville Co., H. W...41
Smooth-On Mfg. Co.....39

Weighing Machines
Merrick Scale Mfg. Co.....29

Welding Processes
Goldschmidt Thermit Co....—

Well Drilling Machinery and Supplies
Broderick & Bascom Rope Co. 47
Harron, Rickard & McCone. Back Cover
Union Iron Works Co.....—

Wheels, Car
Watt Mining Car Wheel Co.27

Wire Cloth
Ludlow-Saylor Wire Co....45

Wire Cables
American Steel & Wire Co..41
Broderick & Bascom Rope Co. 47
Leschen & Sons Rope Co., A.27
Painter Tramway Co.....28
Roebling's Sons Co., John A.27
U. S. Steel Products Co.....41

Wire, Insulated
American Steel & Wire Co..41
General Electric Co.....13
Goodrich Co., B. F.....—
U. S. Steel Products Co.....41
Western Electric Co.....—

Zinc Boxes
Braun Corporation, The....25
Braun-Knecht-Heimann Co.25
Chalmers & Williams.....28
Colorado Iron Works Co....47
Denver Fire Clay Co.....33
Hammond Iron Works Co....33
Mine & Smelter Supply Co..—
Pacific Tank & Pipe Co....46
Redwood Manufacturers Co.28
Traylor Eng. & Mfg. Co....34
Union Iron Works Co.....—

Zinc Dust and Shavings
Atkins, Kroll & Co.....26
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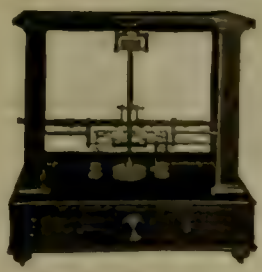

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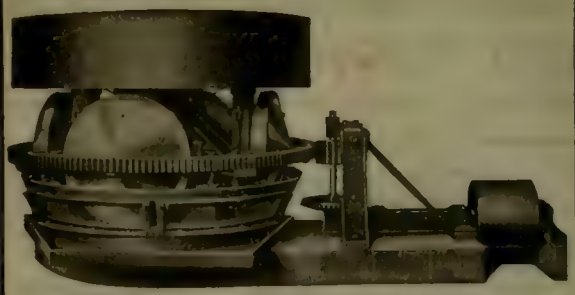

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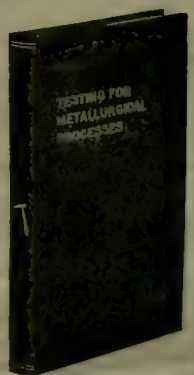

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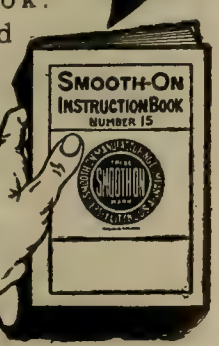

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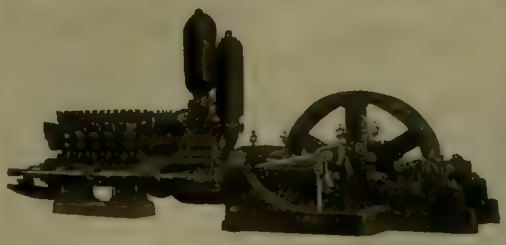

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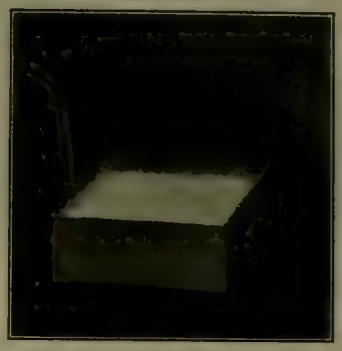

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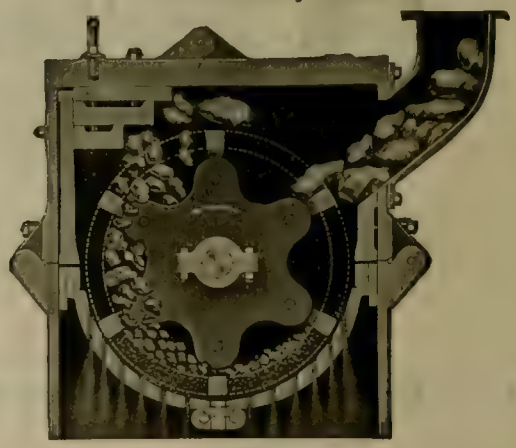

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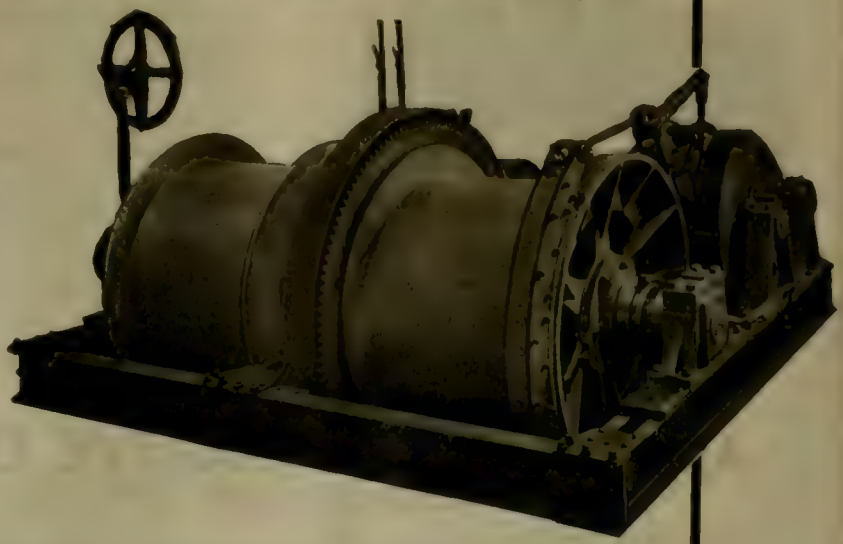

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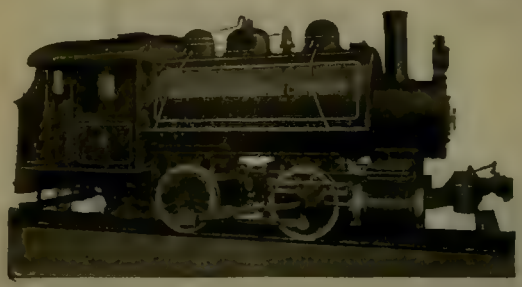

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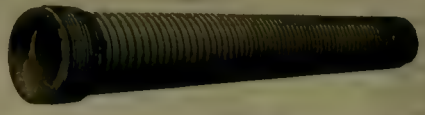

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ALPHABETICAL INDEX TO ADVERTISERS

(—) INDICATES EVERY OTHER WEEK OR MONTHLY ADVERTISEMENT

	Page.
Ainsworth & Sons, Wm.	37
Alberger Pump & Con. Co.	28
Allis-Chalmers Mfg. Co.	5
American Locomotive Co.	44
American Metal Co., Ltd.	26
American Spiral Pipe Wks.	30
American Steel & Wire Co.	41
Atkins, Kroll & Co.	26
Atlas Car & Mfg. Co.	28
Bacon, Earle C.	28
Bartlett & Snow Co., C. O.	41
Bausch & Lomb Optical Co.	—
Beer, Sondheimer & Co.	26
Blake, Moffit & Towne	29
Braun Corporation, The	25
Braun-Knecht-Heimann Co.	25
Broderick & Bascom Rope Co.	47
Bucyrus Company	15
Buff & Buff Mfg. Co.	37
Busch-Sulzer Bros.-Diesel Engine Co.	30
Cal. Perforated Screen Co.	—
Cameron Steam Pump Wks., A. S.	35
Cary Spring Works	37
Chalmers & Williams	28
Colorado Iron Works Co.	47
Consolidated Min. & Smelting Co. of Canada, Ltd.	26
Deister Concentrator Co.	30
Deane Steam Pump Co.	—
Demarest Co., D. D.	29
Deming Co., The	33
Denver Fire Clay Co.	33
Denver Quartz Mill & Crusher Co.	29
Dewey, Strong & Co.	31
Diamond Rubber Co., The	—
Dixon Crucible Co., Joseph	33
Dorr Cyanide Machy. Co.	8
Du Pont Powder Co.	38
Empire Zinc Co.	33
Flory Mfg. Co., S.	29
Frenier & Sons	28
General Electric Co.	13
General Filtration Co., Inc.	40
Goldschmidt Thermit Co.	—
Goodrich Co., The B. F.	—
Grace & Co., W. R.	33
Gt. West. Smelting & Ref. Co.	26
Hallidie Machy. Co.	31
Hammond Iron Works	33
Hardinge Conical Mill Co.	28
Harron, Rickard & McCone.	Back Cover
Heald's School of Mines	23
Hendrie & Bolthoff Mfg. & Supply Co.	2
Hendy Iron Works, Joshua.	9
Ingersoll-Rand Co.	Bulletin
International Smelting Co.	26
Jackson Iron Works, Byron	27
Jeanesville Iron Works.	—
Johns-Manville Co., H. W.	41
Justrite Mfg. Co.	42
Kelly Filter Press Co.	27
Kohlbusch, Herman, Sr.	37
Krogh Pump Co.	—
Laidlaw-Dunn-Gordon Co.	—
Lane Mill & Machy. Co.	38
Leitz Co., A.	37
Leschen & Sons Rope Co., A.	29
Lidgerwood Mfg. Co.	43
Lima Locomotive Corp.	27
Longyear Co., E. J.	14
Ludlow-Saylor Wire Co.	45
Lufkin Rule Co.	37
Lunkenheimer Co.	39
Marion Steam Shovel Co.	—
McKiernan-Terry Drill Co.	28
McMaster, D. J.	44
Meese & Gottfried Co.	Back Cover
Merrell Mfg. Co.	29
Merrick Scale Mfg. Co.	40
Mine & Smelter Supply Co.	—
Minerals Sep. Am. Syn., Ltd.	28
Moore Filter Co.	27
Moyle Eng. & Equip. Co., E. H.	27
National Tube Co.	28
New Jersey Zinc Co.	30
New York Engineering Co.	10, 11
Nordberg Mfg. Co.	27
Pacific Gear & Tool Co.	29
Pacific Tank & Pipe Co.	46
Painter Tramway Co. of San Francisco	28
Pelton Water Wheel Co.	39
Pensacola Tar & Turpentine Co.	29
Power & Mining Machy. Co.	—
Prescott Steam Pump Co., Fred M.	40
Putman Boot & Shoe Co.	29
Redwood Manufacturers Co.	28
Robins Conveying Belt Co.	28
Roebling's Sons Co., John A.	39
Roessler & Hasslacher Chemical Co.	33
Sacramento Pipe Works.	—
Salt Lake Hardware Co.	37
San Francisco Plating Wks.	—
Seattle Machine Works.	41
Selby Smelting & Lead Co.	26
Senn Concentrator Co.	12
Smooth-On Mfg. Co.	39
Snow Steam Pump Works.	—
Southern Pacific Co.	31
Stout, V. A.	29
Sullivan Machinery Co.	7
Taylor-Wharton Iron & Steel Co.	28
Thompson Balance Co.	37
Traylor Engineering & Mfg. Co.	38
Troemner, Henry	37
Union Construction Co.	28
Union Iron Works Co.	—
U. S. Smelting, Refining & Mining Co.	26
U. S. Steel Products Co.	41
Vander Naillen School, A.	23
Vogelstein & Co., L.	26
Vulcan Iron Works.	28
Watt Mining Car Wheel Co.	27
Wedge Mechanical Furnace Co.	6
Wellman-Seaver-Morgan Co.	45
Western Electric Co.	—
Western Pacific Railway	43
Westinghouse Electric & Mfg. Co.	—
Wildberg Bros.	26
Wiley & Sons, John	—
Wood Drill Works.	42
Yuba Construction Co.	28

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Gold Mining and Milling in the Southeastern States—By W. R. Dodge, page 57

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Contents Page 4
Buyers Directory Page 21
Advertisers Index Last Page

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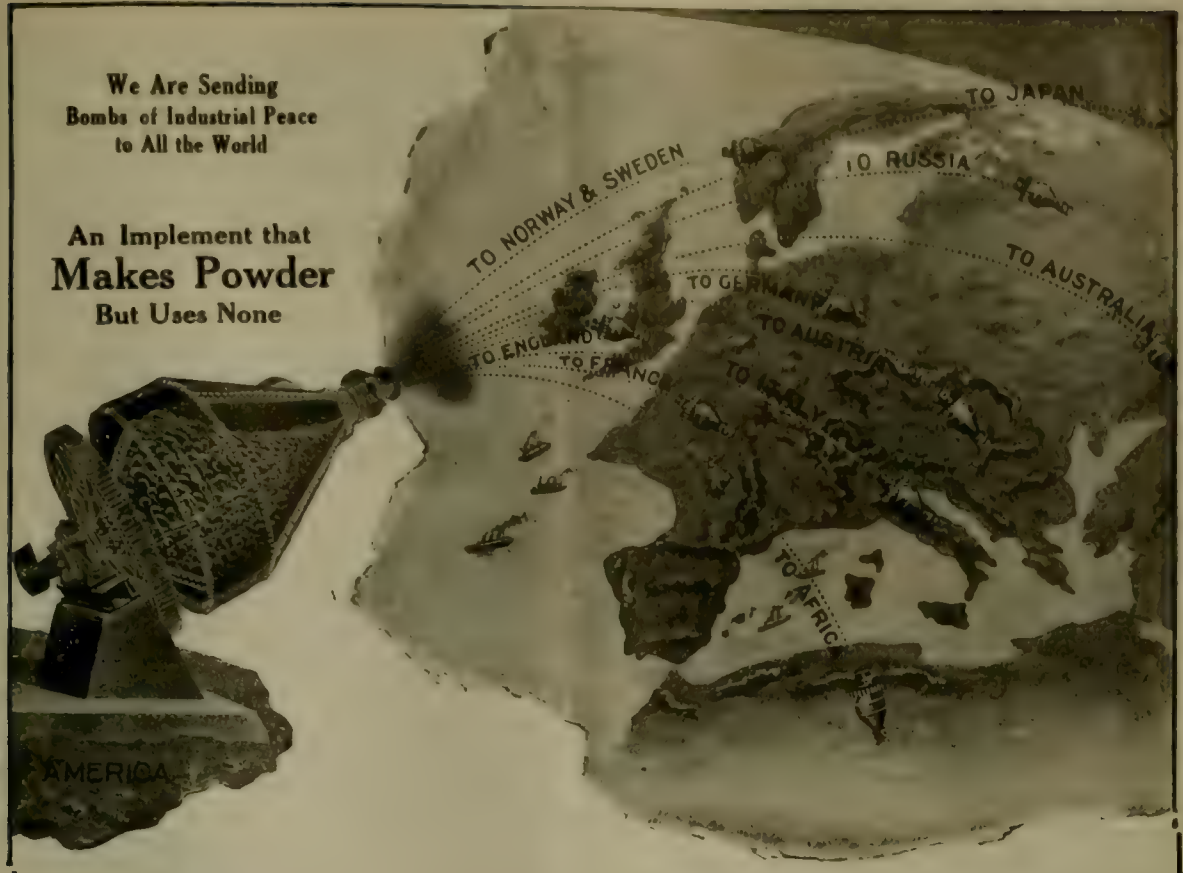

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VOL. 110 SAN FRANCISCO, JANUARY 9, 1915 No. 2

TABLE OF CONTENTS

EDITORIAL Page.

Notes 53
Pyrite Smelting 53
Banding in Ore Deposits 55
Adirondack Gold Deposits Again 55

ARTICLES

FRIENDLINESS V. FRICTION AT THE BUNKER HILL & SULLIVAN.
By John A. Goodell..... 57

The story of the Industrial Y. M. C. A. at Kellogg, Idaho. This now occupies a two-story, with basement, building, affording reading, recreation, game, and lodge rooms, with gymnasium, swimming pool, bowling alley, and other features. A library and classes are maintained, and large use is made of the club. It is supported in part by membership fees and in part by contributions from the B. H. & S. M. & C. Co., and is felt by the manager, Stanly Easton, to have fully justified the support given it by the Company. Mr. Goodell, who writes the article, is an experienced Y. M. C. A. worker.

GOLD MINING AND MILLING IN THE SOUTHEASTERN STATES.
By W. R. Dodge..... 59

The oldest goldfield in the United States is extensive, and in the opinion of Mr. Dodge, a metallurgical engineer resident within it, worthy of reinvestigation. Placers and wide belts of weathered rock, 'saprolite,' are present, and in them fine gold occurs. The material has been worked by hydraulicking, followed in places by stamp-milling and cyanidation, concentration, or chlorination.

MINERAL PRODUCTION OF THE DUTCH EAST INDIES..... 62

DRAINING KERR LAKE AT COBALT, ONTARIO.
By Ben Hughes..... 63

Pumping the water out of Kerr lake began August 28, 1913, and proved much easier than cleaning the mud off the bottom after the water was gone. This work is now under way, hydraulic giants mounted on a scow, with suitable pumping arrangements, being employed. Eight acres is yet to be cleared. The Kerr Lake and Crown Reserve companies will be able, when the work is completed, to mine from the surface the unexhausted rich upper parts of the veins worked below.

THE ORIGIN OF THE DOLOMITES.
By Francis M. Van Tuyl..... 64

Results of studies in Iowa that lead to the belief that dolomites are formed from limestone by replacement, before the beds emerge from the sea.

RHYTHMIC PRECIPITATION OF FERROUS FERRI-CYANIDE AND FERROUS HYDROXIDE IN JELLY.
By H. J. M. Creighton..... 65

Experiments with silver nitrate solution on gelatin show that in colloids, deposition from solution under the influence of electric currents is rhythmic and produces structures similar to the banding in veins. See also Editorial and Discussion departments.

PROSPECTING WET PLACER GROUND BY SHAFT SINKING.
By Donald Steel..... 66

Contrary to general opinion, it is possible to sample wet placer ground by shafts, if the work be carefully done and the methods adapted to it. Mr. Steel describes a caisson sinking method that he has employed, giving full details and sketches as well as results of a test. An article to cut out and paste in your notebook.

PRESERVATION OF TIMBER IN MINING.
By F. K. R. Moll..... 68

Mr. Moll, who as it happens is now serving in the German army, reviews the needs and methods of wood preservation as applied to mine timbers. He points out that the brush and open tank methods have already been proved to be defective, and describes the methods of impregnation that have been brought to success in Germany and Austria. This article was prepared before the war as a result of Mr. Moll's studies of American conditions and needs, and is designed to prevent repetition of old mistakes.

IMPROVEMENTS AT THE TRAIL SMELTER, BRITISH COLUMBIA.. 74

The Consolidated M. & S. Co. spent $482,000 in improvements in the year that ended September 30 last. The lead and copper plants were extensively overhauled. Two Wedge furnaces and a Cottrell precipitating plant were added.

CHEMICAL PROBLEMS IN GERMANY..... 75

The war has made a shortage of gasoline, rubber, nitre, and jute among other important materials. For the first, alcohol and benzol are being used. By combining acetone and benzol products with caoutchouc regenerated from scrap rubber, a substitute is made, but synthetic rubber is being sought. Substitutes for saltpeter for many uses are possible, but the shortage is severe. Cellulose is used in place of jute.

DEPARTMENTS

DISCUSSION:
Shall the Institute Express Opinions?
Report of Institute committee, and argument by F. Lynwood Garrison..... 76

Rhythmic Precipitation and Colloidal Ores.
By J. F. Kemp..... 78

See article on p. 65 and editorial on 'Banding in Ore Deposits.'

Lead Wool in Cyanidation. *By Arthur Feus*..... 79
Report on a simple method of getting the lead-zinc couple in the precipitation circuit.

Lake Superior Copper Mining. *By Homer A. Guck*.. 79
Notes on a mass of copper now being mined which is 6 to 8 in. thick, 40 ft. wide, and extends from above the 25th to the 27th level in the Trimountain mine.

Shoveling Machines at Flat River.
By William Whaley..... 79

CONCENTRATES 80

REVIEW OF MINING: Special correspondence from Joplin, Missouri, New York; Washington, D. C.; Boston; Toronto, Ontario 81

THE MINING SUMMARY 84

PERSONAL 87

SCHOOLS AND SOCIETIES 87

THE MARKET PLACE:
Metal Prices 88

MINERAL PRODUCTION IN 1914..... 89

U. S. Geological Survey preliminary estimates for coal, lead, copper, portland cement, and the mineral outputs of Utah, Nevada, Montana, and Arizona.

QUICKSILVER IN 1914. *By Clifford Dennis*..... 91

EDITORIAL

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TEMPORARILY, at least, the new Arizona law requiring that not more than 20 per cent of the labor employed by one person or concern shall be alien, will not be enforced, an injunction having been granted by the United States court pending a test of its constitutionality.

JOPLIN mines closed 1914 with prices at $50 to $52 per ton, as against $37 to $40 the year before. The war abroad has stimulated the American zinc industry, and the producers are enjoying another of the periods of prosperity that fortunately come between the equally characteristic periods of depression in zinc mining.

GOLD production in the United States in 1914 is estimated by the Director of the Mint, to have amounted to 4,490,336 fine ounces, equivalent to $92,823,500, an increase of 190,532 ounces, or $3,939,100, over the output for 1913. California ranked first with 1,037,537 fine ounces; Colorado was second with 961,748; and Alaska third with 766,744. In silver, Nevada led with 14,814,200 fine ounces, Idaho was second with 12,689,500, Utah third with 11,397,000, and the total was 67,929,700. The corresponding figures for 1913 were: Nevada, 16,090,083; Idaho, 9,989,193; Utah, 13,084,835; total, 66,801,500.

ARMOR PLATE manufacture by the government, as proposed by Congress, was discussed at some length in our editorial columns about a year ago. A special committee, consisting of Messrs. B. R. Tillman, and L. P. Padgett, respectively chairmen of the Senate and House Committees on Naval Affairs, and Rear-Admiral Joseph Straus, has now been appointed to make a thorough investigation of the feasibility of the project as a national investment. As about fifty cities are already making an effort to have themselves recognized as the most desirable site for the proposed plant, there is a probability that other arguments than those founded on business principles will be forced upon the attention of the committee.

THE report by a political commission, composed of the State Veterinarian, the Secretary of the State Board of Health, and the State Horticultural Commissioner of California, stating that serious damage is done to farming lands in the vicinity of the Mammoth smelter in Shasta county and the Penn smelter in Calaveras county, will not carry great weight with technical men, though it may be seriously considered in political circles. This commission did not report upon the Selby smelter, though intimating that it, probably, is also a source of damage. It, therefore, does not come into direct conflict with the findings of the Selby Smelter Commission which we recently summarized. We believe that the Selby commission got at the real facts. We are sure that its members investigated the question more thoroughly than any other commission, and it had the great advantage of being composed of technical men selected by agreement of both agriculturists and smelters. The state commission illustrates an excellent way 'not to do it.'

EXPRESS companies, we are pleased to note, have not all ceased to operate as a result of the establishment of the Parcel Post. Delighted as we are at the success of that, the most recent venture of the United States government into business, we have now a special cause for gratitude that the Wells Fargo continues to bring down the products of the mountain countries. With the assistance of that Company, Mr. Arthur Gibson sent the editorial staff, from Sonora, a box of apples fully equal to any we remember in our early boyhood. No country subscriber has yet paid us in the proverbial cabbage, but between Parcel Post and Wells Fargo we have hopes.

PYRITE SMELTING

Early in December, Mr. Robert Sticht gave a talk on this subject before the New York section of the American Institute of Mining Engineers. His address, a valuable contribution to the literature of the development of the art, was notable in many ways, especially for the modesty and frankness with which Mr. Sticht described his own work. According to his analysis the essential factors which led to the success attained in his development of pyrite smelting at Mount Lyell were the fact that the ore there was well suited to the process, and the high regard in which American engineers are held in Tasmania, which led to his being given a free hand to carry out his ideas. As Mr. Sticht aptly remarks, it is much easier to find a process to suit an ore than it is to find an ore to suit a process; nevertheless there can be little doubt that the scientific imagination and practical ability of Mr. Sticht were larger factors in the success attained than he himself is willing to admit. His

remarks on the occasion referred to were so full of dry humor and keen common sense that our readers will doubtless be grateful for a brief summary of the points made.

When Mr. Sticht went out to Mount Lyell in 1895 he had had some experience with attempts at pyrite smelting, for brief periods, in Colorado, and therefore had some foreshadowings of what might be done. He was singlehanded and the property was just beginning to be developed, so there were all the usual pioneer difficulties, especially in transportation, and it was necessary to pioneer in coke-making as well as to develop copper smelting. He was fortunate in having only two substances to deal with; a pure pyrite free from zinc and lead, and a silicious ore containing 70 per cent free silica, the joint alumina content being satisfactorily low. This material all came to the furnaces in coarse form, not over ten per cent of it being finer than half inch. The furnaces built were not large, according to present standards. Those now in use are 54 inches wide and 18 feet long, and the first furnaces were 36 inches by 10½ feet. The height of the smelting column has been increased until it is now 18 feet as a maximum. The early slags were very silicious, the charge consisting of two parts of pyrite to one of silicious ore. Now, from 1.7 to 1.3 parts of pyrite are used to one of silicious ore. The matte first made required resmelting. At first a hot blast was used, but Mr. Sticht soon perceived that if enough air were provided to oxidize the iron it would furnish its own heat, and additional blowing capacity was provided. The open, coarse charge permitted free passage of the air, and by blowing 20,000 cubic feet per minute it was not difficult thoroughly to oxidize the iron, with the resultant production of a good slag, enough heat to keep the furnace going, and a matte of the desired grade. While it was found entirely possible to run the furnaces at Mount Lyell without any coke on the charge, this was not the practice, since it imposed a degree of strained attention on the metallurgist which is beyond the limits of human capacity. In other words, they had at Mount Lyell the same experience metallurgists have had elsewhere; namely, that while it is quite possible to smelt without coke, it is better economy to use it. According to Mr. Sticht, they formerly used 1.1 per cent coke; now they use 3.5 to even 5 per cent; the silicious material which is now being used not containing so much free silica as that formerly used. As Mr. Sticht phrased it, it is cheaper to burn up coke than to burn out the metallurgist and his staff.

The importance of the absence of fine ore on the charge was emphasized by the other metallurgists present. Mr. H. A. Prosser related that when the smelter at Mammoth, California, was started, limited crushing facilities made it necessary to feed the furnace with lumps a foot in diameter, and experience showed that this coarse material was not a detriment, as had been expected. Speaking of the new smelting plant at Anyox, Mr. George A. Guess related that through a failure of the crushing plant it was necessary to feed the furnaces with lumps as large as a suitcase, no detriment resulting. As the charge here contained 20 to 30 per cent of fine ore it is quite possible that, as suggested by Mr. Prosser, the breakdown of the crushing plant was a blessing in disguise. The early difficulties experienced at Anyox were overcome chiefly by making it possible to get more air through the furnace; for, as pointed out by Mr. Lewis T. Wright many years ago, the essential requisite for success in pyrite smelting is to maintain a sufficiently rapid rate of smelting. Mr. R. L. Lloyd made the point in the discussion that an ore which came to the furnace in lumps might still yield 'fines' in smelting, since some sulphides decrepitate on heating. Mr. Guess confirmed this, relating an experience in which a consignment of sulphide ore completely decrepitated into sand inside the furnace, tremendously increasing the resistance to the blast.

A point which did not chance to attract much attention in the discussion, but which is exceedingly important, is that as compared to an ordinary furnace a pyrite furnace is like a runaway horse compared to old Dobbin. The pyrite furnace must be given its head; it indicates the conditions under which it will run, and must be allowed to have its own way. If enough iron and sulphur are present to yield the heat required and the charge is sufficiently porous so enough air can be blown through to generate the heat rapidly enough, the pyrite furnace will generally run without too much difficulty. The presence of alumina in the charge introduces a difficulty, for the reaction when it unites with the silica is endothermic. Worst of all is the joint presence of alumina and magnesia, since these may unite in the slag to form the spinel molecule, which is almost infusible at blast-furnace temperatures. It is surprising what profound effects apparently minor differences make in this regard. At one of the Russian copper smelters a barren quartz containing 96 per cent SiO_2 is hauled some miles for use in the furnace. Several times during the absence of the consulting engineer, Mr. W. G. Perkins, the local managers have tried to economize by using an equally good looking rock, containing 89 per cent SiO_2, which occurs near the furnace. Always capacity fell and coke consumption rose, and when inquiries came from the London office, the superintendent has had to admit that the substitution had been made. Perhaps the most striking example of the necessity for favorable chemical conditions in the charge is the smelter at Copper Cliff, Ontario, where an ore which is high enough in sulphur and iron to smelt pyritically has defied the persistent efforts of some of the best metallurgists of the day to make it run pyritically. The situation at this plant is such a puzzling one that we shall reserve its detailed discussion for a subsequent editorial. For the present we may conclude by emphasizing the chief point made by Mr. Sticht: namely, that the first essential for success in pyrite smelting is to have an ore which is suited to the process; and by reiterating our own point, that the physical character of this charge must be such as to permit blowing sufficient air through it to smelt at the speed which must be maintained.

BANDING IN ORE DEPOSITS

Banded structures, so commonly observed in veins, have always been a source of interest to geologists, and long ago Posepny devised the term 'crustification' to describe such structures, which he rightly considered an infallible indication of deposition from solution. The term reflected the general view of geologists, then and since, that such structures must necessarily have been produced by variations in the composition in the solutions traversing the fissure, one solution having deposited a 'crust' of a given composition, only to be succeeded by a solution of different composition which deposited a 'crust' of markedly different character. There are several difficulties involved in this explanation. The transition from one crust to another is usually distinct and abrupt, but it is hard to imagine how similarly abrupt changes could take place in the composition of the solutions, for even if one source of supply were suddenly shut off and another took its place it must be expected that a certain amount of mixing would take place while the first solution was being expelled by the second, and therefore a transition layer should occur. More difficult to explain is the alternation of bands, for which a rhythmic alternation of solutions must be presupposed, an assumption that severely taxes our credulity. Thus in the veins of the Reese River district of Nevada well developed bands of ruby silver ores occur alternating with bands of quartz. It is decidedly hard to comprehend how solutions carrying the silver minerals in solution can have been caused to alternate with solutions carrying only silica.

The tremendous amount of work which has been done on colloids of recent years has gradually led up to another and more plausible explanation. The nature of this is clearly indicated by the brief article by Mr. H. J. M. Creighton, published elsewhere in this issue, in which is described a simple experiment by which alternating bands of precipitates are produced in colloidal substances by rhythmic precipitation under the influence of an electric current. The colloidal character of freshly precipitated SiO_2 is well known. Assuming a vein filled with such a colloidal mass, containing small quantities of other substances, it is not difficult to imagine that the combined effect of the ground-water circulation and terrestrial currents would produce alternating bands of precipitated minerals and barren quartz. In addition to overcoming the difficulties already mentioned, another not referred to at once disappears. According to the theory of crustification two bands, one on each side of the supposedly open fissure, are produced, and the vein must necessarily exhibit an even number of bands. But this is not always the case, and no very plausible explanation has been offered. The suggested method renders any explanation unnecessary, since the bands would then be produced one at a time. If the new theory is a valid one, it is no longer necessary to assume the long persistence of open fissures to great depth, since a fissure might be filled with colloid SiO_2 in a brief space of time, while its subsequent conversion into a banded vein might extend over a long period.

Not the least interesting aspect of such a theory is that it reconciles the divergent views of the 'ascensionists' and 'lateral secretionists.' The first filling of the fissure might be brought about by the forcing in from below, perhaps under considerable pressure, and in a semi-consolidated state, of colloid SiO, which may be regarded as the final *liquidous* phase of the consolidation of an igneous magma. But banding whenever found, is commonly parallel to the axis of the fissure, and therefore must be the result of the action of a solution, presumably the circulating ground-water attempting to cross the vein from one side to the other. Such a theory of banding is in many ways a suggestive one, and seems well worth the attention and discussion of geologists. A good deal of work has already been done along these lines. More than twenty years ago Mr. G. F. Becker suggested that the wall rocks of veins might act as semi-permeable membranes. Not long after Mr. R. E. Liesegang discovered the effect of placing a drop of silver nitrate solution on a layer of gelatin, referred to by Mr. Creighton, and out of the suggestive line of thought thus evoked has grown the work of such investigations as Messrs. Hatschek and Simon, and Morse and Pierce. The matter was discussed at some length by Mr. Liesegang in his volume 'Geologische Diffusionen' published last year, but it seems to have attracted comparatively little attention in this country, much less than its apparent importance would seem to deserve.

ADIRONDACK GOLD DEPOSITS AGAIN

In his study of the French Revolution, Thomas Carlyle frequently repeats the assertion that anything which is not founded on truth cannot long prevail. The belief is a comforting one, but unfortunately experience in the field of mining seems to indicate that this rule, as many others, is subject to exceptions. The delusions that gold can be profitably extracted from sea water, and that it exists in ores in forms in which it cannot be detected by ordinary fire assay, have, for example, shown a vitality which is quite out of keeping with their lack of fundamental truth, and survive repeated demonstrations of their fallacy. A less well known but equally hardy belief is that the sand and gravel deposits of the Adirondack region of New York state are rich in gold and precious metals; one which, in spite of repeated demonstrations to the contrary, is still able to inspire hopeful investors with dreams of fortunes to be won.

Around the border of the Adirondack region of New York state, in Saratoga, Warren, Essex, Herkimer, Lewis, and Fulton counties, a vast sand plain occurs. About 1880, William T. Bullis, of Glens Falls, New York, became convinced that he had discovered gold in the sands of that region, and devoted the rest of his life to fruitless schemes for recovering, by barrel amalgamation, gold which could not be detected by fire assays.

About the same time Mr. C. P. Bellows, a dental practitioner of Gloverville, became interested in the sand deposits, and has since remained the chief factor in maintaining a belief in their value. The discovery of the rich gold deposits of the Klondike region gave a tremendous impetus to faith in the richness of these sands, and during 1898 over 4000 claims were filed with the proper state authorities.

Much the most ambitious attempt to recover gold from the sand was that by J. E. Sutphen, who, about the same time, devised a secret process and built a mill for the purpose on the Sacandaga river, near Hadley, Saratoga county. After treatment with a mysterious chemical mixture, the sand was ground in amalgamating barrels and was claimed to yield $7.50 per ton. This mill was described in some detail by Mr. J. Nelson Nevius in the report of the New York State Museum for 1898. Mr. Nevius' samples of the sand being treated by the mill gave no more than a trace of gold. Careful tests made on the Adirondack material by such competent firms as Ledoux & Co. showed conclusively that the amounts of gold present do not exceed the traces which can be found in many rocks, nor is there any possibility of the presence of mysterious substances which prevent the recovery of the gold in an ordinary fire assay. In September 1910 Mr. D. H. Newland, assistant state geologist of New York, published the following statement:

"Without indulging in criticism of the good faith of those who have been at work on the Adirondack sands, we are unable to find in the notices of the press or in any literature which has been circulated for the purpose of informing the public as to their claims, any satisfactory explanation of the processes employed for recovery of the gold which would account for the wide variance between their reported results and those obtained by the usual assay methods. We have been informed recently on creditable authority that in the so-called 'Sutphen' process, which was extensively advertised about 10 years ago, the methods consisted briefly of pulverizing the sand and amalgamating it after treatment with a hot sodium carbonate solution. It was stated that the gold had a silicious coating which necessitated fine grinding and chemical treatment before amalgamation was effective. Even if that were true, there is no reason why the gold should not be set free by fire assay. On the other hand, the claim that the gold exists in volatile state, something entirely new to chemical science, seems to be met and controverted by the recent assays. The economic record of past enterprise in this field is certainly not reassuring to those intent on new ventures. Though it is impossible to give an accurate estimate of the outlay of capital represented by previous experiments, the total must amount to several hundred thousand dollars. An idea of the wide interest which the early enterprises aroused may be gained from the official records which show that over 4000 claims to gold and silver discoveries, mainly within the Adirondacks, were filed in the year 1898. We know of no instance where the public has received any financial return for its investment."

It might be supposed that the belief in the value of the Adirondack sands would have been given its quietus by these disclosures, but such was not the case. The Waverly Reduction Company, which held some 2000 acres in Franklin county, and of which A. E. Copp, of Boston, was president, continued its activities in attempting to recover the 'immature' gold of the sand. E. C. Jordan and G. R. Thurber were authors of schemes for this purpose, and shares in the Company were being marketed by the Union Securities Company of Hartford, Connecticut, until the publicity given it by the New York *Sun* early in 1912 blighted its career. A mill built at Lowville, New York, by N. S. Keith, of Philadelphia, which was claimed to recover an average of over $2 per ton of sand, was subjected to a test run by two competent mining engineers, Messrs. John T. Roberts, Jr., and W. G. Barney, and yielded less than 5 cents per ton. In spite of all these fiascos, the faith of Mr. Bellows continues unwavering, and he has succeeded in selling tracts of land to credulous investors in many of the eastern states, but especially to residents of Philadelphia. Messrs. E. H. Godshalk and Edward W. Patton, of that city, have each recently built mills on the tracts which they have purchased, and George P. Brock and C. J. Rothermel have purchased a 150-acre tract. F. S. Lewis, formerly president of the Lake Superior Corporation, an enterprise likely to be long remembered in Philadelphia, has likewise been active in these ventures, and the claim that recent results show that the sands contain $5 per ton in gold and platinum rests on the authority of John Ogden, who was formerly as assayer of Denver. So many Philadelphia people have become involved in these Adirondack schemes, in one way or another, that to mention them all by name would be tedious.

So long as these people are risking only their own money (and most of them are making no appeal to the public) in ventures which offer no chance for success, it might seem that it is no concern of the mining profession. Such is not the case, however. Every mining fiasco, based on groundless hope and engineered by men without mining knowledge and experience, reflects on legitimate mining, from which the general public is unable to distinguish it. Each year it becomes more difficult to find men willing to risk money in intelligent and well directed prospecting, which must precede development work. The East is the great centre for capital; over three-quarters of the income tax receipts for the entire United States is from New York and Pennsylvania. Mining misadventures such as these, occurring close at home, inevitably act as a deterrent to the furnishing of capital for prospecting and developing mines in the western states, where the deposits actually exist. It is to the disadvantage of the mining profession as a whole that belief persists in such baseless schemes, and engineers owe it to themselves to endeavor in every way possible to publish the truth.

Friendliness v. Friction at the Bunker Hill & Sullivan

By JOHN A. GOODELL

*The one element that modern business cannot reduce to mathematical formulas and stereotyped rules of efficiency, is the human. It defies mathematical regulation, is always developing an unknown quantity to be reckoned with, and it refuses to 'come out even,' in accordance with mechanical standards which work so smoothly on the inanimate equipment of a big business plant. This was demonstrated back in 1903 by the dark and stormy times of industrial war in the Coeur d'Alenes. After the smoke of that conflict cleared, the officers of the Bunker Hill & Sullivan Mining & Concentrating Co. settled down to some hard thinking, and, as we all know, a little thinking goes farther than a great deal of fighting. In this case the thinking resulted in full recognition of the human element. The men were encouraged to organize a club of their own in the nearest town, Kellogg, Idaho. Meantime, R. D. Handy had been away at the Company's smelter and became acquainted with the work of the Industrial Y. M. C. A. He came back with a story of the friendly reception he had met from the secretary, and of the good fellowship that had

SOCIAL ROOMS, A CLASS IN SPANISH, THE BUILDING, BOYS' CLASS, AND READING ROOM, KELLOGG INDUSTRIAL Y. M. C. A.

*Previous articles in this series are: 'Big Returns on an Investment,' by Fred H. Rindge, Jr., November 7; 'Welfare Work Among Mine Workers,' by L. F. S. Holland, November 14; and Safety Work at Calumet & Hecla, 'Looking Forward,' December 19.

GENERAL VIEW OF KELLOGG, IDAHO.

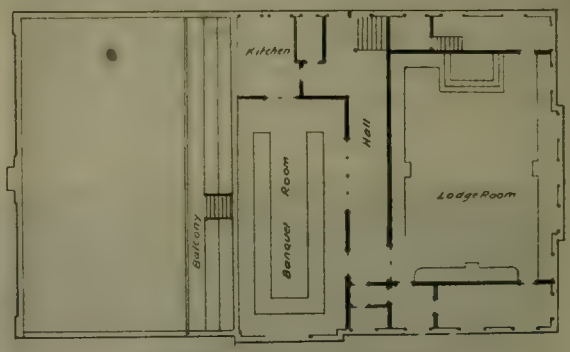
resulted. It struck Stanly Easton, the capable and cordial manager at the mines, that perhaps here was the very thing he was looking for, and he promptly began an investigation of the Industrial Y. M. C. A. The result was that an organizing secretary visited him and an agreement was reached whereby the Company began the erection of a building costing $35,000 to be the home of the Kellogg Industrial Y. M. C. A. The building is now finished. Its arrangement and uses are indicated by the floor plans illustrated. The activities it shelters mean an almost unbelievable amount of good, not to the men of the Company alone, but to the entire community. It houses the labor organization. In the basement are double bowling alleys, in constant use, the women having possession two afternoons a week. There is a billiard room of five tables. In the basement also, are a large locker room and the swimming pool. On the main floor are reading rooms, class rooms, a public library, and offices. A well equipped gymnasium occupies about half the floor space here. The accompanying illustrations give glimpses of the work.

The financing of all these activities is an important consideration. It is on the basis of mutuality. The Company contributes heat, light, and $1500 yearly in cash, and also donates the rent for the second story, which is occupied by the labor organization. This amounts to something over $375, and is set aside by the secretary of the association for the upkeep of the library and the purchase of new books. What the men pay is in the form of memberships, as in any club.

Statistics for the year 1913 show that books taken from the library in eight months (there are about 7000 volumes to choose from) amounted to 4118; attendance at educational classes was 1598; letters written, 10,460; attendance at gymnasium classes, 5044; baths taken, 23,347; number of games used, 16,812. Of course, an organization of men without baseball is not possible in the United States, so the Kellogg Industrial Y. M. C. A. has the 'Twilight Baseball League,' consisting of eight teams, which played last year to an attendance of 10,125.

Social events are of frequent occurrence. Among them bowling tournaments are popular, usually closing with a banquet and the awarding of prizes. Then there is the annual 'Open House' of the association, at which last year, as an interested guest of his employees was F. W. Bradley, of San Francisco.

The active man in the enterprise is J. E. Sturdevant, secretary. His duties are manifold and beyond the possibility of exact specification. Generally speaking, they



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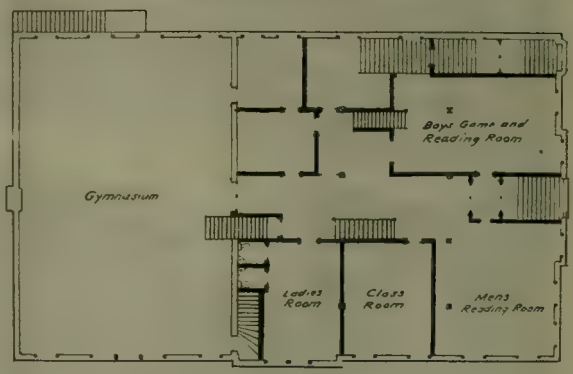

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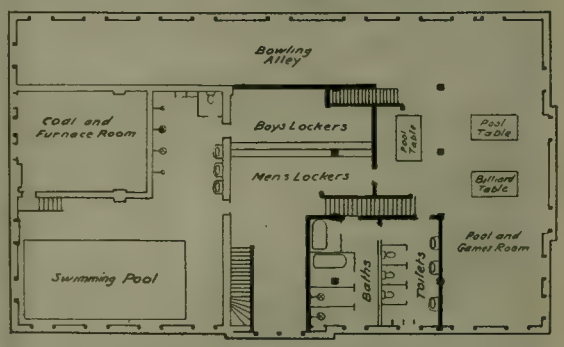

BASEMENT, Y. M. C. A. BUILDING.

embrace the task of being a friend to every man in the community.

It cannot be emphasized too strongly that this centre is not for the men of the association alone, but for every man, woman, and child in the community. After four years' experience with the Industrial Y. M. C. A., Mr. Easton, who has been a thoughtful and active friend of the work from the first, says: "The institution has made good in every sense of the word, and we feel that our support of it has been fully justified by the direct and indirect results secured."

Gold Mining and Milling in the Southeastern States

By W. R. DODGE

In the present-day search for new fields in gold mining, more attention could well be directed to the southern Appalachian region in the states of North Carolina, South Carolina, Georgia, and Alabama.

This is the oldest gold mining territory in the United States, gold having been discovered in the early part of 1800. Considerable activity was shown here in the early thirties and forties when this region supported a mining population of 15,000 to 20,000 with a production of $1,000,000 per annum. There were then United States mints at Dahlonega, Georgia, and New Orleans, Louisiana. Later a United States assay office was established at Charlotte, North Carolina. The California gold excitement in 1849 caused the emigration of the major portion of these miners, who introduced the rocker, long-tom, riffled sluices, much hydraulic equipment, and probably the stamp-mill into that state. These old southern miners gave the first impulse to gold mining in California. The Civil War caused almost complete cessation of mining in the South; the production since then has been but a fraction of that previous to the war.

Gold mining in the South has never enjoyed the systematic development or persistent effort which has characterized other parts of the United States, the reason for this being that when gold was first discovered the country was already a closely settled farming community and the planters looked askance at mining and were much adverse to having their plantations over-run by prospectors or torn up by the surface mining of that time. Those, then, who did engage in mining devoted a part of their efforts to farming and a part to mining on their own tracts. This in part is also the condition at the present time.

The Gold-Bearing Areas

The gold-bearing rocks are largely crystalline schists which extend over a wide area from Montgomery, Alabama, to Washington, D. C. This includes the whole western half of North Carolina; the northwestern half of South Carolina; the northern half of Georgia, and a triangular district in eastern Alabama containing the counties Cleburne, Randolph, Talladega, Clay, Tallapoosa, Chambers, Coosa, Elmore, and Chilton, some 3500 square miles. This area has been divided into belts, the most important ones being as follows: the Carolina belt; the Georgia belt; the Alabama belt. The Carolina belt is the most extensive. It extends from the south boundary line of Virginia in a southwest direction across the central part of North Carolina into the northern part of South Carolina, where it sinks below the Coastal Plain, making its reappearance in Abbeville county, South Carolina, and in Wilkes, McDuffie, and adjacent counties in Georgia near Augusta. Its width is from 8 to 50 miles. The Georgia belt begins in Rabun and Habersham counties, in the northeastern part of the state, and extends southwest through Dahlonega to the Alabama line near Tallapoosa, Georgia. Its width is from 4 to 30 miles. The Alabama belt may be considered an extension of the Georgia belt.

Country Rocks

In the Carolina belt, these consist mainly of metamorphosed slates and schists, including devitrified volcanics (rhyolite, quartz-porphyry, etc.). Its western boundary is made up of igneous rocks (granite, diorite, etc.). Among the slates forming the eastern boundary are the important Monroe slates. These are probably sedimentary and are highly silicified. They occur in Monroe, Stanly, and Montgomery counties. The general strike of this formation is N.20 to 55°E. and the predominating dip 55 to 85° northwest. The Georgia and Alabama belts for the most part consist of micaceous, hornblende gneisses, and schists, often garnetiferous. The prevailing strike is N.20 to 30°E. and dip 30 to 60° southeast.

Gold Ores

In the Carolina belt, the gold ores occur as quartz fissures and disseminations of fine gold and pyrite accompanied with irregular quartz stringers and lens-shaped fillings, usually in the cleavage planes of the schists and slates. The quartz fissures are more apparent in the eruptive rocks, and scarcely discernible in the schists and slates. Silver, lead, zinc, and copper also occur in this belt. In the Georgia and Alabama belts, the gold ores exist in numerous small veins, stringers, and lenses of quartz, aggregated in zones or belts which taken together form the orebody. This is sometimes hundreds of feet in width. Gangue minerals are pyrite, rarely chalcopyrite, garnet, monazite, tourmaline, and bismuth. Weathering agencies have decomposed and softened these rocks from the surface to water-level, varying from 50 to 150 ft. in depth. Such orebodies are called 'saprolites.' The quartz is left unaltered, but is broken. The sulphides are oxidized and the gold changed to the free state. The mining of these large, soft orebodies is rendered simple and profitable.

Mining

This has consisted of both placer and deep vein mining. Nearly all of the early work was confined to placer mining. The placers consist of three kinds:

1. Beds of streams and ancient river channels: the latter being often filled in and obstructed from view. In some cases these penetrate into the hillsides. The 'pay' is shallow (1 to 2 ft. thick) and consists of rounded pebbles and nuggets. Large nuggets have been found in Mecklenburg and Montgomery counties, North

Carolina: White county, Georgia; and the Arbacoochee district, Alabama. The largest (28 lb.) was found at the Reed mine, North Carolina.

2. Placers consisting of vein quartz eroded from hill-sides and collected in concentrated form in synclinal basins and at the mouths of gullies. The nuggets in these deposits are in the form of wire, sheets, and flake gold, and are much smaller than those of the river beds. These placers are small compared to those of California and have only been operated by the crudest methods. No records have been kept as to the values per cubic yard. The average values are given as 15c. to $1 per yard. Extensive hydraulic plants with giants and gravel elevators have been operated in the neighborhood of Dahlonega, Georgia, and in the Arbacoochee district of Alabama. There is little placer work now being done, although it is said there is virgin territory in western North Carolina and in the Arbacoochee district. A company with headquarters at Birmingham, Alabama, is operating a dredge in the Arbacoochee district, near Heflin, Alabama. Details are lacking. Dredges have also operated near Dahlonega, Georgia.

The Saprolite Ores

3. Saprolites. This term has been given to the decayed outcroppings of veins and means literally, rotten rock. They form the most interesting deposits from the point of economic geology. From them the greater part of the gold has been won in the past, and on account of their wide extent will in the future be mined.

These saprolites contain narrow quartz veins from 1 in. to 2½ ft. thick and innumerable lenticular quartz stringers which are for the most part gold bearing. Gangue minerals are garnet, black sand, and unaltered pyrite, which is also gold bearing. Where these veins and stringers come closely together they may be worked as one orebody. The value of such lodes ranges from $3 to $6 per ton and their width is as much as 50 to 100 ft.—as at the Rudisil mine, Mecklenburg county, North Carolina. Such deposits are treated as lodes and are mined by labor and milled in stamp-mills. Where the small veins and stringers are more widely separated, lower values are the rule and the ore is mined as in placers. When these saprolite deposits are upon a hillside or are cut by gulches they are favorable for hydraulic mining.

Dahlonega, Georgia, has been the centre of greatest activity in working these deposits and here was originated the Dahlonega method of mining and milling. This consists of hydraulic mining with 'giants,' the soft decomposed material, which is carried by flume (containing riffles) to the stamp-mill. Here the pulp is received in a large bin behind the stamps. This bin acts as a crude classifier. It has a discharge opening at one end partly closed by slats spaced one-half inch. Here the larger pieces of quartz are retained while the mud and finer quartz escape to waste. What quartz remains in the bin is milled through the stamps, the pulp passing over amalgamating plates. The plant is simple as to first cost, and the operating expenses very low, but the waste of fine gold is excessive from both the bin and the stamp-mill. Costs are given as 25c. per ton and the saving as 35%. Such plants have been in operation also at Auraria, Georgia, and in Stanly county, North Carolina.

Other methods of working those saprolites are with log-washers. There are two types of these machines, the high-speed and the low-speed. The former type consists of two units of double log-washers acting in tandem. The logs are usually 12 to 18 ft. long and mounted in steel troughs with straight sides and a rounded bottom. Provision is made for a wooden cover. At the discharge end of each machine is a revolving screen or trommel. That following the first machine is coarser than the second. The size of the screen openings is optional with the operator. The logs revolve at high speed, No. 1 at 100 to 150 r.p.m., and the second at 200 r.p.m. The soft ores are fed, together with water, to machine No. 1, and thorough disintegration is allowed to take place. The coarse trommel at the discharge end removes rocks and roots, which are delivered to a conveyor and carried to waste. The pulp passing to the second washer receives more water. The pulp is discharged from this machine, and after passing the second screen (about 4 to 6 mesh) is passed over riffles containing mercury. The oversize of the second screen likewise goes to waste. Some coarse gold remains in the washer troughs and is periodically removed.

Such a plant treats 10 tons per hour and requires 75 gal. per minute and 25 hp. to operate. No attempt is made here to mill the coarser quartz.

Another combination of equipment is the slow-speed log-washer, a single unit being used. The logs are longer, 20 ft., and the speed is 15 r.p.m. The washers have a square bottom which fills up with coarse quartz. The washer disintegrates and removes the clay, delivering the washed quartz to a Huntington or Chilean mill.

Very little work is being done with these saprolite deposits at the present time, although they form the most valuable in the South. Nearly all the orebodies can be mined by a steam-shovel.

Results of Ore Test

An ore test that I made may be interesting at this point. A sample of oxidized saprolite ore was first treated in its natural state by cyaniding (all slimed to 100 mesh, as leaching was not practicable). Another portion was washed to eliminate the clay and to recover the quartz in a concentrated condition. This washed product was treated by cyanide, the same as the original ore.

	Per ton.
Original ore value	$2.20
Extracted by cyanide (86.4%)	1.90
Washed ore from original (ratio 5:1)	8.00
Extracted by cyanide, washed ore (92.5%)	7.40
$7.40/5 equivalent to extraction on original	1.48
Difference $1.90—$1.48	0.42

Favor cyaniding crude ore direct.

Cost of treatment (assumed): (1) Based on mining by labor, 100 tons crude ore. This treated by all-slimming cyanide process, agitation, filtration, zinc-dust precipitation, etc. (2) Steam-shovel mining of 500 tons crude ore. This reduced by washing to 100 tons and treated in the same mill as above.

		Per ton of crude ore.
(1) Extracted by cyanide		$1.90
Mining and delivery to mill	$0.35	
Milling and cyanide	1.50	
	1.85	
Profit		$0.05
(2) Extracted by cyanide, washed ore	$7.40 or	$1.48
Mining, washing, and delivery to mill	$0.65	
Milling and cyanide	1.50	
	2.15 or	0.43
Profit per ton washed ore	$5.25 or	$1.05
Difference in favor of washed ore		$1.00

Deep Vein Mining and Milling

The South has no bonanza gold mines as this term is understood in the West. The veins, for the most part, are small, 2 to 6 ft. being an average width.

There have been some exceptions, as the Haile mine, Lancaster county, South Carolina; large lens-shaped orebodies 80 ft. thick. Capps mine, Mecklenburg county, North Carolina; vein 20 ft. thick, etc.

The veins usually follow the general strike of the country rock in which they occur, except in those cases where the veins are split and turned aside by 'horses.'

The general strike of these veins is northeast. It is noteworthy that enrichments occur along the intersections of cross veins, having a northwest strike, or in some cases east and west. Exceptional values are: Stephen Wilson mine, Mecklenburg county, North Carolina, $345 per ton, vein 2 to 3 ft. wide; St. Catherine mine, Mecklenburg county, North Carolina, $27 to $180 per ton, vein 2 to 6 ft. wide.

The majority of these mines are worked crudely at the surface as pits, open cuts, and shallow shafts. As long as the ores were free milling the gold was recovered in rockers, sluices, or small stamp-mills. When water-level, harder formation, or the sulphides were encountered, the workings were abandoned and a new pit sunk. Thousands of these shallow workings exist along these gold belts.

Few of the mines of the South are equipped with modern milling plants, the general practice being stamp-milling followed by amalgamation and concentration.

A few mines in the last decade adopted the Thies chlorination process for treatment of concentrates. This process consisted in roasting the concentrates in hand-rabbled reverberatory furnaces and, after cooling, chlorinating in one-ton barrels by the use of bleaching powder and sulphuric acid. The gold-bearing solution was filtered through a sand filter and precipitation effected by means of ferrous sulphate. The cost of treating 12 to 15 tons per day was about $3 per ton.

Although amalgamation and concentration have outlived all other processes, the saving has been low. The average by amalgamation is about 35%, rarely 50%. Concentration effects 15 to 35% more, the loss being in fine and rusty gold. The usual hard quartz ores retain the gold in a very finely divided state. After passing a 30-mesh battery screen, much of this gold is almost microscopically small and, being suspended in the pulp, is not amenable to saving by these mechanical processes.

Early attempts with the cyanide process were not encouraging. In some cases the leaching process was tried, but as no separation of slime from the sand was made, a very poor extraction resulted. In other cases the ores were not crushed fine enough to liberate the values. Thus, for one reason or another, the various attempts did not succeed.

The Iola mine, Montgomery county, North Carolina, has the distinction of being probably the first to erect a successful modern cyanide plant, treating both the soft oxidized ores and the hard compact ores from below water-level. This mine is in the Carolina slate belt. The ores are very hard and tough slate with quartz. The vein is about 2 to 3 ft. wide, and the sorted ores run in the neighborhood of $13 per ton. The production is about 65 tons per day, and this is reduced by sorting to 50 tons. The cyanide mill has every modern accessory, consisting of five 1750-lb. stamps, 7-in. drop, 107 drops per minute. Screen aperture is about $\frac{1}{3}$ in. and stamp-duty is 10.5 tons.

The resulting pulp is all-slimed in a 4 by 20-ft. tube-mill with a Dorr duplex classifier in closed circuit. The slime is thickened in a Dorr thickener and then agitated in three Parrall agitators in series. After agitation, filtration takes place in a Kelly filter. The slime cakes are passed through a disintegrator and sluiced to the dump. The solutions are precipitated on zinc shavings. The extraction is in the neighborhood of 95%, and the cost of milling and cyaniding is about $1.64 per ton. A special feature to be noted is the non-colloidal nature of the slime. This ore when ground to 200 mesh still retains its crystalline properties, and settles rapidly, thereby requiring a pressure filter rather than a vacuum.

The Uwarra Mine and Mill

The Uwarra gold mine, Candor, Montgomery county, North Carolina, adjoins the Iola property on the north. Development of the mine was carried on for about a year previous to the erection of the mill. The underground workings aggregate a mile, and several thousand tons of ore is blocked out. The ore is similar to that of the Iola, and 50 tons is passed through the mill, which is thoroughly modern. The ore is hoisted from the mine in cars and trammed over a trestle to the crusher ore-bin. From this it is fed to a Blake crusher and crushed to pass a 1¾-in. ring. The crushed product is delivered on a belt-conveyor (22° incline) which carries it to the steel cylindrical mill bin. From

this the ore is automatically fed to crushing rolls and crushed to pass ¼-in. mesh. This product is delivered to a classifier with mill solution. The slime is separated and the coarse ground in a 5 by 20-ft. tube-mill. The slime was thickened and then agitated in mechanical agitators, afterward being elevated to storage and filtered in a pressure filter.* The solution is precipitated on zinc shavings.

The Hog Mountain gold mine is situated near Alexander City, Alabama. This property has had a long, successful record. The ores here are quartz. The surface ores were dry crushed by rolls to ⅛-in. mesh, then trammed to 125-ton vats and leached with cyanide solution. Recent improvements for treating the hard refractory sulphide ores consist of crushing dry with rolls, tube-milling with cyanide solution, and passing the tube-mill discharge, without classification, over blanket tables to the leaching tanks. A 75% extraction was made on a $5 ore, distributed as follows: Extraction in tube-mill, 8%; concentrates, 42%; leached in tanks, 25%; total 75 per cent.

The concentrates were re-run over blankets, and, as shipped, assayed over 100 oz. gold and 15 oz. silver. The concentrates also contain several per cent of bismuth. This mill is operated by hydro-electric power, and costs are very low.

In conclusion, it may be said the southern gold ores are no more difficult to treat than the ores of other sections of the United States, nearly all the surface ores being amenable to cyanide treatment.

Further, the South has in its favor an excellent climate, without the drawbacks of the desert or the frozen mountainous districts of the West.

There is generally an abundance of good water, and water-power is available, or can be made so, in many of the districts.

Fuel, lumber, and all mining supplies can be laid down at the property at much less cost than in the West. Although common labor is cheap, the better labor and skilled labor commands about the same prices as in the West.

With all these favorable conditions, the South should take first rank for producing an ounce of gold at less cost than any other section of North America.

WASTE-ROCK GOLD CONTENT was the subject of an impromptu discussion at a meeting of the Chemical, Metallurgical and Mining Society of South Africa on October 17, 1914. The arguments were interesting, but the members decided that it was informal, and the discussion, therefore, will not be published.

GOLD OUTPUT of the East Rand Proprietary mines, Transvaal, in November, totaled 51,633 oz. from 165,000 tons of ore, crushed by 820 stamps and 25 tube-mills. The profit was $336,000.

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*Use of the agitators has been discontinued and other changes made in the flow-sheet, as shown by Andrew Walz, *Mining and Scientific Press*, December 12, 1914.

Mineral Production of the Dutch East Indies

The principal islands of the group are Banka, Billiton, Borneo, Celebes, Java, and Sumatra. The production of the government tin mines at Banka during last year was 34,481,168 lb., and of the Billiton (private mines) 10,064,816 lb. Some 4,938,800 lb. of Billiton tin was sold at Batavia during last year. Government tin is shipped to the Amsterdam, Holland, market for sale, and during 1913, 32,127,525 lb. was exported on government account. There were no shipments of tin to the United States during 1913.

The Ombilien coal mines (government) in southwest Sumatra increased their output from 408,204 tons in 1912 to 411,083 tons in 1913. This coal was formerly exported to the Straits Settlements and China, but during last year the output was used by the local government. The price of Ombilien coal during the past year was about $6 per ton.

The Puloe Laut coal mines (southeast Borneo) have been purchased by the Netherlands India government during the past year for, it is stated, about $1,280,000.

The Samarinda (East Borneo) coal mines also belong to the government, and produce a fair quantity of inferior coal, which is used entirely for local purposes.

The general output of the few gold mines in this colony during last year was considerably below that for the previous year, and the only two mines giving any results were the Redjang Lebong, Sumatra, producing during 1913 $1,050,000 worth of gold, and Simau, Sumatra (near Redjang Lebong), producing $880,000, and the Ketahoen nearby. While the production of the Redjang Lebong is decreasing each year, that of Simau shows a slight increase. There are two gold mines in the Celebes which, during 1913, produced some gold, namely, the Paleleh and the Totok, with outputs valued at $365,000 and $330,000 respectively.

The oil industry in Netherlands India (Borneo and Sumatra) continues successful, and the output is increasing each year. The yield for 1913 is reported as 1,503,660 tons.—*Daily Consular Report.*

A COMPLETE ANALYSIS of coal gas made in Pittsburgh is as follows:

Constituent.	Formula.	Per cent.
Carbon dioxide	CO_2	2.63
Oxygen	O_2	0.81
Carbon monoxide	CO	13.25
Hydrogen	H_2	37.33
Methane	CH_4	31.13
Ethane	C_2H_6	2.10
Propane	C_3H_8	0.43
Ethylene	C_2H_4	6.05
Propylene	C_3H_6	0.60
Butylene	C_4H_8	0.11
Benzene	C_6H_6	1.33
Nitrogen	N_2	4.23
Total		100.00

Draining Kerr Lake at Cobalt, Ontario

By BEN HUGHES

*Operations in the draining of Kerr lake of water and mud so that it could be prospected from the surface ceased for the year in the second week in November. It was hoped at the beginning of the year that the bed of the lake would be cleared before the frost stiffened the mud, but the boulder clay presented problems that had not been fully considered. Much preliminary work had to be completed before it was possible to start the actual dewatering of the lake, but actual pumping commenced August 28, 1913. An amendment had been inserted in the mining act of Ontario which made it possible for companies to undertake the draining of the lake in order to reach ore. The owners of the Drummond mines made objection and carried their case to the courts. Finally the matter was settled by the Kerr Lake Mining company and the Crown Reserve Mining company buying what is known as the Drummond Fraction, consisting of seven acres under the lake and some littoral, for $150,000.

No further incentive to drain the lake was needed than that up to the end of the year before the work actually commenced, the Crown Reserve Mining company had won 17,003,821 oz. of silver, all from under the 42 acres which the lake originally covered. A considerable portion of the very heavy production of the Kerr Lake Mining company also was from below the water line, and the Drummond Fraction presented ground well worth prospecting. All these mines had raised on their veins under the lake as far as they could with safety.

Drainage operations have been carried out jointly by the Kerr Lake and the Crown Reserve mining companies. From the nature of the lake the Kerr Lake has been the first to obtain definite results. This Company has opened its 10 and 17 vein systems on the surface as well as numerous stringers, and the resulting discoveries have undoubtedly added to the life and value of the mine. The whole of the Kerr Lake area under the lake will probably be cleared of detritus next year. The rewards will come more slowly to the Crown Reserve, as the acreage to be cleared lies right in the bed of the lake. Eight acres have yet to be cleared of boulder clay before

*I am greatly indebted for most of the details contained in this article to H. G. Stewart, superintendent for the Crown Reserve Mining Company.

REMOVING MUD FROM BOTTOM OF THE LAKE BED.

surface prospecting can be efficiently undertaken. The dewatering of the lake proved to be a minor problem compared with that of taking out the mud, and that again was a much simpler problem than the pumping of the clay. During the winter, while the pumps are inactive, a certain amount of water naturally finds its way back into the lake, but last spring it only required eight days to pump it dry, so that this does not play any considerable part in the operations.

Results at Kerr lake are being carefully watched in other portions of the district, where preparations have been made or are contemplated for the draining of lakes and the recovery of known or probable ore underneath them.

The area of Kerr lake amounted originally to 42 acres, of which the Crown Reserve Mining Co. owned 23, Kerr Lake Mining Co. 12, and Drummond Mines 7. A ditch was dug by the Crown Reserve Mining Co. some six years ago from the west end of the lake and leading to Glen lake. By this means the lake level was reduced by eight feet, clearing sufficient area of the Crown Reserve to erect necessary buildings. For the recent work a scow was erected, the dimensions of which were 40 by 20 ft. and the depth 4 ft. It has approximately 70 tons displacement. On this scow was erected four single-stage centrifugal pumps which were arranged in two units, each unit consisting of a compound pumping outfit of two pumps direct-connected by a flexible coupling to a 250-hp. motor. The suctions were 12 in. and discharges 10 in. The runners are of the enclosed type and capable of delivering boulders up to approximately 4 in. diameter. Each of these units was capable of delivering 3000 gal. per minute on a maximum head of 185 ft. with an efficiency of approximately 65%. When the pumping operations were begun, the four pumps worked in parallel, each discharging into a 14-in. pipe and thence to the 20-in. main line. When the level of the lake had been reduced by approximately 15 ft., a change from operating the pumps in parallel to a series of two units, was made. By this means, two units each of a two-stage tandem pump were obtained. While the volume of water pumped decreased, still the efficiency of the outfit was increased to approximately 75%. For priming purposes, a small air-driven plunger pump was used on the scow. During the early period of the operations, the water for this purpose was secured from the Kerr lake, but as the work proceeded and the water became muddy, it was necessary to secure it from the fresh-water plant at Giroux lake. Two of the flexible joints were used in order to allow for any swings that might take place. One was placed on the scow and another upon a concrete pier on the shore. It is the intention to place another half way between these points, set on wheels, which in turn will be on a track so as to allow for a maximum horizontal swing which might take place owing to the mud-slides or other accidents. The water from this plant was handled through a 20-in. spiral riveted pipe, from which it was conveyed to Giroux lake, where it was discharged. Expansion joints were also placed in the line at certain points which each would allow for 16-in. plug. A 12-in. bypass was also put in which would allow for draining the line when necessary.

To date, a total amount of 635,000,000 gallons of mud and water has been pumped, and the lake has been lowered an average of 65 ft. This is an approximate figure, as owing to the depression at the lake bottom, it is a difficult matter to get the correct depth.

At the time that pumping was begun, a fresh-water plant at Giroux lake, consisting of two 500-gal. centrifugal pumps, direct-connected to 45-hp. motors, was erected to supply fresh water to the various mines affected by the drainage operations.

During the past summer, a pump of 5000-gal. capacity was installed to furnish necessary water for hydraulicking purposes. This has consisted largely of cutting channels in the mud bed to a certain point, and then retreating back to the scow, breaking down the sides on the return. This scheme has worked satisfactorily, and it is hoped that after another summer's operation the mud will be almost removed from the bottom of the lake.

The Origin of the Dolomites

By FRANCIS M. VAN TUYL

*A careful study of the dolomites of the upper Mississippi Valley was undertaken for the Iowa Geological Survey during the field season of 1912. More recently a grant from the Esther Herrman Research Fund of the New York Academy of Science has made possible much more extensive studies of the dolomitic limestones of the Eastern and Central states. The present preliminary paper is intended merely to set forth some of the more important results of these studies.

Previous theories of the origin of dolomite are briefly considered, after which the problem is attacked from three standpoints, namely: the experimental evidence; the field evidence; and the petrographic evidence. The conclusion is reached that the great majority of the dolomites, ranging in age from the Cambrian to the present, have resulted from the replacement of limestones before they emerged from the sea. The replacement need not be accompanied by shrinkage, as formerly supposed, but may proceed according to the law of equal volumes, as enunciated by Lindgren. Furthermore, certain cases of apparent interstratification of limestone and dolomite cited as evidence in favor of the primary theory are rather pseudo-interstratifications, which have resulted from selective dolomitization. Examples of limestones mottled with dolomite are interpreted as representing an incipient stage of the process of alteration. Organic factors have exerted a selective influence in some cases of mottling, but in others the phenomenon is purely inorganic.

*Abstract of a paper read before the Geological Society of America, Philadelphia, December 29-31.

Rhythmic Precipitation of Ferrous Ferri-Cyanide and Ferrous Hydroxide in Jelly

By H. J. M. CREIGHTON

*When a drop of silver nitrate solution is placed on a thin layer of gelatin containing potassium dichromate, silver chromate precipitates out in circles which are concentric to the drop of silver nitrate. This precipitation of silver chromate has been investigated during the past few years by Liesegang and others.[1] Analogous phenomena have been observed by Liesegang[2] with mercurous chromate, lead chromate, and Prussian blue, and by Morse and Pierce[3] with lead sulphate, silver carbonate, phosphate, bromide and thiocyanate, cobalt hydroxide, barium chromate, and mercurous bromide. This phenomenon of rhythmical precipitation is explained by Ostwald's theory of supersaturation.[4] I have recently observed phenomena similar to the foregoing with Turnbull's blue and ferrous hydroxide.

The horizontal part of a glass tube 70 cm. long and 2 cm. in diameter the ends of which were bent up at right angles, was filled with a 10% solution of agar-agar containing small quantities of potassium ferri-cyanide and sodium chloride. After the jelly had solidified, the vertical arms of the tube were filled with a dilute solution of sodium chloride, and an iron electrode, made from a clean wire nail, was placed in the liquid in each arm. An electric current having a potential gradient of 0.00679 volt per cm. was then passed through the jelly.

Within a short time after the current was started, the end of the jelly near the anode became blue, and for four days the blue color continued to advance through the jelly. During the following 24 hours there was no perceptible advance of the color, but at the end of this time a very thin dark blue layer or disc was observed to have formed in the jelly at right angles to the axis of the tube. This blue disc gradually increased in thickness during the next few hours until it attained a width of 1 mm. This disc, which was more intense in color than the blue jelly behind it, was separated from the latter by 3 mm. of practically colorless jelly. At the end of another 24 hours a second disc had formed which was separated from the first by 4 mm. of colorless jelly. In this experiment a new disc appeared every 24 hours, the discs forming in the direction of the flow of the electric current.

An experiment similar to the foregoing was carried out, except that the jelly contained small quantities of sodium chloride and phenolphthalein. The ferrous ions diffused into the jelly under the influence of an electric current having a potential gradient of 0.0093 volt per cm. The progress of the hydroxyl ions was followed by means of phenolphthalein. The ferrous and hydroxide ions, which were moving in opposite directions, met at the end of 115 days from the beginning of the experiment, and a dark green layer or disc of ferrous hydroxide was precipitated in the jelly at right angles to the axis of the tube. At the end of 24 hours, a second disc was observed to have formed. This was separated from the first by 3 mm. of jelly, colored pink by the phenolphthalein. Every day or two a new disc formed, each being separated from the preceding by several millimetres of pink jelly. The discs formed in the opposite direction to the flow of the electric current. The time at which each disc appeared, and the distance between each and the preceding one is shown in Table I. The ferrous hydroxide discs always commenced to form at the bottom of the tube and continued to grow toward the top, always sloping in the opposite direction to the flow of the electric current. Sometimes a new disc started to form before the preceding one was completed. In such cases the old disc ceased growing.

TABLE I

	Turnbull's blue discs.		Ferrous hydroxide discs.	
Number of disc.	Time of appearance of discs, days.	Distance between consecutive discs, mm.	Time of appearance of discs, days.	Distance between consecutive discs, mm.
1	0	...	0	..
2	1	4.0	1	3
3	2	4.0	2	5
4	3	5.0	3	3
5	4	4.0	4	5
6	5	3.5	5	4
7	..	...	6	4
8	..	...	9	6
9	..	...	11	4
10	..	...	14	6

The cause of the rhythmical precipitation of Turnbull's blue and ferrous hydroxide may doubtless be ascribed to supersaturation phenomena. As the Fe^{++} ions are carried into the jelly by the electric current, a metastable supersaturated solution with respect to Turnbull's blue first forms. Ultimately precipitation occurs and the $Fe(Cy_6)^{---}$ ions in the neighborhood are removed; the Fe^{++} ions then advance a few millimetres and form a new supersaturated solution, when the process is repeated. In the case of ferrous hydroxide, the OH^{-} ions form a supersaturated solution with the Fe^{++} ions. After precipitation has taken place, the OH^{-} ions must advance a few millimetres before a sufficient number of Fe^{++} ions are encountered to form a new supersaturated solution.

*From *Jour.* Amer. Chem. Society.

[1] R. E. Liesegang, *Z. physik. Chem.*, 23, 365 (1897); 59, 444 (1907); 88, 1 (1914); Morse and Pierce, *Ibid.*, 45, 589 (1903); Bechhold, H., *Ibid.*, 52, 185 (1905).

[2] 'Chemische Reaktionen in Gallerten,' Düsseldorf, 1898.

[3] *Loc. cit.*

[4] 'Lehrb. d. allgem. Chemie,' 2 Aufl., 2, 778.

Prospecting Wet Placer Ground by Shaft Sinking

By DONALD STEEL

A rather general opinion seems to prevail among mining engineers that shaft sinking in loose wet ground is not a reliable method of prospecting. While this opinion may be in general justified, the work described below is thought to have given reasonably correct results.

The ground prospected was a loose creek wash averaging about 14 ft. deep with water-level at about 8 ft.

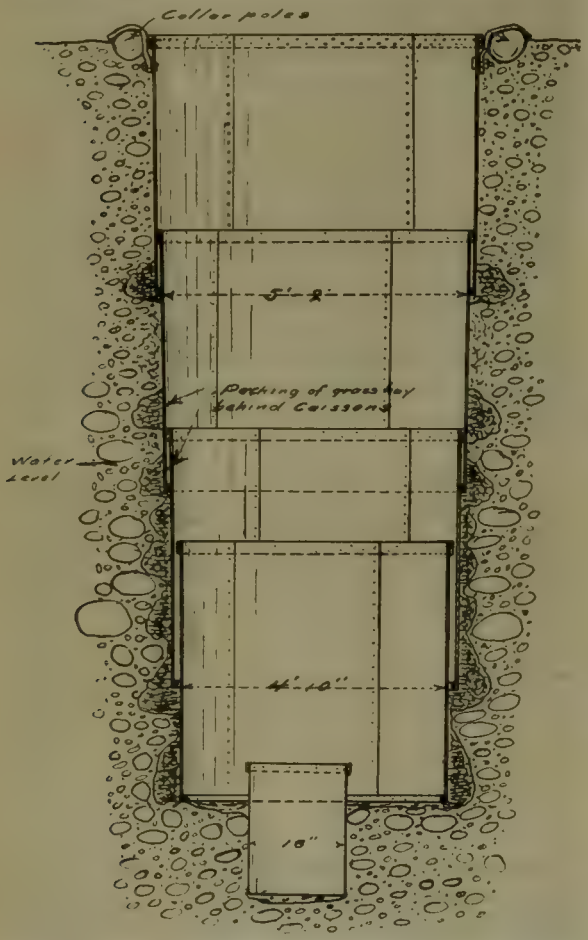


FIG. 1. SECTION THROUGH SHAFT SHOWING PACKING BEHIND CAISSONS AND METHOD OF SAMPLING BOTTOM OF SHAFT.

The greatest depth below water was in a hole 17.8 ft. deep with water-level at 6 ft. The crew required for this work was three miners and a panner, and the average speed of sinking was 4.4 ft. per 9-hr. day, including all lost time.

Equipment.—The main features of the equipment were:

1. A nest of seven caissons of ⅛-in. steel, 4 ft. long, and ranging from 5 ft. 2 in. to 4 ft. in diameter, slightly tapered to allow them to telescope readily. Each caisson had a band of ½ by 2-in. steel on the outside of the larger or top end, and a band ⅜ by 1¼ in. on the inside of the bottom end. These bands served as stiffeners and also to prevent the inner caisson from slipping entirely past the outer in telescoping. The method of using the caissons is illustrated in Fig. 1.

2. A windlass, bucket, and rope.

3. A sheet of heavy canvas covered with sheets of 16-gage iron for receiving the sample from the bucket.

4. A measuring box of ½-cu. yd. capacity.

5. A long-tom with accessories.

6. A 2½-in. pump with a 3½-in. suction and a 3-in. discharge, driven by a 4-hp. gasoline engine.

FIG. 2. LOADING A 4½-FT. CAISSON.

7. A 3½-in. pump with 3½-in. connections driven by a 6-hp. gasoline engine.

8. A small caisson, 18 in. diam. by 24 in. long, for taking samples in the bottom of the shaft.

9. A measuring box of 2-cu. ft. capacity.

10. A stump puller with cable, sheave, and hooks for pulling the caissons.

11. Two large canvases, cord, and sealing wax for sealing the shaft.

Sinking.—The ground above water was usually of comparatively low grade. In such cases a sample of 30-in. diameter was cut from the surface to water-level and kept apart until the shaft water should be sufficient for washing. As soon as this pit became so deep that there was danger of caving or it was difficult to shovel out, the bottom was covered with sacking and the pit was reamed out to the size of the first caisson. The caisson was then put in place and sinking was continued in the small pit. As soon as the first caisson was down, the next smaller was put in place and was lowered as sinking progressed. In some cases this system was varied by taking every fourth shovelful for the first sample, and in some instances water was brought

from the creek in a hose and the entire content of the shaft was washed as excavated.

At water-level an excavation was made around the outside of the bottom of the caisson and was filled with soft grass hay. The caisson was then driven down, leaving a packing of hay around the entire outer circumference. Care was taken below water-level to keep the bottom of the caisson close to the bottom of the shaft and to keep all space behind the caissons firmly packed with hay. In this way no considerable motion of ground was allowed to start, and the settling of the gravel on the packing served to shut out any flow of sand from above and a good deal of water. The bedrock was soft, so that high points could be removed, letting the caisson down around its entire circumference.

The efficiency of the packing was shown in several instances where shafts were sunk adjacent to others in which no packing had been used. As they were sunk at different times and by different engineers, no close comparison can be given. It is significant, however, that the required pump capacity and the amount of ground handled were noticeably less where the packing was used.

Sampling.—As it was impossible under the conditions to get an accurate measure of the space excavated, all figuring on samples from below water-level was done from measurements of the excavated material.

It was found by measuring excavations above water-level, and by settling the excavated material in a measuring box with water so as to fill the voids with fine material, that a close approximation could be made to the original volume. Where there was a considerable amount of soil present, there was generally a slight shrinkage in settling the excavated material. Where the gravel was solid, there was sometimes as much as 5% swell; but for the loose creek gravel the two measurements checked as closely as could be expected of two independent measurements.

At water-level, or as soon as considerable gold was found, the entire content of the shaft was saved and washed. In addition, whenever there was a marked change in value as indicated by panning, or whenever it was seen that sand was running under the caisson, a small sample from an 18-in. caisson was taken from the centre of the shaft as a check against the remainder of the shaft area. This sample was clearly not affected by run-in, and where it differed materially from the larger sample due allowance was made.

A new sample was started: (a) when there was a change in the formation or in the values as indicated by panning; (b) whenever a new caisson was put in, changing the diameter of the shaft; (c) whenever there was a shift of the crew.

FIG. 3. SHAFT EQUIPMENT: (1) LONG-TOM ENGINE; (2) LONG-TOM; (3) MEASURING BOX, ½-YD.; (4) SMALL MEASURING BOX; (5) CASING, 18-IN., FOR SAMPLING SHAFT; (7) CANVAS COVERED WITH SHEET IRON; (8) PUMPING ENGINE.

FIG. 4. WASHING PLANT: (1) SAMPLE OF IRON SHEETS; (2) MEASURING BOX; (3) LONG-TOM; (4) LONG-TOM ENGINE; (5) HOSE FROM PUMP.

Measuring Samples.—The plant used for handling and washing the samples is illustrated in Fig. 3 and Fig. 4. The material from the bucket was dumped on a 16-gage iron plate under which was a large canvas to prevent loss. From the plate it was shoveled into a measuring box of ½-cu. yd. capacity. This box was

made 2.4 ft. wide by 5 ft. long, so that each inch in depth represented one cubic foot. Water was poured into the box as the gravel was being shoveled in, and the larger rocks were buried in the finer matrial. When the box was full and well settled by puddling with a shovel and pounding on the sides of the box, it was marked on the log and washing was begun.

The long-tom driven by a 1¾-hp. gasoline engine, as shown in Fig. 4, proved a very efficient part of the equipment. One man with the occasional help of the pump tender had no trouble in washing the gravel as fast as delivered from the shaft and in cleaning up after each ½ yd. of sample. The riffles used were a combination of Hungarian riffle and cocoa matting with expanded metal.

Nature of material.	Vol. of hole, cu. ft.	Vol. excavated material, cu. ft.
1. Medium to coarse gravel	37.2	38.4
2. Medium gravel	22.4	23.0
3. Medium gravel	34.0	35.0
4. Fine gravel and sand	14.7	15.0
5. Medium gravel, surface to bedrock	46.0	45.0
6. Medium gravel, some sediment	19.6	19.0
7. Medium gravel	108.0	109.0

Figuring Values.—In figuring the results, the value per cubic yard of each sample was multiplied by the depth represented, and the sum of these products was divided by the sum of the depths, or the total depth of the shaft. A factor for swell was applied to this result, giving the average value for the hole.

In summing up the possible sources of any considerable error and the ways in which it was attempted to guard them, possible sources of error may be noted as: (1) error in measurement of volume; (2) salting of sample by fine material washed under the caisson; (3) inflow of barren sand and consequent lowering of average value; (4) loss by imperfect cleaning of bedrock; (5) loss in tailing; (6) possible wilful salting. Considering these, it may be noted that:

1. The close agreement of all measurements of loose materials with the measurements of their respective pits where these could be measured gives confidence.

2 and 3. The inflow of sand was prevented to a large extent by the packing of grass hay, and where it was impossible to prevent it a sample unaffected by the run-in was obtained with the small caisson.

4. With the caisson close to bedrock and most of the water shut off, the bedrock was easily cleaned and tested.

5. Frequent panning and occasional washing of large samples of the tailing from the long-tom showed it to be a very efficient gold saver.

6. Frequent cleaning up and systematic shifting of the crew; check samples with the small caisson; and continual panning ahead of the shaft make undetected salting by any member of the crew, excepting the panner, impossible. Careful sealing of the shaft at night and separate washing and weighing of the first box of dirt in the morning make a good safeguard against salting during the night.

Preservation of Timber in Mining

By F. K. R. MOLL

There are four main fields in which timber is used in enormous quantities and where by natural conditions this timber is rotting extremely rapidly. Telegraph and telephone line poles, railway ties, the piles and jetties of harbors, and mine timbers last when untreated so short a time, that, if means be not found prolonging the lifetime by artificial processes, the use of iron and concrete soon may be more profitable. In consequence of this fact the preservation of timber has become more and more common in recent years in the United States. It is in mining that up to this time almost nothing has been done. Unmeasurable quantities of timber and millions of dollars are therefore lost every year.

From the year 1905 Kellog in the U. S. Department of Agriculture Circ. 49 gives the following figures on the amount of timber used in mining, (all data in cubic feet, round and sawed timber combined):

	Cu. ft.
Bituminous coal mines	103,000,000
Anthracite mines	52,000,000
Precious metal mines	29,000,000
Iron mines	15,000,000
Miscellaneous	2,000,000
Total	201,000,000

If the production in the year 1905 be taken at 69,000,000 tons of anthracite, 287,000,000 tons of bituminous coal, and 24,000,000 tons of iron, the amount of timber was 0.75 cu. ft. per ton of anthracite, 0.36 cu. ft. per ton of bituminous coal, and 0.85 cu. ft. per ton of iron ore. In the year 1912 the amount of timber per ton in the German mines was 1.0 cu. ft. for anthracite, 0.33 cu. ft. for bituminous coal (lignite), and 0.2 to 0.7 cu. ft. for iron. There is evidently no great difference. Using these units and the production of 1910 the total quantity of mine timber will be found to be as below:

	Tons.	Cu. ft.	Cu. ft.
Anthracite mines	85,000,000	× 0.75 =	64,000,000
Bituminous mines	370,000,000	× 0.36 =	134,000,000
Iron mines	24,000,000	× 0.85 =	20,000,000
Other mines			42,000,000
Total			260,000,000

This is equivalent to 7,400,000 cu. m. The German mines used in the same time about 6,300,000 cu. m. = 220,000,000 cu. ft. of timber; that is only 15% less than the American mines. Of the 260,000,000 cu. ft. of mine timber, nearly 170,000,000 cu. ft. was hardwood, and only 90,000,000 cu. ft. softwood. Among the softwoods pine ranks first with 40,000,000 cu. ft.; among the hardwoods, oak with 40,000,000 cu. ft. On the contrary in Germany only 2% of all mine timber was beech and 1% oak, nearly all the remainder was pine.

The price for mine timber is rising from year to year

and is today about 6.5c. per cu. ft. for round timber and 20c. per cu. ft. for sawed timber; an average of 8c. While the timber was formerly cut near the mines, today these forests are exhausted and only second growth round timber of small dimensions is available. Most of the sawed timber, boards, lagging, and planks must be shipped in from great distances. The United States faces now the same situation that Europe faced 30 years ago.

Slowness to Adopt Process

Compared with the annual cut of timber the amount of mine timber used in the United States is only 1%; but it should be realized, that every year four times the annual growth is cut. If only the annual growth were cut and the capital of the forests were kept constant, the percentage for the mine timber would be 3.3. More than 50% of this timber is every year lost by decay in the mines, while the percentage of timber for new work is ridiculously small. To the trained engineer it is astonishing and incomprehensible, that in spite of the knowledge of this fact, up to this time almost nothing has been done for the artificial preservation of mine timber. It is true, there is some interest in the question of timber treating even among the mining people, but if one asks: "Why then do you not begin with treating?" the answer is: "Oh, first we must try this thing, we have read and heard this and that, and some processes are offered to us, but without our own experience we cannot start with timber treating. So we have set some 10 or 20 test props and if they prove to be good, we will take up the matter."

A practical engineer however, never expects to study all problems himself and to try out all processes in his own plants. He determines first whether others have made the tests, and if he finds that they have done so he makes use of their results. In treating timber, and especially mine timber, so many tests have already been made that there is no longer any question as to what to do. It is possible that the tests now arranged may show that some new invented processes are more favorable than the old ones now in use, but I think, up to the time such tests are finished, it is safe to use the old processes of which the results have long been known. The technical journals of Germany, France, and England, where the matter of treating mine timber has long been one of great importance, contain a great number of articles giving the results of experience with a great number of timber-treating processes. It is true that even in Europe there was not much impregnation of mine timber during the nineteenth century, but since the year 1900 there has been a great change, especially among the German mine-owners, and in that country since the year 1905 no less than 100 large and small timber treating plants for mines have been erected.

Timber Preservation Important to Miners

Artificial preservation of timber is of especial importance in mines, for nowhere does timber decay as quickly, especially in coal mines. The most favorable conditions for intensive growth of the wood destroying fungi are the presence of a certain degree of heat and dampness. In most of the coal mines both the temperature and the dampness are such as to afford optimum conditions for the fungi. All other causes of destruction of timber are unimportant when compared with the decay. Wear and fire cause the loss of about 5%. Against the breakage, the consequence of crushing, squeezing, or swelling ground, it is possible to protect timber by special methods of constructing the sets. Against the damages caused by insects the best protection is to bark the timber as soon as possible after it has been cut. Against the decay the only remedy is impregnation with liquids poisonous for the fungi.

Artificial preservation of mine timber was first studied in the United States in 1906. At the suggestion of the U. S. Forest Service the Philadelphia & Reading C. & I. Co. carried out a great series of experiments. The Company placed about 1000 sets of round gangway timber that had been treated by 15 different methods, so that each method was tested by from 20 up to 150 sets. While this test marks a great step onward, it is regrettable that the number of tests was so small. This is the same mistake that the German mines made 20 years ago. With so small a number of sets for each test it is not possible to get positive results. The individual conditions of the timber, of the place where set and of the men watching the tests, may well influence to a high degree the results.

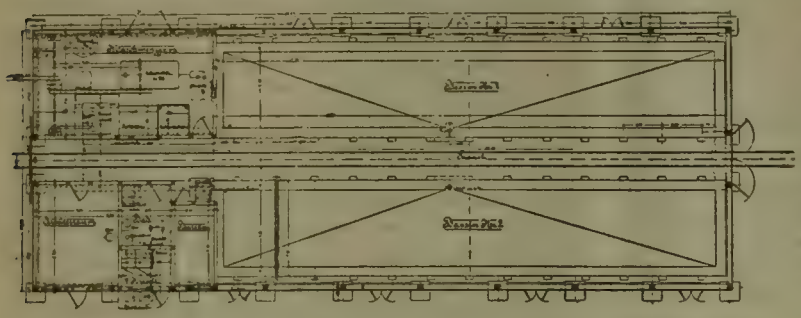
Unsatisfactory Methods Still Recommended

When studying the Forest Service *Bulletin* 107 it is interesting for the timber-treating engineer to see that processes, the uselessness of which has been realized in Germany for years, here get the certificate "not unsatisfactory." Processes such as the mere seasoning of the timber, charring it, and especially all kinds of paintings, including the so-called 'brush treatment' with tar, creosote, carbolineum, may be mentioned. In Circular No. 111, p. 11, Nelson states the disadvantages of brush treatments in the following words: (1) the difficulty of completely covering the timber and filling all checks and cracks; (2) the very slight penetration secured. The subsequent checking or opening of the timber may often allow disease to pass through the shallow exterior band into the interior wood. "And yet only one passage before," he says, "for small individual operators who cannot afford the cost of a large plant, brush treatments are feasible and economical." Testing this by the long experience of European administrations and private concerns, it seems to be a dangerous error. Again and again it was found in tests that were not based only on 2 or 3, or even 20, but on thousands of ties, poles, and props, that brushing the timber not only is of no advantage, but may even be a great disadvantage if the cost is greater than the prolongation of life.

Experience with the open-tank system has been as good or even better, as Mr. Belson shows. The prolongation of the life of mine timber in the tests was remarkable. The question will be, if the economic result, too, will be

good. That depends on the cost of the antiseptic. Using a solution of chloride of zinc or commercial creosote the impregnation was without any doubt to a certain degree economic.

The investigations of the Forest Service did not touch the matter of the influence of the impregnation on the health of the workman and miners. That is regrettable, for in Europe, where now more than 250 mines use treated timber, much trouble has been caused by the use of inappropriate antiseptics. Especially creosote, one of the most common means for treating timber, and that even in the tests of the Forest Service gave the best technical results, has been almost entirely abandoned in the European mines because of its marked influence on



OPEN-TANK PLANT FOR KYAN PROCESS.

the skin and eyes of the miners and the increase in the fire risk.

In the following pages I shall deal more especially with the experience of European mines. The engineering journals of Germany, England, and France contain many articles on timber treating in mines, but since more than three-fourths of them are written by persons interested in some way in the production and the sale of special compositions for impregnation, I prefer to use in this paper data collected from the mines through direct correspondence or personal inspection.

History of Process

Information on preserving mine timber before 1910 is rather scanty. The first reference I found ('Franklin's Journal,' 1831) relates that in 1831 a French engineer, Bréant, read a paper on wood preservation and showed a collection of impregnated wood before a circle of mining engineers pointing out the great importance of his invention to the mining industry. Real impregnation seems first to be executed with creosotnatron. This was at a time when, in mining, artificial protection of wood was not thought of. This may seem strange at first sight, the more so since creosotnatron has been used nowhere else. Contrary to the custom at anthracite mines, in lignite mines the wood is worked up at the mine to recover, if possible, paraffin. One by-product, and a very troublesome one, is creosotnatron, which is often used for fuel, although this use is difficult because of the high percentage of caustic soda lye. Nor can this be turned to waste in streams. Thus, curiously enough, preservation of timber was not begun so much in order to preserve the wood, but to get rid in the cheapest way of a by-product which otherwise was difficult to dispose of.

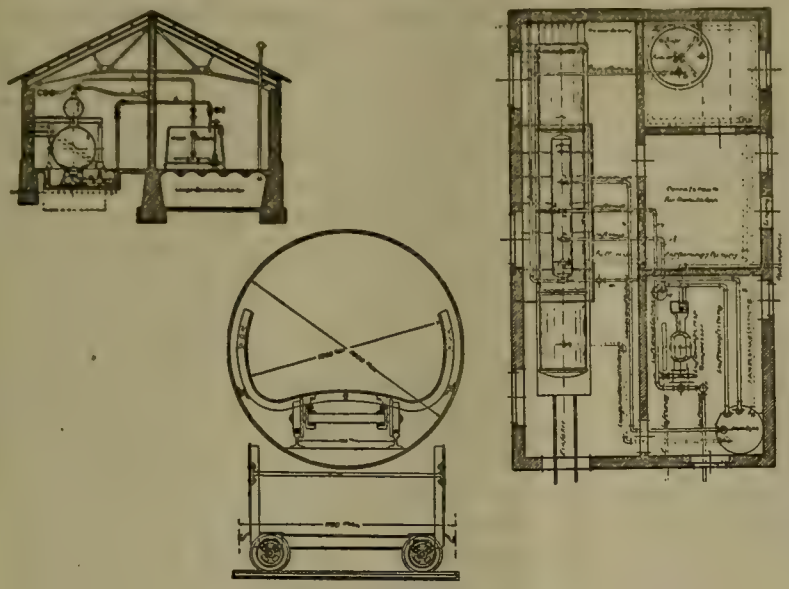
From 1890 to 1900 a number of mines were reported to soak their mine timber in hot tar or salt solutions. But until 1900 only desultory trials and proposals occurred without any connection or system. Doubtlessly wood has been preserved in mines far more often than might be supposed from the scanty literature, but certainly the question of preservation was not recognized as of general importance in mining before 1900. Then the conviction began to gain ground that economical reasons demanded preservation of wood for mining purposes as well as in the case of telegraph and railway uses. Establishments were erected and investigations on different questions connected with preserving mine timber came so rapidly that it is nearly impossible to quote them here chronologically. What preservation has become for mining in the past 14 years and which experience has been obtained in this time may, however, be shown.

What Is Mining Timber?

At first it is necessary to answer the question, what is to be understood under the term 'mining timber'; a question which will be answered rather differently according to who is asked. At a mine using the timber, the answer would be: mine timber in the narrow sense of the word is all timber serving for construction in the mine, chiefly the timber for pillars, props, slabs, and the ties for the mine railways. This wood is destined to keep the rooms of the mine open, to secure against roof falls and walls slabbing off, and to help win the minerals. Mine timber in the wider sense is all other timber employed underground and above ground, as in shafts, the sheds over the shafts, storehouses, cooling towers, and other buildings. Contrary to the general opinion of wood owners, mine timber is far from being wood useless for other purposes. In fact, it comprises many different sorts and classes. Duration of wood is not always the deciding factor. The more intensively a mine is working, the shorter the continuation of work at one spot will be, and it may occur that a place will be abandoned or filled with waste only a few days or a few weeks after the starting of the work. This case, however, is exceptional and is only mentioned to point to the fact that, besides solidity, other properties of wood, such as the light weight, cheap price, and above all 'warning faculty,' are not to be neglected. In former times all over the world oak was considered the best wood for mine purposes. Yet with the continual rise in its price, it has more and more yielded its place to coniferous wood, and in the United States the soft wood now constitutes nearly one-third of the mine timber. Surely oak wood is durable, yet its price is high and the weight twice that

of pine. The 'warning faculty' of pine, too, is far better than that of oak. For these reasons the use of coniferous wood, and especially pine, is increasing from day to day.

The total value of mine timber amounts to about $21,000,000 annually in the United States (in Germany, $20,000,000; Austria, $3,000,000 for 45,000,000 cu. ft.). But only a few years since the mines have begun to consider the question of wood preserving, to decrease somewhat the immensely increased demand. In the year 1904 there were in the mining district of Dortmund, Germany, 16 mines which treated wood, and 25 others that had made trials. About 1903 the Silesian Mine Timber Impregnation Co., Ltd. (Wolman system), entered the field, and since then this Company has erected over 30 plants in Silesia alone. It will be helpful to review some of the experiences of the mines.



IMPREGNATION PLANT, WOLMAN SYSTEM.

Tar products, mixtures of carbolineum and chloride of zinc, creosote oil and chloride of zinc, carbolineum and solutions of 'waste salts,' pure creosote, and many other oils won from tar—offered often under most quaint names and at prices by far exceeding the real value ('Carbolineum Avenarius,' 'Barol,' 'Cruscophenol,' 'Carburol,' 'Exsiccator') were all tried at various mines. Not one of these won favor. The extreme improvement claimed for some of these oils rested upon some secret addition and the promises of advertisements failed to be made good. Salts suspended in the oil (such as chloride of zinc and chlorine gas in 'Carbolineum Avenarius,' copper salts in Nördlinger's 'Barol') are entirely useless, as has been proved beyond question by numerous impartial investigations. In all cases the price was far too high for mine purposes ('Carbolineum Avenarius up to 32c. per gallon). Many mines, too, are able to produce creosote from their own by-products and at a price of 4 or 6c. per gallon.

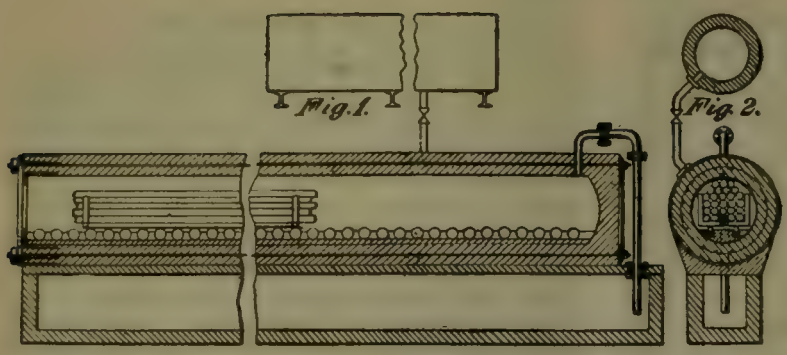
Salt Solutions Most Used

The technical methods advocated were painting (brush system), open tank, and cylinder treatment. The brush system proved to be entirely worthless. Open-tank systems, provided that the timber is soaked long enough and that the oil is hot, give better results. Tanks for this process were erected at numerous mines (a great number of them by Cruskopf), but only one mine is today using the process with creosote or cruskophenol; all others (39 in Germany) use now salt solutions.

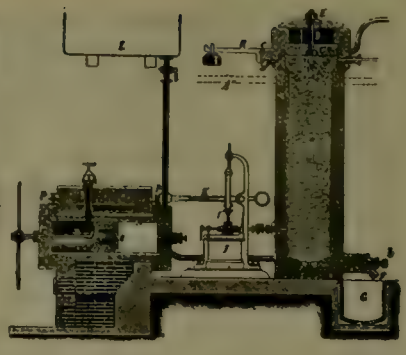
Impregnation in the cylinder has proved the best method, provided that the oil is cheap enough, as when obtained as a by-product at the mine. That is the case with Lothringen mine (Gehrte, Westphalia), that obtains the oil at a cost of 3c. per gallon. All reports show that the brush system is worthless, the open-tank system gives but little effect, and only the cylinder process gives good results. The chief condition, however, is the production of the creosote by the mine company itself.

If only prolongation of the duration were the point of interest, creosote might be called a very good antiseptic. In the course of time, however, so many unpleasant features have developed, just as with the similar creosotnatron, that a great number of mines have abandoned creosote. Stens, a Royal mine inspector, as a result of his experience as director of one of the greatest mines, enumerates these disadvantages as follows: "Creosote has a piercing, disagreeable smell; many men decline to work where wood preserved with it is employed; furthermore, creosote means a considerable augmentation of the danger of fire; where the men are sweating at the work, which in mining is the rule, the oil causes very disagreeable diseases of the skin." The ingredients, evaporating from the oil, affect the eyes. The timber becomes very heavy. An impregnation of only 6 lb. per cubic foot means, with pine wood, an increase of weight of about 20%. These statements were confirmed by a communication from the Belgian anthracite mines at Mariemont, which used creosote since the year 1899. In spite of the very satisfactory results, considering economy, the mine had to stop employing this process on account of the effect on the workmen. The same happened with the creosotnatron, used for more than 50 years in German and English mines. Most of these mines in the last years changed over to impregnation with salt solutions.

The influence of salt solutions on the duration of wood in the mines has been long known. The good preservation of wood in copper and iron mines where they were



CYLINDER OF REINFORCED CONCRETE, MOLL PATENT, FOR KYANIZING WITH PRESSURE.



BRÉANT IMPREGNATION CYLINDER.

traversed by the so-called 'cement waters,' that is, solutions of the vitriols made by a conversion of copper and iron pyrite, attracted attention long before a regular intended impregnation was thought of. In the Spanish copper mine, Rio Tinto, timber has stood since the times of the Romans. The first artificial impregnations were made with the salt brine and abraum salts of salt mines. Aitken in 1893 erected two iron tanks at the Niddrie mine in Scotland to impregnate timber with a concentrated solution of kitchen salt and magnesium-chloride. The Eschweiler Mine Union (Germany) has used the Burnett process since the year 1890, with chloride of zinc. This mine, however, was not entirely content with the results.

It may seem strange that the old methods of Boucherie, Kyan, and Burnett, well proved since the year 1850 by the railway and telegraph administrations, remained almost entirely neglected by the mining companies. As to chloride of zinc, the reason of this fact may have been the low efficiency of this salt. The Boucherie method met with other difficulties, mine timber being delivered to the mines (on account of the high freight) dressed and well seasoned, while the process is intended for use with fresh cut wood. The kyanising firms at that time had no plants in the mining districts. Thus it came that in mining, impregnation at first went its own way, without connection and totally neglecting the experiences of other industries.

Many mines use salt brine (Morl in Saxony, Hagenbeck, Humbold Neuglücker Verein, and Wische in Westphalia), others tried the processes of Hasselman, Viscal, Aczol, Wiese, Höttger, and Haskin. Most of these processes have completely disappeared and none are now of great interest. There was only one of the new processes based on the studies of the Austrian engineer named Malenkowicz, the Wolman process, that has won a leading position in mining. Wolman's metal-salt mixture processes, by skillfully measuring the single ingredients, has won position among the best processes for timber treating. The base of these mixtures is either the well known sodium fluoride or the bichloride of mercury.

To look closer at the demands, which can and must be met today by any successful method of preserving wood, especially mine timber, and to see how far the various more important methods suit these demands, they may be summarized as below:

1. Preservation is to prolong the duration of wood. For this purpose the substances employed must be injected into the wood in efficient quantity, either taking small quantities of highly effective substances or great quantities of little effective substances. The quantity of feeble salts, however, is limited by the quality of the wood. Salts can be injected in liquid form only, and pine wood cannot absorb more than 22 lb. of liquid per cubic feet. The more the concentration approaches the point of saturation of the solution, the more difficult this becomes. When using kitchen salt, 6 lb. of salt per cubic foot of timber should be used. That would mean a solution of at least 27%. According to practice it is far better to work with strong effective salts, of which small quantities of 1 lb. at most is sufficient. Such salts are sublimate, fluoride of sodium, and fluoride of zinc.

2. Economy is based upon the efficiency and on price. As to the efficiency it is difficult to find a fit scale. Often the numbers of cultures of fungi on gelatin and other substances are taken as a measure for the efficiency. Practice must, however, decide. Every culture works with a certain fungus, while in every mine, mixtures of most different fungi are found upon the wood. It is necessary to render the wood prophylactic, that is, to impregnate before putting in the timber, and to protect it against the strongest enemy to be expected. The methods used by the telegraph administration and proved by 50 years' experience yield the following succession as to duration and economy (based on the prices of today): Kyanizing and creosoting; burnettizing with chloride of zinc; boucherie process with sulphate of copper. Wolman's process with sodium fluoride may be ranged near the kyanizing process.

3. The antiseptic must not increase the combustibility of the timber, nor must it have a bad influence on the mine workers. The disagreeable effects of creosote have already been discussed. A mine director plainly said shortly: "Luckily these creosoted instruments of torture are put in only a few mines." It would be equally bad to raise the danger of fire in coal mines, great enough without that, by employing the oil. Creosote may therefore be dropped from further discussion.

4. Salt solutions should be made to penetrate all parts of the wood, which can be impregnated, at least the whole sap. Where one cannot work with cylinder, the timber should be immersed long enough in an open tank. When the wood has been well seasoned this will be sufficient in many cases, provided that the solutions are effective. Using sublimate (Kyan's process), the solution may be used cold. Wolman's fluoric salt mixture should be used only hot. If great quantities of timber are to be preserved, it is at any rate better to work with a cylinder with vacuum and pressure. The cylinders are constructed of iron or of armed concrete (for sublimate).

5. The antiseptic must not destroy the wood. This demand seems absurd, and yet several times methods of preservation have been employed for mine timbers, which severely affected the wood. I name as the most important in this respect the creosotnatron, the Aczol, the Viszal, the kulba (sodium zincate), and the Hasselman process. In the trial cellar or the Petri dish these processes have given excellent results, for the wood was destroyed to cellulosis, and cellulosis is not attacked by fungi. But if the fibres of the wood have lost their contact, the timber in the mines is soon destroyed.

From all the hundreds of salts proposed for preservation of mine timbers, only two have proved their fitness at all, and this may be considered the best according to the present state of knowledge. These are the sublimate (bichloride of mercury) and the sodium fluoride. The latter is, on account of various reasons, not profitably employed pure, but with other salts. These mixtures have been studied for years by Wolman, and their composition has been so perfected that any difficulties arising of free acids is prevented.

Sublimate and Creosote

Sublimate usually is employed in the open tank process. The timber is immersed in big concrete tanks for a suitable time, the solution being generally of 0.⅔%. The invention of cylinders of armed concrete, allowing the impregnation under vacuum and pressure (Moll construction), and the mixture of sublimate with other salts preventing the corrosion of iron cylinders by the solution (Wolman invention), afford great advantages over the old process as devised by Kyan.

The method of impregnation in cylinders may be briefly described as follows: At first the wood which is to be impregnated is sufficiently seasoned. After this it is put on small cars and carried to the impregnation cylinder. The dimensions of this cylinder, of course, are adapted to the wants of the mine as regards the length and the thickness of the timber. The cross-section, as a rule, is about 6 or 7 ft., which gives good working conditions. The length varies from 20 to 150 ft. The figure shows an establishment of the Silesian Mine Timber Impregnation Co., Ltd. (Wolman system). Note especially the small cylinder above the big one. When the lye is forced into the wood this small cylinder is filled with the solution and is connected with the impregnation cylinder. As the lye passes into the wood the latter is always replaced by influx of solution and the surface of the wood does not become exposed. The storage tank of the solution is arranged in the basement of the plant, with the dissolution tank above it. This must be of considerable dimensions on account of the great quantities of solution which are needed.

After the wood has been brought into the cylinder it is closed and as high a vacuum as possible is produced, which is kept on for one hour. By this means the wood is intensively seasoned. Then the solution is sucked from the storage tank into the cylinder by means of the same vacuum. As soon as the cylinder is filled, pressure is produced by means of an air-pump. The temperature of the solution is kept at 60 to 70°C.(180°F.). Fast at first, then more and more slowly, the wood absorbs the solution. The pressure is regulated according to the sort of wood, being between 4 and 8 atmospheres (60 and 120 lb. per square inch). After two or three hours the process is finished. The door of the cylinder is then opened and the wood brought out and seasoned. By evaporating the water the salts are fixed to the fiber.

Some general remarks may be appended as to the costs of mine timber treatment. The impregnation surely needs not to be as intensive as that necessary for ties, mine timber serving in most cases but a few years. But as untreated wood seldom lasts longer than one year, even a prolongation of 3 to 5-fold of the original duration is an extraordinary gain. This prolongation is certainly to be obtained with a quantity of 1 lb. of sublimate or 12 lb. of the sodium fluoride mixture to 25 cu. ft. of timber. The pound of sublimate costs today 50c. and the pound of the salt mixture 5c. Regarding the costs for heating the solution, for amortization and interest, working capital, and wages, and all other items, these may safely be taken to not exceed 5 to 6c. per cu. ft. of timber. These statements show clearly that the preservation of mine timber on an economic scale is today possible, and that the use of impregnated timber in mining is a necessity for personal and national economy and for the conservation of the valuable forests, that under the present system soon will be exhausted.

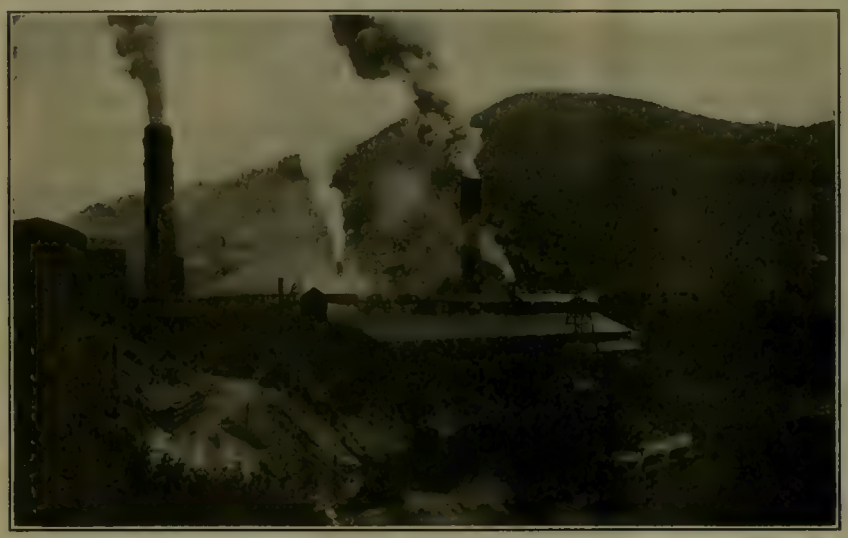
Gold output of the Crown Mines, Johannesburg, in November, totaled $1,238,000 from 199,000 tons of ore. The profit was $480,000. There were 660 stamps dropping for 27.25 days. During the third quarter of 1914 the following resulted: ore crushed by 660 stamps and 24 tube-mills, 613,000 tons; gold recovered, 183,325 oz.; value per ton, $6.34; working cost per ton milled, $3.72; profit, $1,364,000. There were 12,682 natives employed.

The Frontino & Bolivia property, Bolivia, produced $423,000 from 33,876 tons of ore during the year ended June 30, 1914. This was a small increase over the previous year. The profit was $31,700. Reserves in the Silencio mine are 16,800 tons assaying $21 per ton. A new pump is being installed on No. 13 level, and sinking is to be resumed.

Improvements at the Trail Smelter, British Columbia

*This plant is operated by the Consolidated Mining & Smelting Co. of Canada, and in the year ended September 30, 1914, it treated 374,771 tons of mixed ores, yielding gold, silver, lead, and copper worth $6,000,662.

Expenditure on equipment at the property during the year was $571,207. Of this amount, $482,134 was spent in improvements to the smelter. This was mainly as follows: Rebuilding the lead plant, including placing two Wedge roasters, having a capacity of from 85 to 95 tons per day each; conveyors and automatic scales for handling ore from storage to the roasters, and for handling pre-roasted product from roasters to sintering pots; three new lead blast-furnaces and extensions to building, with crane for handling receivers and by-products such as matte; a Cottrell plant for clearing the blast-furnace gases of lead fume; flues connecting the blast-furnaces with the Cottrell plant; and new charge-cars and some small equipment for the lead-sampling mill.



TRAIL SMELTER, BRITISH COLUMBIA. THE COTTRELL PLANT HAS CONSIDERABLY REDUCED THE LARGE FUME LOSSES SHOWN.

Alterations to the copper plant included rebuilding of three of the five blast-furnaces and increasing the dimensions of two of them; building of a new smoke-stack; repairs to the flues; and installation of a crane in the copper furnace building, and rebuilding of the launders leading to the slag dump.

Improvements in the blower-room were the installation of an additional blower having a capacity of 40,000 ft. of air per minute; extensive repairs to the blower-room on account of the rotting of timber foundations, floors, and retaining walls, all of which have been replaced with concrete; rebuilding of the fire-protection system was also necessary during the year; and small expenditures were made on tracks, on tunnels for recovering ore from storage, and on extra locomotives for charging the furnaces.

The objects of these alterations and improvements were to increase the capacity of the plant, to increase recoveries, and to decrease costs of operation.

The lead plant formerly handled a considerable tonnage of high-grade clean concentrate, comparatively low in sulphur and free from zinc, which was supplied mainly from the St. Eugene mine. With the depletion of the St. Eugene mine, it has been necessary to replace the tonnage, to a large extent, with ore of lower grade and of a much more refractory nature, largely from the Sullivan mine; and carrying more sulphur and requiring more capacity for roasting and furnacing in order to produce an equal tonnage of lead.

In the roasting plant, particularly, the seven Godfrey roasters with which the smelter was previously equipped, had a capacity of only 25 tons per day each of Sullivan ore; the two Wedge roasters, just installed, have a capacity each of from 85 to 95 tons per day, and are costing at present about 50c. per ton less to operate, the saving being mainly in fuel and firing.

The installation of conveyors handling the ore to and from the roasters will still further reduce costs of operation of the roasters, by substituting mechanical equipment for manual labor.

The costs of operating the Heberlein sintering plant have already been materially reduced by the substitution of mechanical appliances for hand labor, which alterations were made last year.

The building of new lead furnaces was made necessary by the condition of the old ones, which had been in operation for a long time, and it was considered advisable in rebuilding them to place them farther from the copper plant, in order to allow for any necessary extensions to the copper plant; also to allow for better arrangements for charging and handling the products.

The installation of the Cottrell plant was necessary on account of large losses in fume from the blast-furnaces. The flues and Cottrell plant are now saving approximately eight tons per day of material high in lead, a considerable portion of which was previously lost.

Improvements to the copper plant were made necessary by the wearing out of jackets on the old furnaces.

*Abstract from annual report of general manager, R. H. Stewart.

In rebuilding, two of them have been increased in size from 300 to 420 inches in length, and from 42 to 50 inches in width at the tuyeres. The enlarged furnaces so far show an increase in smelting capacity of from 60 to 80% over the older ones. This increase in capacity will result in a proportionate decrease in cost of labor, and probably in a decrease in cost of coke per ton of ore smelted.

Generally speaking, it is thought that the changes made in the smelter during the past two years will result in sufficient saving in costs of operations and recoveries to pay for themselves within the next two to three years' operation.

Chemical Problems in Germany

*As a result of the war, German chemists have been confronted with a number of very important technical problems. Some of these problems are old ones that have been rendered acute by the war's interference with commerce, while others are newer and are all the more difficult because little attention had been given them before the opening of hostilities. The chemists are co-operating in a marked manner to furnish substitutes for gasoline and rubber.

As regards the supply of gasoline, Germany has in the past depended almost entirely upon foreign markets. The greatest quantities of this important fuel were imported from Russia, Galicia, the Dutch East Indies, and especially Rumania. Normal imports at this time can be had only from the last-named country.

It has been necessary, therefore, to turn to substitutes, the most important of which are benzol and alcohol. Benzol is a by-product of the manufacture of coke, and the German production amounts to about 160,000 tons per year, of which about 60,000 tons are used for chemical purposes, especially in the dye and color industries. About 100,000 tons is available for fuel purposes. As the consumption of gasoline in Germany amounted to 179,800 tons in 1912, it will be seen that a considerable part of the gasoline can be replaced by benzol.

Benzol possesses valuable qualities as a fuel, containing 9560 heat units per kilogram (2.2046 lb.), and being only slightly inferior to gasoline in this respect. A disadvantage in winter is the high freezing point. Benzol freezes above zero (32°F.), and then must be raised to about 7° (44.6°F.) before it will melt. Efforts are being made to overcome this disadvantage by adding nitrogen. There is no danger of freezing if alcohol is added, and mixtures of benzol and alcohol have proved very successful. There is no shortage of alcohol for motor purposes. Toward the end of August the available supply in Germany amounted to more than 26,000,000 gal. On account of complications arising from the war, the average distillation was reduced by 40 per cent.

The by-products of the distillation of brown-coal tar may also be considered as substitutes for gasoline. The number of substitutes from all sources would be considerably increased if carburetors could be adapted to other fuels than the ideal gasoline. As progress is being made in this direction the shortage of gasoline becomes less important.

Problems arising from the shortage of rubber are much more difficult than those arising from the motor-fuel situation. This is already shown by the increases in rubber prices and by the strict military regulation of its use. The importation of caoutchouc (India rubber) has been interrupted, and the synthetic production of this valuable material was neglected before the war. The necessity for a substitute exists today, and the scarcity of natural caoutchouc will focus attention on the development of a synthetic process. Several satisfactory substitutes have been evolved by combining acetone and benzol products with caoutchouc. A certain supply of caoutchouc can be maintained by the manufacture of regenerated caoutchouc from scrap rubber. This regenerated-caoutchouc industry is highly developed, and large stores of old rubber exist.

The problem of providing the industries and agriculture with nitrogens is a serious one. The importation of Chile saltpeter has been interrupted, and the country is short nearly 800,000 tons of this material as measured by the consumption in 1912. It is estimated that one-third of this quantity is used in manufacturing and the remainder in agriculture. It is used in the production of nitric acid, which is so important in the manufacture of explosives. The existing stores of saltpeter have to serve, in the first place, the purposes of the army, and a substitute for a half million tons for agricultural purposes must be supplied. Sulphate of ammonia, a by-product of coal distillation, is the most productive source of nitrogen that Germany has, and as a fertilizer is a formidable rival of Chile saltpeter. It is though that a larger percentage of nitrogen in the form of ammonia can be obtained from coal than has hitherto been done. The synthetic production of ammonia may be of assistance in furnishing a supply of combined nitrogen, and, finally, the manufacture of cyanamid, a mixture of atmospheric nitrogen and calcium carbide, will supply the country with an important nitrogenous fertilizer.

The imports of jute have been cut off by the war. This fiber is needed in the manufacture of bags, which are, of course, in great demand. Cellulose is used in making a substitute for jute, and a kind of paper is manufactured out of which bags are made. 'Textilose,' a composition of paper fiber and cotton fiber, is being considered as a bagging material. American resin in large quantities is needed for the tightening of fibers in the manufacture of paper. For this purpose there is no satisfactory substitute.

*Report of deputy consul-general Daniel J. Waters, Berlin, November 21.

EXTRACTION at the Cam & Motor mill, Rhodesia, is improving, and during November, 11,748 tons of ore yielded $86,000, with 73% recovery.

DISCUSSION

Readers of the MINING AND SCIENTIFIC PRESS *are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.*

Shall the Institute Express Opinions?

The Board of Directors of the American Institute of Mining Engineers being divided in opinion as to the advisability of adoption of the proposed amendments to the constitution designed to remove the present restriction on any expressions of opinion by the Institute, appointed a special committee to formulate the arguments for and against them. The committee consisted of E. Gybbon Spilsbury, F. Lynwood Garrison, Sidney J. Jennings, James F. Kemp, Albert R. Ledoux, Rossiter W. Raymond, Thomas T. Read, and Horace V. Winchell.

The report submitted was as follows:

ARGUMENTS IN FAVOR

1. The Institute with its membership of 5000 is the recognized organization of the mining profession, and should be able to take action as such. The limitations placed on the activities of the Institute by its constitution are a denial to its members of liberty of action and judgment, and thus in conflict with the essential principles of democracy.

2. The Institute has become so strong and so truly national in its make-up that whatever necessity once existed for guarding against its passing into the control of a small coterie which might use its influence for improper ends, has long since passed away.

3. There is no reason to suppose that the membership of the Institute will be less competent to deal with its problems in future years than at the time the constitution was drawn up. It is reasonable to assume that situations may arise in which the course of action laid down in past years will not be the best to follow.

4. There is no reason to suppose that the Institute will at once abandon its successful policy of 43 years. All that is proposed is to permit the Institute to take action as a body in the rare instances in which it is clearly desirable to do so.

5. The Board of Directors must, according to the constitution, represent every section of the country. It is made up of responsible men who give to Institute matters such careful consideration that it can be safely assumed no hasty action on any matter will ever be taken.

ARGUMENTS AGAINST

1. The certificate of incorporation states the purposes of the Institute, namely: "to promote * * * by means of meetings for social intercourse and the reading and discussion of papers, and to circulate by means of publications among its members the information thus obtained, and to establish and maintain a place of meeting * * * and a library of books * * *:" These functions are specific and were intended to be exclusive. Other means, equally praiseworthy, are excluded, if they tend, as shown below, to impair the effectiveness of these.

2. The success of the Institute as a forum of free discussion would be impaired by making it a tribunal of decision.

3. On the important questions likely to arise, the members are certain to be divided; and the defeated party will become less hearty in its loyalty and co-operation.

4. The voting membership comprises three nations; and is therefore not a suitable body to decide questions of policy, etc., affecting one nation only.

5. Every man who joins the Institute is entitled to the assurance that its influence will not be used for or against any scheme or proposition affecting his views or interests.

6. The prohibition which these amendments seek to remove was put into the former constitution and repeated in the present constitution as the result of long experience. It has worked well for 43 years, and it should not be removed without the provision of careful safeguards against abuse of power. If there are certain acts now forbidden, which would be useful and unobjectionable, then the certificate of incorporation and the constitution should be amended by specifying such acts. Let us put a gate where it is really desirable to go through the fence, but not tear down the whole fence.

ANOTHER ARGUMENT FOR

The Editor:

Sir—The mining industry of the United States is second in importance to that of agriculture, and represents from mining and metallurgical establishments an annual product that amounts in value to $4,600,000,000. There are engaged in this industry 2,300,000 men, and there are probably depending upon it for a living, something like ten to twelve million people. It is safe to assume that a majority of the men who direct and control this tremendous industry are members of the A. I. M. E. and that the Institute is the only organization of which this may be said.

Few of its members realize that the Institute is today prohibited by a drastic clause in its constitution from exerting any influence for the direction, protection, and fostering of this vast and fundamental constituent of our civilization. Article VIII, Sec. 2, of the constitution reads as follows:

"The Institute shall not assume responsibilities for any statements of fact or opinion advanced in the papers or discussions at its meetings. Neither the Board nor the Institute shall officially approve or disapprove any technical or scientific opinion, or of any proposed enterprise which is outside of the management of the meetings, discussions and publications of the Institute, and the conduct of its business affairs by the Board of Directors."

And Sec. 3:

"Special committees may from time to time be appointed by the Board to make investigations and prepare reports for presentation to the Institute, but no action shall be taken binding the Institute for or against the conclusions embodied in any such reports."

It is now proposed to amend these sections by striking out part of the inhibiting clauses of the two articles, so that they will read as follows:

"Sec. 2. The Institute shall not assume responsibilities for any statements of fact or opinion advanced in the papers or discussions at its meetings."

"Sec. 3. Special committees may from time to time be appointed by the Board to make investigations and prepare reports for presentation to the Institute."

Some objections have been raised to this course, chiefly on the ground that it places too much responsibility in the hands of the Board of Directors. In reply to this objection it is submitted that no organization composed of a large number of individuals or of diverse interests, can be properly conducted without delegating to the representatives of the members on a board of directors, sufficient power properly to conduct, control, and direct the policy of the organization as a whole.

The question now before the members of the Institute is therefore primarily one of policy. Shall it, or shall it not, be the policy of the Institute to protect and foster this industry and those engaged in it? The certificate of incorporation of the Institute states:

"That the purposes for which this corporation is to be formed are: To promote the arts and sciences connected with the economic production of the useful minerals and metals and the welfare of those employed in these industries by means of meetings for social intercourse, and the reading and discussion of professional papers, and to circulate by means of publications among its members the information thus obtained; and to establish and maintain a place of meeting for its members and a hall for the reading of papers and delivery of addresses, and a library of books relating to subjects cognate to the sciences and arts of mining and metallurgy."

It is furthermore submitted that although the Institute has done a vast amount of good in furthering the objects above set forth, it has fallen far short of the possible usefulness it might have achieved had its policy not been hampered and restricted by the constitutional provisions it is now proposed to amend. It should be pointed out that when the Institute was organized in 1871, and for perhaps 25 years following that date, the desirability, or necessity, for an organization that had the power now sought, was not so evident as at present.

Within recent years it has become more and more evident to those most closely in touch with mining matters throughout the whole United States, that if these interests are to be wisely conserved and directed it must be done by some such organization as the A. I. M. E., and that if the Institute fails to realize its responsibility and opportunities in this respect, some other organization, perhaps less well qualified, will arise and do it. To be more specific, it is not intended that the Institute, through committees or otherwise, should ever stoop to legislative lobbying in order to achieve its ends, but it should be free, when occasion offers, to advise, recommend, and point out, as a body of experts, what are the needs of the mining industry, so that efficiency, economy, and national well being may be thereby attained. At the present time there is absolutely no other organization which is so well fitted to do this. Responsibilities in life must not be shirked by organizations of individuals such as the Institute, any more than by individuals themselves.

The responsibilities that would be thrown upon the Board of Directors of the Institute, should these amendments be adopted, would probably be no greater than those now carried by the Board of Directors of the American Society of Civil Engineers, which has a membership of over 7500 and the highest qualifications for entrance of any of the great engineering societies. The A. S. C. E. has no clause in its constitution prohibiting its directors from acting upon public questions, and its policy is, and I believe always has been, never to shirk responsibilities of this kind. That the men whom its members have elected as directors are able, broad minded, and of sound judgment, is attested by the remarkable growth of the Society in the past 20 years. Its membership has increased in that period from 1733 to 7635, and its material resources from $60,000 in 1894 to $650,000 in 1914. Surely the A. I. M. E. is just as capable of selecting its directors and has just as many able men to draw from.

Has the Institute grown to manhood, or must it still be hampered by the swaddling clothes of infancy and irresponsibility? Is it still to be an organization solely for the purpose of publishing papers and holding social meetings; or a great body of experienced and capable mining men, truly representative of a great national industry, anxious for its welfare and ever ready when called upon to lend a helping and directing hand? If it now fail to recognize and accept its responsibilities it cannot complain if others less competent undertake to do what it neglects, and a great national industry suffer in consequence.

Thoughtful and well informed men must recognize that the most important need of the present time is that the great industries be wisely guided. Governmental interference in business is becoming more and more frequent; this condition must be accepted as a fact, for it

cannot be successfully opposed. It will be for good or ill, accordingly as it is directed. Are the mining engineers, from timidity or a childish policy, to sit still and let the mining industry become a football of politics, the butt of labor unions, and continue under the spell of an archaic mining law? Engineers surely desire neither to engage in politics nor to antagonize labor, but this organization, representing the most and best elements of a great industry, must be free to speak when occasion demands and be in a position to lay before the public what is known to be the truth and believed to be best for the interests of all. The importance of this matter cannot be overstated, and its consideration may not safely be delayed. If the Institute is not to progress and assume the responsibilities of a vigorous maturity, and no greater than those entrusted to the American Society of Civil Engineers, it surely will revert to senility that has but one end.

F. Lynwood Garrison.

Philadelphia, October 29, 1914.

Rhythmic Precipitation and Colloidal Ores

The Editor:

Sir—The paper by Mr. Creighton and the editorial comment elsewhere in this number are timely, and remind the readers of the *Mining Press* of one of the live subjects of thought today among students of ore deposits. The importance of colloids and their applications to certain forms of ores seem to have been brought out among the first by F. Cornu, who published a paper in March 1909, in the *Zeit. für prak. Geologie*, p. 81, with the translated title of 'The Significance of Colloidal Bodies in the Oxidized Zone of Ore Deposits.' Various amorphous minerals were cited in illustration, of which limonite is, of course, the most frequently present in the iron hat. Mr. Cornu considered that colloids or 'gels' (gelatinous bodies) were limited to the oxidized zone, so far as his observations extended. The elaboration of this subject was taken up at the International Geological Congress in August 1913, at Toronto, by Paul Krusch, whose paper, delivered and printed in German, has the translated title 'Primary and Secondary Ores, Especially with Regard to the Colloid (Gel) Ores and those Rich in Heavy Metals' (proceedings of the Congress, p. 275: translated by Adolph Knopf and printed in the *Mining and Scientific Press*, September 13, 1913). For some years before the delivery of this address, Krusch had been giving attention to the distinctions between primary and secondary ores, as one familiar with his writings readily observes, and had directed his attention in consequence to colloids. He became especially impressed with their importance in the hydrated silicates of nickel, which constitute one of the sources of this metal. He was led to the conclusion that these ores, of no definite crystal form, developed in the alteration of peridotites as 'gels.' Further reflection convinced him that other primary colloids might be precipitated in veins and far below surface conditions, but he realized that acidity in solutions operates unfavorably to the formation of colloidal ores. We have learned, however, from the observations of W. H. Emmons and F. F. Grout of the University of Minnesota, and of their student E. T. Hodge, that descending acid waters soon became alkaline, whereas ascending waters, as was long known, are almost, if not quite, universally alkaline. To this extent ascending waters are not unfavorable to 'gels.' Krusch reminds us that gelatinous silica has been maintained for several years at temperatures of 80 to 100°C., and that sulphide 'gels' may develop above 100°C., but that their tendency is strong to crystallize. We infer, however, that colloidal sulphides could separate in uprising alkaline waters at temperatures as high as 100°C. We are also impressed with the fact that quartz veins might begin as gelatinous silica up to this temperature and that they might contain sulphides likewise colloidal, but that in time all might become crystalline. The importance of the experimental work of Messrs. Hatschek and Simon,* referred to in the editorial, now appears. The wonderful banding of precipitated metalliferous compounds in 'gels' of various sorts reminds us of agates and to some extent of banding in quartz veins. Nevertheless, we are reminded that opaline or even chalcedonic quartz is rarely seen in mineral veins such as we mine, but that crystalline quartz is the form of silica with which we specially deal. The banded structure of the last is, however, strongly reminiscent of some of the beautiful figures given by Messrs. Hatschek and Simon in their paper before the Institution of Mining and Metallurgy. Certain white and amethystine quartz veins banded with cloudy black argentite which one can observe underground at Pachuca and Guanajuato, Mexico, recall to mind most strongly the cases of artificial precipitation.

In the case of other banded veins such as the Freiberg types, with their alternations of sulphides, barite, calcite, fluorite, and quartz, or the wonderfully developed ones at the Enterprise mine, Rico, Colorado, as beautifully figured years ago in the *Trans.* of the American Institute of Mining Engineers by T. A. Rickard, and in which quartz and rhodochrosite alternate with zinc-blende and rich silver minerals, we cannot so well infer an original colloid condition. We know of no colloid forms of some of the components, at least as yet.

A recent contribution of Messrs. C. F. Tolman, Jr., and J. D. Clark in *Economic Geology* for September last, describes the precipitation of the chalcocite molecule in finely divided colloidal form from solutions containing an excess of hydrogen sulphide, on the escape of the gas. The colloidal form, however, quickly passed to the crystalline, but the reaction possessed no features incompatible with conditions in uprising waters in mineral vein formation.

We cannot avoid the conclusion that colloids or 'gels' may be a form of matter calling for serious attention

*Inst. of Min. and Met., April 18, 1912.

in our studies of the formation of minerals, whether in the vadose or the deep-seated zones.

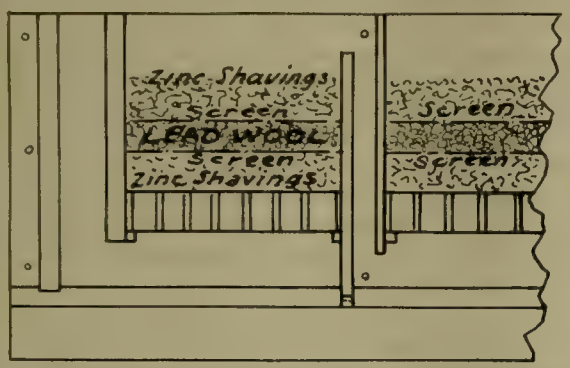
December 17, 1914. J. F. Kemp.

[The influence of colloids in ore formation is just beginning to be appreciated, though the fact that silica enters solution as a colloid and travels as such is old.—Editor.]

Lead Wool in Cyanidation

The Editor:

Sir—A number of years ago, while in New York City, I had my attention attracted to the lead-wool used in calking gas mains, and at once thought of using it in conjunction with zinc as a precipitating agent in the cyanide process. Accordingly, I took some ten pounds of it with me to Nicaragua and used the lead wool as an intermediate stratum in the head compartment of one of our zinc-boxes. The fibres, being just like the zinc shaving but less elastic, lend themselves easily to the process. As the precipitate, for the month I used this lead-wool zinc-shaving couple, was decidedly the higher grade (36.1% bullion against a 25% bullion precipitate), I thought it might interest some one else to give this material a more thorough test than I could give it. I realize there is nothing new in the use of lead or its salts, but I have never seen this lead-wool, which is analogous to zinc shavings, used, and I wish to offer this as a suggestion for some one who has the opportunity to make a conclusive test.



SECTION SHOWING METHOD OF PLACING SHAVINGS.

New York, December 12, 1914. Arthur Feust.

Lake Superior Copper Mining

The Editor:

Sir—In the article appearing in your issue of December 5, by Thomas T. Read, he speaks of "large masses of copper, one of which weighed 130 tons." In my weekly copper letter published recently I referred to one mass of copper which will represent a total weight of thousands of tons, before it is exhausted. This mass was found at the Trimountain mine, one of the Copper Range Consolidated group. It has been producing chunks, weighing from one ton to one and a half tons, for over a year, and men are still cutting from the same mass, and likely will be for some time to come. This mass was found 50 ft. above the 25th level and has run continuously, without a break down to the 27th level, a distance of nearly 300 ft. to date. It appears just as persistent now as ever. It averages a width of 40 ft. and is about 6 or 8 in. thick. Technically there might be some idea that this is a fissure and not a mass, but I believe the best authorities are agreed that it is in reality a mass, as it appears in the foot-wall and did not pinch out at any point. Two miners work on it all the time, using a chisel propelled by air. Its richness is such that wages are paid out of the chips cut off by the chisel. Both Calumet & Hecla and Ahmeek developed somewhat similar formations. For eight levels, 800 ft. on the angle, No. 11 shaft of the Calumet cut through this solid slab of copper. It occurred in the hanging, however, and was not continuous. Ahmeek's fissure picked up solid slab copper at the surface and carried it to the sixteenth level.

Homer A. Guck.

Houghton, December 10, 1914.

Shoveling Machines at Flat River

The Editor:

Sir—I have noted the article on our shoveling machines at Flat River, by E. H. Leslie, which appeared in your issue of November 21 and am interested in the data given regarding the performance of these machines at the Federal Lead Co. and the St. Louis Smelting & Refining Co.'s properties.

The statement regarding repair costs on the machine at the St. Louis Smelting & Refining Co.'s plant is erroneous and does an injustice to the machine. The only repairs necessary on this machine while in use at that plant were the renewal of one axle and two cast iron truck wheels, and repairs on a motor armature, which had been injured by exceedingly low voltage. The cost of these repairs could not possibly have been over $75, and the other charges mentioned in the lump sum of $322.48 include the cost of putting the machine under ground, erecting it, arranging the tracks and power wires, and later removing the machine. They are not properly chargeable to repairs.

William Whaley.

Knoxville, Tennessee, December 2, 1914.

[We are, of course, glad to publish Mr. Whaley's criticism of the figures presented in Mr. Leslie's article. As stated in that article "The repair charges of 0.033c. per ton at the St. Louis Smelting & Refining Co.'s property will appear high, but it must be said that the loader was operating at a shaft three-fourths of a mile from the machine shop and was charged with the time of the men going and coming as well as when actually working on the machine. The loader was new at the time of the test and it was thought best not to have the operating men look after the repair work." The repair cost as published is that supplied from the Company's record of the performance of the machine.—Editor.]

CONCENTRATES

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

TUNGSTEN is principally used in the manufacture of high-grade tool steel and for filaments in electric incandescent lamps.

A PLANT using a flotation process, to treat 600 tons of ore per week, is to be erected at the Mt. Lyell copper mine, Tasmania. This will deal with ore from the Lyell Comstock mine for the present.

SILVER CONTAINED in the 135,853,409 lb. of copper recovered from Michigan mines in 1913 amounted to 295,173 oz. This was equal to 0.04 oz. per ton of 'rock' treated, 7,016,370 tons being stamped.

IRON to the amount of 0.023% was found in analyses of tomatoes grown in Florida. The soil in which they were grown contained 1.06 to 1.3% iron. The acidity in this vegetable is supposed to be due to citric acid, according to C. A. Brautlecht and G. Crawford, in the *Journal* of the American Chemical Society.

FIREPROOF is a term loosely used in building construction, and conveys a false sense of security, because at present nothing now known is strictly fireproof, but may be as 'fire resistant' as modern ingenuity and materials can make it. Gypsum is now used as a fire-resistant or for steel protection on account of its low conductivity of heat, low amount of expansion, incombustibility, lightness, strength, adaptability, water effect, and small corrosive effect.

GOLD AND SILVER extracted by processes in the United States in 1913 was as follows, according to the U. S. Geological Survey:

Process.	Gold, %.	Silver, %.
Placer mining	24.9	0.2
Amalgamation	21.5	0.6
Cyanidation	31.2	19.7
Chlorination	0.3	....
Smelting	22.1	79.5
Total	100.0	100.0

POWER HOUSE for the Mt. Margaret hydro-electric scheme of the Mt. Lyell company is 110 ft. long, 72 ft. wide, and 30 ft. high, of concrete. It contains four turbines of 1750-hp. each, driving four 1200-kw. generators; three turbine-driven exciters of 50 kw. each; a 10-ton traveling crane; and a complete controlling and distributing apparatus mounted on a switchboard of white marble. The two transmission lines are five miles long. The sub-station is of concrete, and 73 ft. long, 66 ft. wide, and 27 ft. high. Rainfall at the power-site was 94 in. during the six months ended September 30, 1914. The blower building for the blast-furnaces and converters is of steel, and 100 ft. long, 45 ft. wide, and 27 ft. high. Four electrically driven turbo-blowers, each of 25,000-cu. ft. capacity, and two of 3500-cu. ft. capacity, were installed in that time. Power was delivered at the end of November. This electric plant is valued at $600,000.

A STUDY of the copper deposits of Ely, Nevada, by Alfred R. Whitman, resulted in the following conclusions: (1) that the matrix of the ores is an altered monzonite-porphyry, and that this rock is the oldest of the local monzonitic rocks which have intruded the Devonian and Carboniferous sediments, as a series of stocks; (2) that the chief agency in producing the present state of alteration of this rock was descending meteoric water, and that the present ores are due essentially to a diffused secondary deposition of chalcocite by this process; (3) that this enrichment occurred above the groundwater level; and (4) that it had occurred before the eruption of the rhyolite.

BAR GOLD IMPORTED BY ENGLAND per year amounts to as much as £47,000,000 in normal times. Owing to war risks, the metal has been held in Australia, Africa, Canada, India, New Zealand, and other colonies, and the Bank of England has made advances on deposits. In this connection the following official notification has been made regarding Australia: "The government of the Commonwealth of Australia having agreed to receive, on behalf of the Bank of England, deposits of gold, the bank is prepared to purchase, on the basis of $18.66 per ounce, such bullion as may be deposited to its order in the name of the Commonwealth treasurer. The gold is to be deposited with the federal treasury at Melbourne, and with the Commonwealth Bank at the capital cities other than Melbourne. The Bank of England is also prepared to purchase sovereigns ($4.80) of legal tender weight deposited as above in the name of the Commonwealth treasurer." An advance of a sum representing 97% of the value of the gold and of the sovereigns is to be paid on account, and the balance adjusted on delivery in London, after deducting the expenses of shipment, etc., to England. The use of the word 'purchase' in regard to sovereigns suggests an unusual method of dealing with coin legally current throughout the British Empire. As, however, it is intended that coins of legal current weight thus deposited, should change hands on the basis of their face value, the arrangement merely affords facilities for placing sovereigns to the credit of the Bank of England in Australia, subject to reimbursement of the expense attaching to transit 'home.'

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

JOPLIN, MISSOURI

REVIEW OF THE PAST YEAR, AND PROBABLE MARKET IN 1915.—ORE SHIPMENTS AND VALUES.

The value of zinc and lead ores shipped from the 20 districts of Missouri-Kansas-Oklahoma in 1914 totaled $11,627,327, compared with $14,356,461 in 1913, and $18,043,379 in 1912, which was the banner year.

The accompanying table shows the shipments of zinc and lead ores from the district for the past year:

	Zinc-blende.		Calamine.		Lead.		
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Total value.
Webb City-Carterville, Missouri	136,103,130	$2,666,181	.....	.....	34,951,660	$824,944	$3,491,125
Joplin, Missouri	90,157,650	1,942,869	5,213,340	$50,984	13,707,891	316,187	2,310,040
Miami, Oklahoma	56,969,070	989,268	.....	.....	17,033,465	392,749	1,382,017
Duenweg, Missouri	42,255,830	848,201	315,580	3,482	5,930,572	136,605	988,288
Alba-Neck City-Purcell, Missouri	49,044,580	854,109	459,880	5,390	613,450	13,502	873,001
Galena, Kansas	32,182,760	600,361	.....	.....	3,924,768	86,482	686,843
Oronogo, Missouri	18,729,050	379,700	.....	.....	3,255,320	76,751	456,451
Granby, Missouri	9,128,410	155,811	20,863,660	233,945	843,690	18,077	406,833
Lawton, Kansas	13,498,978	264,626	.....	.....	201,810	4,373	268,999
Spring City-Saginaw-Spurgeon, Mo	6,245,940	116,024	3,614,470	38,864	1,606,510	35,809	190,697
Belville-Klondike, Missouri	8,985,820	175,901	.....	.....	337,200	5,561	181,462
Carl Junction, Missouri	7,194,920	142,992	.....	.....	46,090	1,055	144,047
Carthage, Missouri	3,724,940	69,270	.....	.....	40,210	920	70,190
Cave Springs, Missouri	2,796,755	54,950	.....	.....	31,450	685	55,635
Aurora, Missouri	1,000,200	17,332	1,905,160	19,766	460,440	10,823	47,921
Sarcoxie, Missouri	1,704,990	35,990	.....	.....	.....	.....	35,990
Springfield, Missouri	677,000	15,462	96,920	1,056	.....	.....	16,518
Wentworth, Missouri	728,260	13,608	93,290	616	.....	.....	14,224
Quapaw, Oklahoma	381,430	5,815	.....	.....	.....	.....	5,815
Seneca, Missouri	23,630	231	.....	.....	.....	.....	231
Total shipments	481,533,343	$9,348,701	32,562,300	$354,103	82,984,526	$1,924,523	$11,627,327
Average value per ton	.....	38.82	.....	21.13	.....	46.38	.....
PRODUCTION BY STATES							
Missouri	378,501,105	$7,488,631	32,562,300	$354,103	61,824,483	$1,440,919	$9,283,653
Oklahoma	57,350,500	995,083	.....	.....	17,033,465	392,749	1,387,832
Kansas	45,681,738	864,987	.....	.....	4,126,578	90,855	955,842
Total	481,533,343	$9,348,701	32,562,300	$354,103	82,984,526	$1,924,523	$11,627,327

While 1914 was a year of comparative inactivity, the outlook for a heavier production and higher prices in 1915 is unusually bright. The factor of greatest importance is the added demand for spelter resulting from the European war. Exports within the past few months have been more than 65 times heavier than they would be under normal conditions. The heavy demand for export continues, and it is doubtful if the combined production of all the United States smelters can meet this demand, and at the same time supply the ever growing domestic demand, which is now much better in view of the recent eastern railroad rate decision, which will mean increased steel orders, these, in turn, creating a stronger market for zinc.

While shipments from the districts in the aggregate are

TYPICAL MINING SCENE IN THE JOPLIN DISTRICT, BETWEEN WEBB CITY AND ORONOGO.

lighter than in the past few years, a number show important gains. Among those to show the greatest development are Miami, Oklahoma, Alba-Neck City, Missouri, and Lawton, Kansas.

The new year dawns with ore prices at a much better figure than they were a year ago, the present offerings being $50 to $52, basis of 60% metallic zinc, or about $10 better than at this time in 1914. This is from $5 to $6 higher than they were at the beginning of 1912, while the outlook is such that there is every reason to presume that strong prices will continue throughout the year.

NEW YORK

American Interest in Mines in the Fighting Zone.—Copper and Rubber Notes.—German Potash.

There has been considerable interest here in the raid made on the properties of the Caucasus Copper Co. by Turkish troops last month, not only because J. P. Morgan & Co. has a considerable interest in the property, but also because R. T. White, formerly manager at the Braden and Balaklala mines, was wounded by the troops while he and his staff were engaged in attempting to defend the property. The mine is only a few miles from the Turkish frontier in the Mourgoul valley, 40 miles from Batum. The Russian government is reported to be taking prompt action toward regaining control of the district, but the latest advices are that it is still in possession of the Turks, and both the mine buildings and the town occupied by the employees are reported to have been burned. The many friends of Mr. White have made strong efforts to learn his whereabouts and the extent of his injuries; a cablegram received recently states that he has made his way safely to Tiflis, and has already almost completely recovered from his wound.

The spirited note sent by the State Department to the British government in regard to the seizure and detention of American ships carrying cargoes destined to neutral countries has been the chief theme of interest during the week. The position taken by our State Department is so sound and even moderate, in view of the circumstances, that no offense could legitimately be taken by Great Britain. On the other hand, it is somewhat doubtful whether that country will take any effective action, and it is quite probable that, as in earlier protests, there will be a long delay before any reply is made at all, and then finally a statement will be made which is generally reassuring, but does not improve the situation as a matter of fact in any way. Other interests than the copper producers are affected by the policy which Great Britain has been pursuing, and the rubber manufacturers are reported to be in a bad position. The larger part of the rubber production of the world is grown in British colonies, and the rubber is sent to London to be sold at auction, being shipped thence to the United States. Great Britain has put an embargo on the export of raw rubber, and all the material is accumulating on the London docks, while the manufacturers here cannot get any except by buying direct from Brazil. The Brazilian producers quite naturally take advantage of the situation to charge all they can get. If the rubber manufacturers could be assured that the situation would remain as it is now, they would be likely to go ahead and pay higher prices for their raw material, passing the increased cost along to the consumer, but it is quite possible, of course, that England may raise the embargo at any time and thus turn a flood of cheap rubber loose on the market, thus ruining the men who stocked up at the high prices.

Returning to the subject of copper, it is interesting to notice that since the note was sent to Great Britain another shipment of copper has been seized, and it is reported that altogether something like 45,000,000 lb. of metal has been detained in this way. This is alone enough to unsettle the copper market, as there is no knowing when the question of the disposal of this metal will be settled, nor what will be done with it. Exports from this country during August, September, October, and November of this year averaged about 50,000,000 lb., compared with 75,000,000 lb. average for the same months last year. The export figures look fairly good, considering the disturbed conditions, but when it is remembered that nearly one-quarter of the copper shipped in those four months is being held and will possibly be seized, the situation is not nearly so favorable as might be supposed.

The German Kali Syndicate has at last arranged to repay to potash consumers in this country the $1,000,000 refund which was authorized last June by the Reichstag, being the amount paid by the Americans under protest during 1910 and 1911 during the operation of the German potash law which was enacted to do away with all the favorable American contracts. The payment is not to be made in money, but in potash salts, which are to be shipped at a valuation of $4 per ton higher than the former contract prices, on the basis that the extra cost of shipping at this time justifies the advance. Since the Syndicate has notified the trade that it is obliged by the war to rescind its regular contracts, it is somewhat puzzling that it is able to arrange to pay its indebtedness in potash salts. The situation is not likely to cause American consumers to feel especially grateful to the Syndicate, and the California producers when they get into stride should reap the benefit of this natural irritation.

WASHINGTON, D. C.

Bill to Separate Railroad and Producing Corporations.

A bill deemed of importance is one introduced in the House of Representatives by Congressman Adamson, chairman of the Committee on Interstate Commerce, and prepared by the Attorney General. It seeks to divorce railroads from producing corporations. Mining is included in the purview of the bill. This bill proposes that from January 1, 1917, it shall be unlawful for any railroad to transport in commerce any articles or commodities thereafter manufactured, mined, or produced by such railroad company, or under its authority directly or indirectly, or by any person, firm, or corporation subject to its control in any way, the prohibition applying irrespective of whether there is any relation, direct or indirect, between the railroad company and the producer of any article or commodity at the time of transportation. Lands for the foregoing purposes cannot be owned or controlled in any way. Violations will be deemed a misdemeanor and be punishable by fines or imprisonment.

BOSTON

Boston's Interests in Cotton and Copper.—Boston Finances.—Burton and Lawson.—Quincy A. Shaw and Albert H. Holden.—Calumet & Corbin.

The International diplomatic duels over cotton and copper as contraband of war have been of vital concern to Boston, fully as much so as to the South where cotton is grown, or to the West where copper is recovered. Boston stock market and textile interests have been watching the administration closely, and hoping that a way out would be found without affecting our neutral attitude.

There have been comparatively few changes in the banking and stock brokerage alignment beginning with the new year in Boston. Boston houses have weathered the storm caused by the war abroad as well as any in the country, and are ready for greatly improved business in 1915.

Richard J. Burton, a former confidential secretary of Thomas W. Lawson, and a few years ago a member of the Curb, who made some sensational markets for Champion Copper, Humboldt Smelter Mines, and Southwestern Development Co., has

[illegible] as it were and is again actively manipulating [illegible] and Humboldt, on the Curb. The Humboldt is an Arizona corporation which was organized to take over and operate about 80 acres of mining ground near the Humboldt smelter at Big Bug, Arizona. Capitalization is 150,000 shares, par value $5. Champion Copper is being reorganized and assessed the authorized capitalized stock of 2,000,000 shares being reduced in par value from $1 to 10c. Champion is called the Copper Baby of the Curb. The Company has about 20 acres of ground at Copper Hill, Taos county, New Mexico. Burton uses Lawson methods of advertising and manipulation in handling these stocks. Thomas W. Lawson is apparently inactive in a market way. He came East from Oregon, just before the election, to vote for his relative by marriage Samuel W. McCall, and to settle some litigation, and immediately went back West.

The Utah Metals & Tunnel Co., a reorganization of the Utah Metals Co., is going back on the Boston Curb, and it is stated that the strong interests behind the issue will make a broad market for it. The old Company had a capitalization of $7,500,000, which has been reduced to $500,000. The old Utah Metals stock never made a good showing on the Curb, selling at its highest price the first day it appeared for trading, around $2.50 per share. From this eminence it descended to less than 10c., and a reorganization became necessary. The new Company is a Maine corporation, and through assessments has accumulated over $100,000 cash in the treasury for development purposes. The Company is a consolidation of several mining companies and several tunnels in Bingham, Utah, and is known locally as the 'Big Tunnel.' The Company owns the larger part of West mountain, at the head of Bingham cañon, separating it from Middle cañon, at the foot of which is the town of Tooele, the site of the International smelter. The Company owns about 3400 acres, half of which is available for development, with 600 acres of proved mineralized ground. It has a tunnel completed from Bingham to Tooele, a distance of over two miles. Mining, transportation, and supplying water are the three principal sources of income. The Clark and Coolidge interests and D. C. Jackling are prominently identified with the present Company. The stock, $1 par, has been selling, prior to listing, up to $1.25 per share, and higher prices are predicted for it.

Quincy A. Shaw, president of the Calumet & Hecla Mining Co., has been for some time past suffering from mental breakdown, and grave fears are expressed as to his recovery. His deplorable condition is said to be directly traceable to brooding over the protracted and bitter fight in the Lake district with the Western Federation of Miners, in which the miners were defeated. The Shaw interests are among the largest taxpayers in Boston, and he has one of the largest among the famous estates at Pride's Crossing, Massachusetts, a few miles out of Boston. His neighbors are Henry C. Frick, W. H. Moore of Wall Street, John Hays Hammond, and other magnates.

The late Albert F. Holden, mining engineer and financier, connected with Alaska Gold and several Boston mining enterprises, made provision for the disposition of a large part of his estate in establishing in Lakeview cemetery, at Cleveland, Ohio, his home, near the Forest Hill estate of John D. Rockefeller, a mortuary *arboretum*, a sort of Westminster Abbey, as a place of honor for the burial of the illustrious dead. Mr. Holden, some time before his death, enjoined his executors against throwing his mining stock holdings upon the market in settling his estate, with the result that there has been no disturbance in the market values of these stocks due to liquidation of his interests.

One of the active Curb stocks recently has been Calumet & Corbin, a Company which has had many disappointments in developing a paying proposition. Calumet & Corbin, after having failed in making a mine in the Corbin district, Montana, has acquired a group of 15 quartz lode-mining claims and two millsites, known as the New Era in the Freeland district near Idaho Springs, Colorado. These mines were located in 1876, and have been worked almost continuously ever since. It is said that when the Calumet & Corbin company acquired the property a year ago the records showed $90,000 net earnings in two years. The former president of the Company is James Wilcox, an old Cornish miner who resigned his position as superintendent of the Mass Consolidated Mining Co., in the Lake district, in order to give his attention to the development of the Company's properties at Corbin, Montana, without result. The Calumet & Corbin stockholders entered into an agreement with C. A. O'Leary, of Minneapolis, who agreed to secure for them a property and finance its efforts to make good. Mr. O'Leary has been in Boston recently in connection with the making of a market for this issue, which has been selling so far as from 5 to 20 cents.

TORONTO, ONTARIO

NIPISSING AND MCKINLEY.—DARRAGH OPTIONS.—PETERSON LAKE SURPLUS.—PEBBLE SUPPLY.—WAGES DISPUTE.—DOMINION COAL COMPANY.

The Nipissing company has taken up its option on the Teck-Hughes property in the Kirkland Lake district, although recent developments hardly proved as encouraging as was anticipated. No. 3 vein on the 185-ft. level, though it produced some rich ore, proved considerably shorter than the shoot at 75 ft.——The McKinley-Darragh of Cobalt has given up its option on the Jupiter mine, the stock of which received quite an impetus for a while on account of the general impression that the deal would go through. It is understood that the McKinley-Darragh interests made a new proposal which was not entertained by the Jupiter directors.——The quarterly statement of the Peterson Lake company shows a surplus of $208,471 on hand. During the quarter, 967 ft. of driving and cross-cutting, and 255 ft. of rising was done.

The board of conciliation appointed by the labor department at Ottawa, to investigate a dispute over wages between the owners of the Miller Lake-O'Brien mine, Gowganda, and their employees, reports that all danger of a strike has been averted.

The supply of pebbles for the Cobalt and Porcupine mills from France and Denmark having been cut off by the war, a shortage was feared, but this has been averted by the arrival of a large consignment from Newfoundland.

The Dominion Coal Co. of Sydney, Nova Scotia, has had a poor year on account of the war, although the Canadian market has considerably improved. The total coal shipments of the Company by the St. Lawrence route totaled 1,921,491 tons, compared with 1,698,131 tons last year, and would have been still larger had trade conditions been favorable. The approximate output from the Company's mines in Cape Breton will amount to about 4,300,000 tons, against 4,740,000 tons in 1913. The Springhill collieries, a sudsidiary, will produce approximately 430,000 tons, compared with 381,000 tons last year, so that the net decrease in the combined outputs will be about 390,000 tons. The Company is finding it practically impossible to compete with American operators for a share in the South American trade, in view of the advantage enjoyed by the latter in freight rates with the aid of the Panama canal, and the markets which might under ordinary conditions be found in Norway and Sweden are closed by the war. The starting of an additional blast-furnace by the Dominion Steel Co. will relieve the coal company of a considerable part of the surplus slack which has accumulated, and work is likely to be steadier during 1915.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press.

ALASKA

JUNEAU

November returns of the mines on Douglas island were as follows:

Details of work.	Mexican.	Treadwell.	United.
Stamps working	120	540	240
Ore crushed, tons	17,850	69,699	38,514
Concentrate saved, tons	397	1,591	849
Gold recovered	$39,199	$129,450	$82,681
Profit	4,614	18,091	6,070

CONCENTRATING MILL, BEATSON COPPER CO., LA TOUCHE, ALASKA.

Construction expenditure was $8601, $35,629, and $21,192, respectively.

ARIZONA

A nominal output of quicksilver has been reported to the U. S. Geological Survey from both Maricopa and Yuma counties in 1913 and 1914, in the Mazatzal range and in the Quartzsite district, respectively. The production from both localities greatly decreased in 1914.

COCHISE COUNTY

Damage by floods to the town of Bisbee is estimated at from $10,000 to $15,000.

YAVAPAI COUNTY

The Western Gold & Copper Co. has been incorporated to operate its mine at Providence, the post-office being at Huron, with W. W. Lewis as superintendent. During the past few weeks the Company has spent about $2000 in sampling and examining the Great Belcher and nine other claims. The assays gave an average of $6.75 per ton for the large deposit, which so far is 54 ft. wide. In the four principal claims over 5000 ft. of work has been done, including two 500-ft. adits, a 700-ft. shaft, and other connections. It has been decided to mine the deposit by open-cut methods, which will make a low mining cost. A 150-ton plant consisting of crushers, rolls, amalgamating plates, concentrators, and a flotation process will be erected in the near future to treat the gold-silver-copper ores. F. W. McConnell and G. Demaine are associated with the Company as mining engineers and assayer, respectively.

A plant using the Wagner process is under construction at some mines near Crown King, by the Grey Eagle Reduction Co. This electric process is to treat gold-silver-lead-zinc ores of the Wildflower and other properties near by.——The 'Hog-Back' at Jerome has been sold to F. S. Stephens, of Scotland, for $25,000. A good tonnage of 5 to 40% copper ore is said to exist.

CALIFORNIA

CALAVERAS COUNTY

Suits for damages for alleged injury to cattle and vegetation, etc., by smelter fume have been begun in the United States District Court of San Francisco against the Penn Mining Co., which has a smelter at Campo Seco, by Leroy Southworth, who asks for $17,511, and J. G. and F. W. Foster for $20,884.

INYO COUNTY

The new hoist, mill, and cyanide plant of the Wilshire Bishop Creek company is ready for work, but on account of the winter the mine will not be unwatered till February, and the plant in April. E. W. Walter is superintendent.

NEVADA COUNTY

(Special Correspondence.)—San Francisco people are examining the Orleans mine, and a few men are examining oreshoots in an old rise. The property was formerly operated by the Sultana Mines Co., and for years was a large producer. ——Driving on the vein recently cut near the 900-ft. level of the Union Hill mine is under way. The shoot is about two feet wide, with some free gold visible.——George W. Root and associates are planning an early resumption of operations at the Kenosha, about four miles below town. It is understood the Kenosha Mining Co. will be reorganized, the shaft deepened, and extensive lateral development carried forward.——A small force is working at the Gold Mound, from which some ore was recently crushed at the Golden Center mill with satisfactory results.——Ore ranging from $15 to $50 per ton is being mined at the Colling property, near Rough and Ready. There are three small veins crossing the main orebody, the latter assaying $9 per ton.——Recent work in the Champion mines, in the Nevada City district, has been highly satisfactory.——The Phoenix mine has been taken under bond by J. A. Largent, and arrangements are being made for extensive work. Formerly known as the Sneath & Clay, the property produced much rich ore, but has been idle several years. It is equipped with an excellent hoisting and pumping plant, also a 10-stamp mill.——A good deal of new work is going on in the Oustomah, now operated by the owners. Mill ore has been opened at several points in new territory. Frank Morgan is superintendent.

Grass Valley, January 2.

The new 20 stamps at the Empire mine are now working. They weigh 1370 lb. each, and in place of amalgamating plates a new device of Frank Hooper is used, giving good results. ——Owing to San Francisco capital being interested, the Deadman's Flat district is showing greater activity.——Work at the Golden Center of Grass Valley is giving good results.

PLACER COUNTY

During 1913 there were 253 proofs of assessment work done on gold mines filed for record. It is expected that 1914 will show a total expenditure of about $30,000, an increase over the previous year.——It is alleged that the Yukon Gold Co.'s dredge on the American river, near Auburn, has been polluting the water supply of Fairoaks and Orangevale, and an injunction suit to prevent operation of the boat was started. The Company does not admit the charge, but will help remedy the trouble by assisting to construct a settling basin in the North

Fork supply ditch. The cost is estimated at $5000, of which the Company will contribute $2500, and the El Dorado Dredging Co $1000, on certain agreed terms. The Yukon company asserts that it is unfairly attacked, as the Mountain Quarries Co. and Pacific Gas & Electric Co. deposit debris in the river.

SHASTA COUNTY

Owners of the Shasta Belmont near Heroult will resume work early in February. The mine was closed on account of the copper market. The ore contains copper, gold, and silver.

SIERRA COUNTY

The Alleghany district shows encouragement for the coming year. There has been plenty of employment for miners. Deep mining is to be a feature. The Rainbow mine is being worked under lease. Quartz and gravel mining is being carried on in the same adit of the North Fork mine, near Forest, by two companies. Both are doing well. The Tightner continues to produce rich ore, while prospects at the Plumbago, Eldorado, Twenty-one, Sixteen-to-One, and others are good.

TUOLUMNE COUNTY

A drainage adit over 5000 ft. long has been driven into Table mountain near Columbia, and in February miners will start to extract the gravel which before could not be reached on account of the water. According to A. L. Horner, general manager, a great deal of gold will be recovered and several hundred men employed.

YUBA COUNTY

The Guggenheim interests have made a final settlement on several claims acquired on the Yuba river. Marysville people were interested in the deal.

COLORADO

GILPIN COUNTY

Owing to the Frontenac and Aduddell mines, in Russell gulch, being closed, the output of this county in 1914 will show a considerable decrease. These were large producers. A number of other properties which are idle contain profitable ore. Efforts are being made to open some of them on Quartz hill, where are the Kansas, Burroughs, and Gunnell veins. The latter is worked through the Newhouse tunnel, ore being treated at the Argo mill.——The Lake mine, owned by H. Sayre, is one of the best producers at present. It is operated at 1700 ft. through the Big Five tunnel, ore going through to Idaho Springs. The November output was about $30,000.——*The Weekly Register-Call* estimates the year's production of the county at about $1,000,000.

LAKE COUNTY (LEADVILLE)

The weather at Leadville has been cold, and on one day last week the temperature was 1° above zero. On December 27 the maximum was 38° and minimum 4° above zero. There has been fear of a shortage of water for the mines. The Iron Mine ditch, which is very low at present, supplies many properties. There has not been much snow to augment the supply. The Wolftone has connected a pump with the Carbonate Hill reservoir of the Leadville Water Co., and others will have to do likewise.

TELLER COUNTY (CRIPPLE CREEK)

Cripple Creek mines produced $1,165,855 from 81,250 tons of ore in December. The smelters received 5000 tons of $55 ore, while the local plants treated material assaying from $2.10 to $7 per ton. Dividends paid in 1914 were as follows:

Golden Cycle	$1,005,000
Portland Gold	360,000
Vindicator Consolidated	270,000
Elkton Consolidated	200,000
Stratton's Independence	100,000
Mary McKinney	78,567
El Paso Consolidated	50,000
Stratton's Cripple Creek Mining & Development Co (Stratton estate)	40,004
New Haven	17,617
Jerry Johnson	12,500
Gold King	10,000
Cresson Consolidated (estimated)	500,000
Strong (estimated)	250,000
Total	$2,893,684
Profits of leasing companies and lessees (estimated)	250,000
Total	$3,143,684

GEORGIA

CARROLL COUNTY

(Special Correspondence.)—A 50-ton cyanide plant is being erected here by T. H. Aldick. The orebody to be treated is of considerable size, being a low-grade quartz, and when blasted 85% crumbles to about 8 mesh and finer. No mill is necessary, and the product cyanides readily, the gold being very fine. Walter F. Posley is superintendent.

Villa Rica, December 25.

IDAHO

SHOSHONE COUNTY (COEUR D'ALENE)

In reviewing the mining outlook of the district, *The Wallace Miner* states that while 1914 produced no records, it was significant of work done which will have a bearing on the future. The most important achievements were the new processes for recovering more metal in the copper, lead, and zinc ores, mainly flotation systems. Also the process being tried by the Bunker Hill & Sullivan company to do away with smelting the mill products. There were numerous important mine developments, and ore reserves show increases. Dull times have not been felt so much in the Coeur d'Alene as in other parts of the country.

The predicted probable fight between the Washington Water Power Co. and the Montana Power Co. has started. The former has filed a complaint against the Montana Power Co., the Thompson Falls Power Co., the Federal Mining & Smelting Co., and the Tamarack & Custer Consolidated Mining Co., alleging conspiracy. The Washington company asks a restraining order forbidding the defendant companies to erect transmission lines and selling power, claiming that the two power companies have not filed articles of incorporation in Idaho nor appointed resident agents. Some interesting points will be raised in the suit. Meanwhile the Montana company's lines are being extended to the mines.

The Bunker Hill & Sullivan company paid dividend No. 208 on January 4, amounting to $81,750. The total to date is $15,792,000.——Two 6 by 14-ft. Chalmers & Williams patented adjustable quick discharge tube-mills are being installed in the Hunter mill, and not the Hardinge type as published in the *Press* of December 26. A 5 by 14-ft. C. & W. mill had been previously at work in this plant.

MONTANA

SILVERBOW COUNTY

Excepting development, mining has been suspended in the Original mine of the Anaconda company, and work will be resumed in the Badger State mine, which was closed in August. The 1000 tons daily cut off from the former will be made up by a similar quantity from the latter.

NEVADA

CHURCHILL COUNTY

The Nevada Hills mine produced 6313 tons of $6.21 ore in November, of which 44.4c. per ton, or $2797, was profit. Assets

amount to $257,937, including silver worth $28,739, less $6429 overdraft at the bank. The annual report will be distributed early in February.

ESMERALDA COUNTY

The Goldfield Consolidated Mines Co. has closed its New York transfer agency. Any future transfers of shares will be made at the office at Goldfield. On February 27 the twenty-first dividend, of 15c. per share, will be distributed.——The fourth rise above 1017 ft. in the Jumbo Extension has cut $28 to $104 ore at a height of 40 ft. It contains gold, silver, and copper.——There is now 9 ft. of ore in a rise above 1750 ft. in the Atlanta. Three feet of this assays $60 per ton, but the general average is $23 per ton.

According to A. A. Codd, the line from Nenzel to the Rochester Mines Co.'s mill, a distance of 11 miles, is finished, and is carrying material to Rochester. The new mill should be ready by February 15. The ore-shoot in the Codd lease is 8 ft. wide, assaying $20 per ton. Ore reserves are 12,000 tons on the dump, 2000 tons in stopes, and 40,000 tons blocked out in the old vein.——The Big Four is shipping up to 40 tons of $25 to $35 ore daily.——The Rochester district's output is 150 tons per day.——The two-stamp mill of the Forvilly-Rochester Mines Co. has produced $18,000 to date.——The Seven Troughs Coalition mine produced the largest amount of gold in its history in December. The last bar was worth $7000.——The U. S. Geological Survey estimates the silver output of Rochester in 1913 as 701,407 ounces.

LINCOLN COUNTY

At the Amalgamated Pioche the No. 1 shaft of the Raymond and Ely mine has been sunk to 1400 ft., and 800 ft. of cross-cutting has been done. The orebody there is as strong as at 1200 ft. Stoping is under way between these levels, the zinc ore assaying 40% zinc, $2.50 gold, 30 oz. silver, and 2.5% lead. Shoots of rich lead-silver ore are also found. According to Trippe & Co., of New York, a mill is to be erected to treat the ores.

LYON COUNTY

At the Nevada-Douglas mill, concrete and framework of the ore-bins is complete. Excavating for the crushers is done. Work on the digester is well on, also on the absorption towers. Generally good progress is being made, although the weather has been cold.

NYE COUNTY

The U. S. Geological Survey estimates the output of the Tonopah district in 1914 as 577,000 tons, yielding 11,757,000 oz. silver, against 11,563,437 in 1913. The gold output was $2,660,000 and $2,613,843 respectively. The output of the district in the last week of 1914 was 8950 tons, worth $187,060.——The report of the Belmont for the quarter ended November 30, 1914, shows that the revenue was $728,170; net income, $372,020; and due from smelters, silver stored, loans, and cash was $1,333,637.——Some encouraging developments were made in the Montana last week.——The Extension company's new 150-hp. Nordberg hoist is ready for work. A Rockwell duplex melting furnace is being erected.——Shareholders in the Mizpah Extension have ratified the lease and option to the Tonopah Mining Company.

The three main operating companies now at work in the Manhattan district are the Big Pine, White Caps, and Consolidated. The White Caps works the 10-stamp mill and cyanide plant recently operated by Mushett and Wittenberg on Big Pine ores, and treats about 50 tons per day. The mill work is under the supervision of J. P. Montague, some time at Tonopah. The mine is developing well.——About 250 tons of ore is mined daily from the Big Pine, of which 125 tons goes to the tube-mill.——The Manhattan Consolidated is to sink its shaft deeper. The Associated mill is making a good recovery.——The U. S. Geological Survey estimates the yield of Manhattan in 1914 to be 40% less than in 1913.

WHITE PINE COUNTY

The Cumberland and Mulligan claims at Osceola are the subject of a lawsuit between F. D. Goody and J. H. Marriott. The latter owns twelve-fifteenths and Mr. Goody, it is claimed, has been interfering with him, and may stop a deal with Denver people. An injunction has been granted, it is claimed.

NEW MEXICO

The passage of a more liberal mining law, and of a law to encourage the oil industry in New Mexico, are the most important recommendations made by state land commissioner R. P. Ervien. He hopes to see both recommendations carried out by the legislature that convenes January 12. The present mining law, he declares, is too stringent, particularly in relation to prospecting.

GRANT COUNTY

In the suit of Mary Belle Whitehill v. the Chino Copper Co. and another for $20,000 damages in connection with an accident in a street of Hurley, the plaintiff was awarded $8800.

LINCOLN COUNTY

The Alto Light & Power Co., capital $150,000, has been incorporated at Santa Fe to supply electric power to mining properties in this county. The new concern is an auxiliary of the Wildcat Leasing Co., which is operating near White Oaks, in the county. Construction of transmission lines was started some time ago, and the power-plant is being enlarged for greatly increased service.

OREGON

BAKER COUNTY

Ten of twenty stamps at the Golden Gate mine near Greenhorn are ready for work. The mine is well developed.

JACKSON COUNTY

It is proposed to erect a custom mill in Grants Pass. An examination of the district mines is to be made to see how much ore is available for supply. E. H. Richard is chairman of the committee.

SOUTHWESTERN OREGON.

UTAH

The itinerary of the U. S. Bureau of Mines Rescue Car No. 2 in this state is as follows: Midvale, December 21 to 31; Salt Lake City (University of Utah), January 3 to 11; Arthur,

Jan. 12 to 13. Magna, Jan. 19 to 26. Garfield, Jan. 27 to Feb. 10. Bingham, Feb. 11 to 18. Murray, Feb. 19 to 26. Tooele, Feb. 27 to March 6, and Park City, March 7 to 18.

BEAVER COUNTY

The Moscow mine, in the Star district, shipped 11 cars of ore, worth $1600 each, in December, the same output as in November. The new shaft does away with the previous expense of haulage around the mountain. Developments at 800 ft. are good, and it is proposed to sink farther.

SALT LAKE COUNTY

The Utah Copper Co.'s mine and mill was stopped from December 27 to the end of the year. This was to give a general vacation to employees, and make necessary repairs.——In the Cardiff mine, in the south fork of the Big Cottonwood cañon, the rise is up 50 ft., showing 10 ft. of ore assaying 17.4 oz. silver and 52.3% lead. There has been 850 tons of ore shipped averaging $30 per ton.——From 12,691 tons of ore, net earnings of the Utah-Apex in November were $27,260.——Transactions on the Stock Exchange of Salt Lake City totaled 3,387,020 shares, worth $693,473, in 1914. The value in 1913 was $1,234,629.

WASHINGTON

A shipment of mineral specimens from this state has been sent to the expositions at San Francisco and San Diego. The assistant mine commissioner, Joseph Daniels, is in charge of the collection from the various mines. Spokane is to be the headquarters of the Stewart Mining Co. of Idaho, which had an office at Butte. M. W. Bacon is general manager.

The United States Assay Office at Seattle received gold valued at $8,770,058 in 1914. Of this, Alaska contributed $6,271,441; Yukon, $1,018,521; Washington, $27,907; and Oregon, $111,507. Since its establishment in 1898 it has received $227,539,656.

WYOMING

CROOK COUNTY

The Moorcroft oilfield, 12 miles north of Moorcroft on the Chicago, Burlington & Quincy railroad, is described in *Bulletin* 581-C of the U. S. Geological Survey, by V. H. Barnett. About $200,000 has been spent on development, with a return of about $1000 in oil. It has been thoroughly prospected, and the future is not encouraging.

NATRONA AND CONVERSE COUNTIES

The possibilities of oil in the Big Muddy dome of these counties is also described in the above-mentioned bulletin. The Salt Creek field was developed on a dome-shaped structure, and prospectors are busy searching for similar formations in the state with fair results. The conclusion is that if water is found at the top of the Big Muddy dome it will be useless to test further, but if dry rock or gas be found, oil may be struck lower down in the flank of the fold.

CANADA

BRITISH COLUMBIA

The Hedley company's power-plant had a trial run during the last week of 1914. It will develop 1800 hp., or twice as much as the old one, and cost about $200,000. On December 31 a quarterly dividend of 3% and a bonus of 7% was paid.

ONTARIO

The new shaft of the Casey-Cobalt mine is nearly finished, and a station will be started at 400 ft. during January. Seven drills and two stoping machines are working underground. The mill is treating 85 tons per day. There are 130 men employed in the mine and mill.

The Hollinger made a profit of $152,644 during the four weeks ended December 2, and a total of $1,630,620 for the year. There was $1,080,000 paid in dividends.

PERSONAL

R. S. BOTSFORD is now at Petrograd, Russia.

FRANK LAWRENCE has returned to Baja California.

H. S. DONNY expects to leave London for Mexico in January.

DRUMMOND MCGAVIN, who has been spending a couple of weeks in San Francisco, has returned to Toronto.

W. G. ANDERSON, manager for the Ore Chimney Mining Co., Ltd., of Ontario, is in Nova Scotia examining a mining property for that Company.

W. G. SWART is now with the Hardinge Conical Mill Co. as consulting engineer in the West, and has offices in the Foster building, Denver, Colorado.

N. C. SHERIDAN has resigned as superintendent of the Interstate-Callahan mine in Idaho, and it is stated that he will go to Mexico to engage in mining.

CHARLES W. NEWTON, of Butte, who recently resigned as superintendent of the Butte-Ballaklava, has been appointed superintendent in Mr. Sheridan's place.

A. H. BOYD is now with the C. H. Shaw Pneumatic Tool Co. of Denver, Colorado. Mr. Boyd was formerly with the Denver Rock Drill Manufacturing Company.

WALLACE N. TANNER has been promoted to the position of chief engineer of the smelter plants at Anaconda and Great Falls. For two years Mr. Tanner has been chief engineer of the Anaconda Copper Mining Co. at Butte.

Obituary

E. D. MEIER, president and chief engineer of the Heine Safety Boiler Co., died December 15. Mr. Meier was a distinguished mechanical engineer widely known in the profession. He was the founder of the Heine company, and its success and growth for many years was practically entirely due to his efforts.

THOMAS CRUSE, died, aged 78, on December 20, at Helena. He was one time owner of the famous Drumlummon mine at Marysville. Cruse was a prospector, but not the proverbial one, for he died rich. In 1886 he sold the Drumlummon for $1,000,000 cash, and a large and profitable stock interest in the property. He invested in land, livestock, and mines to good advantage, and lived a useful and honorable life. In a quiet, unassuming way he contributed largely to public benefactions and private charities.

SCHOOLS AND SOCIETIES

The SEISMOLOGICAL SOCIETY OF AMERICA bulletin for December contains a great deal of interesting matter pertaining to earth movements in various parts of the United States and the world.

The INDIANA ACADEMY OF SCIENCE held its thirtieth annual meeting at Indianapolis on December 4 and 5. There were numerous papers read on bacteriology, botany, zoölogy, chemistry, engineering, geography, geology, mathematics, meteorology, physics, and human life. These were restricted to from 5 to 25 minutes each.

The WASHINGTON STATE COLLEGE at Pullman will hold its annual winter school of mines from January 4 to March 29, and six courses will be given. Tuition is free, only a small charge being made for materials used. The school will be in charge of Francis A. Thompson, head of the department of mining engineering.

THE MARKET PLACE

Weekly Summary of Prices of Shares and Metals

Metal Prices

San Francisco, January 7.

Antimony	15 —15¾
Electrolytic copper	13½—13¾
Pig lead	4.95—5.00
Quicksilver (flask)	$51.50
Spelter	7 — 7¼
Tin	34½—36
Zinc dust, 100-kg. zinc-lined cases	9

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, January 7.—There have been good domestic and export demands for electrolytic copper, and the price advanced to 13.25c. Lead is quiet at 3.80c., and spelter strong and advancing at 5.50c. per pound.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.		Average week ending	
Dec. 31	48.50	Dec. 2	49.33
Jan. 1 Holiday		" 9	49.91
" 2	48.50	" 16	49.33
" 3 Sunday		" 23	48.66
" 4	48.75	" 30	48.65
" 5	48.75	Jan. 6	48.65
" 6	48.75		

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	63.01	57.58	July	58.70	54.90
Feb.	61.25	57.53	Aug.	59.32	54.35
Mch.	57.87	58.01	Sept.	60.53	53.75
Apr.	59.26	58.52	Oct.	60.88	51.12
May	60.21	58.21	Nov.	58.76	49.12
June	59.03	56.43	Dec.	57.73	49.27

The past week's market has been steady, but there has not been much demand from India or China.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Dec. 10	52.50	Dec. 24	53.00
" 17	52.50	" 31	52.50
		Jan. 7	51.50

Monthly averages.

	1913.	1914.		1913.	1914
Jan.	39.37	39.25	July	41.00	37.50
Feb.	41.00	39.00	Aug.	40.50	80.00
Mar.	40.20	39.00	Sept.	39.70	76.25
Apr.	41.00	38.90	Oct.	39.37	53.00
May	40.25	39.00	Nov.	39.40	55.00
June	41.00	38.60	Dec.	40.00	53.10

The average price of quicksilver in 1914 was about $49 per flask, irregular business done during August and September making a true average difficult to obtain. A résumé of the situation in 1914 appears on page 90 of this issue. It is reported that two lots of 1000 flasks each came from Italy to New York since the war started.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	50.45	37.85	July	40.70	31.60
Feb.	49.07	39.76	Aug.	41.75	50.20
Mch.	46.95	38.10	Sept.	42.45	33.10
Apr.	48.00	36.10	Oct.	40.61	30.40
May	49.10	33.29	Nov.	39.77	33.51
June	45.10	30.72	Dec.	37.57	33.60

Tin is quiet at 33 to 34c. per pound. It is reported that a fairly large stock is being held in New York, but not for sale. The possibility of an embargo on shipments from England and the Straits has been discussed.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Dec. 31	12.75	Nov. 25	12.25 to 12.50
Jan. 1 Holiday		Dec. 2	12.62
" 2	12.75	" 9	12.73
" 3 Sunday		" 16	12.70
" 4	12.87	" 23	12.84
" 5	13.00	" 30	12.75
" 6	13.25	Jan. 6	12.92

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	16.54	14.21	July	14.21	13.26
Feb.	14.93	14.46	Aug.	15.42	12.34
Mch.	14.72	14.11	Sept.	16.23	12.02
Apr.	15.22	14 19	Oct.	16.31	11.10
May	15.42	13.97	Nov.	15.08	11.75
June	14.71	13.60	Dec.	14.25	12.75

Copper averaged 13.5c. per pound in 1914, against 15.5c. in 1913. Shipments of metal from Michigan in 1914 totaled 53,933 tons, or 107,866,000 lb. The Anaconda output in December was 11,800,000 lb., against 12,700,000 lb. in November. The Company's total in 1914 was about 230,000,000 lb., compared with 271,029,240 lb. in 1913. The Nichols Copper Co., operating a large refinery at Laurel Hill, New York, has passed its quarterly dividend on account of the copper situation. A résumé of the situation last year appears on page 89 of this issue.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Dec. 31	3.80	Nov. 25	3.90
Jan. 1 Holiday		Dec. 2	3.80
" 2	3.80	" 9	3.80
" 3 Sunday		" 16	3.80
" 4	3.80	" 23	3.80
" 5	3.80	" 30	3.80
" 6	3.80	Jan. 6	3.80

Monthly averages.

	1913.	1914.		1913.	1914
Jan.	4.28	4.11	July	4.35	3.80
Feb.	4.33	4.02	Aug.	4.60	3.86
Mch.	4.32	3.94	Sept.	4.70	3.82
Apr.	4.36	3.86	Oct.	4.37	3.60
May	4.34	3.90	Nov.	4.16	3.68
June	4.33	3.90	Dec.	4.02	3.80

The average price of lead in 1914 was 3.9c., compared with 4.4c in 1913. A résumé of the situation last year appears on page 89 of this issue.

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
Dec. 31	5.50	Nov. 25	5.10
Jan. 1 Holiday		Dec. 2	5.20
" 2	5.50	" 9	5.50
" 3 Sunday		" 16	5.50
" 4	5.50	" 23	5.37
" 5	5.50	" 30	5.40
" 6	5.50	Jan. 6	5.50

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	6.88	5.14	July	5.11	4.75
Feb.	6.13	5.22	Aug.	5.51	4.45
Mch.	5.94	5.19	Sept.	5.55	5.16
Apr.	5.52	4.98	Oct.	5.22	4.75
May	5.23	4.91	Nov.	5.09	5.01
June	5.00	4.84	Dec.	5.07	5.40

The Joplin market is still strong, and for ore containing 60% metal, the average last week was $51.50, the highest paid being $54.50 per ton.

MAGNESITE

Eastern inquiries for 20,000 tons of California magnesite are reported this week, and a buyer is in the market for that amount.

Pig-iron production in 1914 is estimated by 'The American Metal Market' at 23,200,000 tons, a decrease of 25%; steel ingots, 21,000,000 tons, 30%; finished steel, 16,000,000 tons, 30%; steel castings, 600,000 tons, 40%; and rolled iron, 1,200,000 tons, 28%. Prices at the end of the year were the lowest since 1898, being $13.03 per ton.

There is an increased demand for barium and strontium in the eastern markets.

MINERAL PRODUCTION IN 1914

Preliminary figures of production for a number of the states and metals are given below. Additional figures will be printed from week to week as they be-
silver, and the Survey estimate will be found following his review.
market page.

Anthracite Production

Shipments of anthracite coal from Pennsylvania, as reported by the Bureau of Anthracite Coal Statistics, with those of December estimated, indicate that the quantity sent to market during 1914 was about 68,240,000 long tons, against 69,069,628 tons in 1913. To the shipments of 1914 should be added about 1,000,000 tons, principally of nut and steam sizes, which were stocked in the storage yards, so that while the shipments to market showed a decrease of nearly 1,000,000 tons, the production of the mines was about the same as in 1913, or approximately 81,700,000 long tons, of which 1,800,000 tons was sold locally and 8,650,000 tons used at the mines. The condition of the industry was somewhat peculiar. Consumers throughout the year usually bought for immediate demand, and no more than was necessary. Labor conditions in the anthracite regions are stated as normal. A few strikes of sporadic character occurred, but these have not been of much importance, merely keeping up the interest of the members of the union in the organization.

U. S. Geological Survey Estimates

Coal Production of the United States

Notwithstanding the slough of despond through which the coal-mining industry of the United States was compelled to work its way during the last nine months of 1914, a decidedly hopeful tone prevailed at the end of the year, and the opinion generally expressed to Edward W. Parker was that the receding time had reached its full ebb, and optimism was apparent regarding the coming year. The total coal production of the United States in 1914 is estimated at about 510,000,000 short tons, a decrease of about 60,000,000 tons compared with the record output of 1913. Practically all of this decrease was in the output of the bituminous mines. The production of Pennsylvania anthracite in 1914 was not materially different from that of the preceding year. The principal decreases in the production of bituminous coal were in the coking districts. It is estimated that in Pennsylvania alone the production of bituminous coal decreased between 20,000,000 and 25,000,000 tons, and that the larger part of this decrease was in Fayette and Westmoreland counties, which constitute the Connellsville and Lower Connellsville coking districts. The weekly reports of coke production published in the *Connellsville Courier* indicate that the output of coke in the two Connellsville districts was less than that of 1913 by about 6,000,000 tons, or 30%, and as each ton of coke represents about 1½ tons of coal, a decrease of nearly 10,000,000 tons in the coal output is indicated in these districts alone.

Coal in Ohio

The estimated output of this state last year is 20,000,000 tons, compared with 36,200,527 tons in 1913. A strike and recent legislation worked for this decrease, according to E. W. Parker, the Survey's coal statistician.

Coal in West Virginia

Conditions in the coal-mining industry of this state may be expressed as 'mixed' during the year. Labor troubles, business depression, and other factors resulted in the output being about 70,000,000 tons, against 71,308,982 tons in 1913. The coke manufactured was only about 55% of the previous year.

Coal in the Southern States

The yield of these states was as follows, in tons:

State.	1914.	1913.
Alabama	12,500,000 to 15,000,000	17,678,522
Kentucky	20,000,000	19,616,600
Maryland	4,200,000	4,779,839
Tennessee	5,500,000	6,903,784
Virginia	7,500,000	8,828,068

The business depression made itself felt particularly in Alabama, because of its iron industry.

Coal in the Pacific Coast States

Washington is the only one of any importance, the output being from 20 to 30% less than it was in 1913, when the total was 3,877,891 tons. It is estimated that the consumption of California oil for fuel on the Coast is equivalent to about 20,000,000 tons of coal, or six times the production of Washington.

Utah's Metal Output

As a result of the depression in the metal market due to the European war, there was a decrease of about $6,900,000 in the value of the gold, silver, copper, lead, and zinc output from Utah mines in 1914, according to estimates by V. C. Heikes. Mr. Heikes gives for 1914 a value of $38,000,000. There was an increase in the quantity of lead produced, but decreases in gold, silver, copper, and zinc estimated as spelter. The metal output was as follows:

Production.	1914.	1913.
Ore mined, tons	9,550,000	10,202,566
Gold recovered, value	$3,300,000	$3,565,229
Silver, ounces	11,752,000	13,084,835
Copper, pounds	155,901,000	161,445,962
Lead, pounds	181,553,000	166,126,790
Zinc, pounds	14,297,000	18,857,827

Large Decrease in Metals in Nevada

A decrease in the metal output of Nevada in 1914 of over 22% compared with 1913 is credited to the influence of the European war in lowering the price of the base metals, especially copper. The value of the metal output of Nevada in 1913 was $37,097,000, and the estimate for 1914 is $28,800,000. The yields were as follows:

Metal.	1914.	1913.
Gold, value	$11,320,000	$11,795,130
Silver, ounces	15,200,000	16,090,083
Copper, pounds	60,561,000	90,693,751
Lead, pounds	13,794,000	16,344,023
Zinc, pounds	13,000,000	14,419,671

There was a total of about 2,700,000 tons of copper ore concentrated and smelted.

Metal Output of Montana

The yield of this state in 1914 was seriously affected by the conditions of the copper market due to the European war, as Montana is primarily a copper producer. The value of gold, silver, copper, lead, and zinc from Montana mines decreased from nearly $62,000,000 in 1913 to about $48,000,000 in 1914. The decrease in copper was large, and that in silver was notable, but there were considerable increases in gold, lead, and zinc. The gold recovered increased to a trifle over $4,000,000, or more than for seven years previous. This shows an increase of 14% over 1913, due to dredging and production of silicious ores. Silver decreased from 13,819,201 to

12,000,000 oz., or 13%; and copper from 287,828,699 to 238,000,000 lb., or 17%. Lead increased from 10,935,827 to 15,000,000 lb.; and zinc from 88,673,083 to 109,000,000 lb., or 23 per cent.

Arizona Metals in 1914

The value of the gold, silver, copper, lead, and zinc produced at mines in Arizona in 1914 decreased over 16% compared with 1913, owing principally to the lower price of copper on account of the European war. The estimated output is $59,000,000, compared with $70,875,027 in 1913. There was little decrease, however, in the output of copper, lead, and zinc, and considerable increases were made in gold and silver. The mine yield of gold increased from $4,023,911 in 1913 to about $4,570,000 in 1914. This increase of nearly 14% was almost entirely in silicious ores of gold and silver mines. A record production of silver was made, notwithstanding the reduced market price. The output increased from 3,948,091 oz in 1913 to about 4,469,000 oz. in 1914. While Arizona still leads in copper production, the output decreased, on account of market conditions, from 407,923,402 lb. in 1913 to about 388,000,000 lb. in 1914, a decrease of nearly 20,000,000 lb., or about 5%. The output of lead was practically the same as that of 1913, when the mines produced 16,144,772 lb. The mine production of zinc ore was close to that of 1913, when 14,726 tons of concentrate and crude ore produced 9,428,067 lb. of spelter, chiefly from the Golconda and Tennessee mines in Monave county.

Reduced Production of Portland Cement

According to preliminary returns from all the operating mills in the United States, except one, it is estimated by Ernest F. Burchard that the quantity of portland cement manufactured in 1914 was approximately 88,514,000 bbl., compared with 92,097,131 bbl. in 1913, a decrease of about 3,583,000 bbl., or nearly 4%. The estimated shipments of portland cement during 1914 totaled 86,715,000 bbl., compared with 88,689,377 bbl. in 1913, a decrease of about 1,975,000 bbl., or 2.2%. On account of the surplus of production over shipments, stocks of cement at the mills apparently increased more than 14%, or from 11,220,328 bbl. in 1913 to 12,818,000 bbl. at the close of 1914. It may be necessary to revise downward the figures for stocks, as the estimates furnished by some producers undoubtedly include more or less unground clinker, but it is believed that the figures for production and shipments are very close to those that will be shown later by exact reports from cement producers. Although only general statements as to selling prices are at hand, it is evident that the average value per barrel was slightly lower than in 1913, when the average was $1.005 per bbl. Slight increases in prices are reported from a few plants in the eastern states, but decreases were reported from the majority of plants in all districts.

Production of Copper in 1914

The copper production of the United States in 1914 will show a marked decrease from that of 1913, according to figures and estimates collected by B. S. Butler. Reports have been received from all plants known to produce blister copper from domestic ores and refined copper. At an average price of about 13.5c. per pound, the 1914 output has a value of $152,400,000, compared with $189,795,000 for the 1913 output. The large decrease in production in 1914 was due to curtailment of production during the latter part of the year on account of the reduction in tonnage exported to Europe.

The figures showing smelter production from domestic ores represent the actual production of most of the companies for 11 months and an estimate of the December output. The November figures for a few companies were not available and these companies furnished estimates for the last two months of the year. According to the statistics and estimates received, the output of blister and Lake copper was 1,129,000,000 lb. in 1914, against 1,224,484,000 in 1913. The statistics and estimates indicate that the output of refined copper from primary sources, domestic and foreign, for 1914 was 1,493,000,000 lb compared with 1,615,067,000 in 1913.

According to the Bureau of Foreign and Domestic Commerce, the imports of pigs, ingots, bars, etc., for the first 11 months of 1914 amounted to 187,433,676 lb., and the copper contents of ore matte and regulus amounted to 97,348,866 lb., a total import of 284,782,542 lb. This compares with an import for the 12 months of 1913 of 409,560,954 pounds.

Exports of pigs, ingots, bars, plates, sheets, etc., for the first 11 months of 1914 amounted to 780,048,777 lb., compared with an export for 1913 of 926,441,152 pounds.

At the beginning of 1914 there was about 90,000,000 lb. of refined copper in stock in the United States. This added to the refinery production gives a total available supply of about 1,583,000,000 lb. of refined copper. On subtracting the export from this, with an estimate for December, it is apparent that the supply available for domestic consumption is materially below the 812,000,000 lb of 1913, without taking account of stocks held at the close of the year.

The average price of copper for 1914 showed a decrease from that of the preceding year, being about 13.5c. per pound compared with 15.5c. in 1913. After the outbreak of the European war copper sold considerably below the yearly average, but toward the close of the year the price showed notable improvement.

The leading states were estimated as follows, in pounds:

State or territory.	1914.	1913.
Alaska	20,850,000	23,423,000
Arizona	380,000,000	404,000,000
California	25,000,000	32,492,000
Michigan	160,000,000	155,700,000
Montana	206,000,000	285,700,000
Nevada	60,000,000	85,200,000
New Mexico	60,000,000	50,196,000
Tennessee	18,000,000	19,489,000
Utah	145,000,000	148,000,000

Lead Production a Record

The year 1914 was marked by an enormous increase in the output of domestic lead in the United States, according to C. E. Siebenthal, an increase of nearly 100,000 tons over the production of any preceding year. There was also a heavy decrease in the tonnage of lead of foreign origin treated in the United States, and for the first time in years a great increase in the quantity of domestic lead exported to European countries. At the same time the average price of lead in the United States was the lowest since 1898.

The estimates have been compiled from reports to the Survey by all lead refineries and soft-lead smelters in operation during the year. These reports cover actual production for the first 10 or 11 months of the year, with an estimate for the remainder of the year, and from them the figures of production are made up without change. The statistics of imports, exports, and lead remaining in warehouses have been taken from the records of the Bureau of Foreign and Domestic Commerce for 11 months, the figures for December having been estimated.

The production of refined lead, desilverized and soft, from domestic and foreign ores in 1914 was approximately 537,079 short tons, worth at the average New York price $41,892,162, compared with 462,460 tons, worth $40,696,480, in 1913, and with 480,894 tons in 1912. The figures for 1914 do not include an estimated output of 12,850 tons of antimonial lead, against 16,665 tons in 1913 and 13,552 tons in 1912. Of the total production, desilverized lead of domestic origin, exclusive of desilverized soft lead, is estimated at 312,257 tons, against 250,578 tons in 1913 and 221,480 tons in 1912; and desilverized lead of foreign origin comprised 25,295 tons, compared with 50,582 tons in 1913 and 88,377 tons in 1912. The production of soft

lead mainly from Mississippi Valley ores is estimated at 199,527 tons compared with 161,300 tons in 1913 and 191,614 tons in 1911, the largest prior output of soft lead. The total production of lead desilverized and soft, from domestic ores, was thus about 511,784 tons, almost 100,000 tons more than in any previous year, and 25,000 tons more than the total output of the country from both domestic and foreign sources in any previous year.

The imports of lead are estimated at 11,764 short tons of lead in ore, valued at $743,332; 14,998 tons of lead in base bullion, valued at $1,029,233; and 142 tons of refined lead, valued at $9751, a total of 26,904 tons, valued at $1,782,316, compared with 37,145 tons, valued at $2,965,817, in 1913. Of the 1914 imports about 20,000 tons, or nearly 75%, came from Mexico, against 47,847 tons in 1913 and 79,728 tons in 1912, the decrease being due to domestic strife in that country. From Germany came 2265 tons, from German East Africa 1278 tons, and from Chile about 1250 tons.

The exports of lead of foreign origin smelted or refined in the United States again show a big decrease, being estimated at 21,193 tons, against 54,323 tons in 1913.

For the first time in years there were exports of domestic lead to Europe, the total for the year being estimated at 62,924 short tons, valued at about $4,804,000.

The amount of lead available for consumption during 1914 was 442,744 tons, which, compared with 419,463 tons in 1913, 388,148 tons in 1912, 385,319 tons in 1911, and 379,196 tons in 1910, and taking into account trade conditions during the year, seems to be an excessive figure, making it seem very probable that there has been an increase in lead stocks. Of the foreign lead remaining in warehouses at the close of November 1914, there was at El Paso 2176 short tons and at New York 4846 tons, with small quantities at Chicago and St. Louis. The average New York price for the year was 3.9c. per pound, compared with 4.4c. in 1913 and 4.5c. in 1912.

Quicksilver in 1914

By Clifford G. Dennis

Production and Development

During the year 1914 the quicksilver production of the United States was approximately 20,670 flasks of 75 lb. each, valued at $1,017,171; an average value per flask, based on monthly averages, of $49.21. California produced 16,571 flasks, and Arizona, Nevada, and Texas 3099 flasks. The production up to August 1 was at a rate far below that for 1913, in which year the lowest production for years was recorded. In August the price of the metal reached the highest since the early days of quicksilver mining in California, and many operators whose plants were closed on account of poor market conditions, started up. At the year's end the production is estimated to have exceeded that for 1913 by 989 flasks and $343,117 in value.

The average price, computed from monthly averages, for the first seven months, was $38.70 per flask, and for the last five months $63.80 per flask. The approximate production and monthly averages are given below.

Month.	Flasks.	Per flask.
January	1320	$39.25
February	1601	39.00
March	1482	39.00
April	1683	38.90
May	1592	39.00
June	1720	38.60
July	1506	37.50
August	1467	80.00
September	1877	76.25
October	2230	53.00
November	2103	55.00
December	2089	55.00

Production 1899 to 1914 (Incl.)[sic]

Year	Cal. flasks.	Texas flasks.	Others flasks.	Total metric tons	Value
1899	29,451	261		1,925	$ 1,[illegible],700
1900	26,417	1,700	233	974	1,[illegible],430
1901	26,720	2,932	75	1,031	[illegible],300
1902	29,552	5,252		1,208	1,[illegible],744
1903	32,091	5,029		1,288	1,564,734
1904	28,876	5,436	700	1,204	[illegible],184
1905	24,655	5,000	1,050	1,045	1,217,652
1906	19,516	1,517	1,276	861	1,[illegible],138
1907	17,532	3,000	400	712	[illegible],678
1908	16,969	2,832	346	685	903,391
1909	16,217	1,188	810	701	941,283
1910	18,536	3,382	500	763	1,054,991
1911	18,860	2,396	....	732	989,254
1912	20,600	2,700	1,847	855	1,067,742
1913	15,396	....	4,285	670	774,054
1914	16,571	....	3,099	703	1,017,170

The price of the metal was low during the first part of the year, but the demand was fairly good. In August the price was bid up, presumably by foreign buyers, to phenomenal figures. One small lot of 20 flasks was bought and paid for with cash at the mine at $110 per flask. During these very high prices in the United States, the price quoted at London remained the same, about £7. Later the London quotation has been above the American quotations.

California.—The New Idria, in San Benito county, continues to lead California producers, although this mine has been running far below the record for 1913. Extensive developments are said to be under way that will make available a large tonnage of low-grade ore that will be of commercial value when these developments are completed. At the Aurora mine, in the New Idria district, experiments with a rotary furnace have been under way, thus far without results. The operators expect some returns early in 1915. The Oceanic mine, in San Luis Obispo county, has experienced a successful year, under the management of Murray Innes. The furnace has been supplied with ore principally from old stopes. New developments in the lower levels are said to have been disappointing, but lateral work on the adit level has been most encouraging. At the Guadelupe mine, in Santa Clara county, extensive developments have been under way, which are said to be most successful. The New Almaden furnaces, under the management of W. H. Landers, have operated this year entirely from old dumps, surface croppings, and from refuse about the furnaces. The reorganization of the Quicksilver Mining Co., which owns these mines, has been retarded on account of the financial conditions, but it is expected that during 1915 a vigorous campaign of development will be put under way. At the Helen mine, in Lake county, most of the year has been spent doing development work. The St. Johns mine, in Solano county, has been operating in a small way since June 1.

The Cambria Quicksilver Co., while an important producer from 1906 to the end of 1908, was then idle until October 1914. Since that date, 15 men have been engaged in prospecting and development. An orebody has been found, and if it proves sufficiently extensive the 50-ton furnace now on the property will be put into operation early this summer.

Texas.—The Chisos mines, at Terlingua, Brewster county, had considerable difficulty in securing labor owing to the nearness to the Mexican border. It has been reported that these mines will be equipped with additional furnace capacity in 1915.

Arizona.—The Sunflower district reported a new body of ore, also a discovery was reported from Gila county. No further activity was reported by the Cinnabar Development

Co. that was operating the Colonial mine in west central Yuma county.

Nevada.—The Mercury Mining Co., at Ione, Nye county, closed down its furnace early in the year, and development was continued under the direction of W. E. Goldswarthy. Sufficient ore was opened so that the furnace could be started again in the fall. The Nevada Cinnabar Co. put its 50-ton furnace in operation early in the year and has experienced a successful year under the management of John Andrews. At the Goldbanks property, operating near Winnemucca, a set of 15 inclined pipe-retorts was erected. Later this set of retorts was discarded and replaced with a 10-ton, inclined, 10-muffle retort. The muffle is arranged so that it may be charged and discharged a carload at a time, making the treatment continuous. This Company has made and burned 360,000 common brick and is preparing to erect a furnace in the spring. A new furnace was not erected at the Ruby mine last year as reported. Treatment of the high-grade ore was continued in the pipe-retorts and further development carried on. A new furnace is planned for 1915. A 10-pipe retort was erected at the Dalbare mine, which is situated at the southerly end of the Humboldt mountains.

METALLURGICAL IMPROVEMENTS

Hearth Furnaces.—Considerable discussion has arisen of late, among operators, regarding the hearth type of roasting furnace, as to its application to quicksilver ores. There is no doubt that these roasters can be adapted to roasting quicksilver ores, and the saving and condensation of the fumes accomplished successfully. The ore would probably be roasted more rapidly than in the Scott type of furnace, and with the application of fewer heat units per ton of ore treated. The first cost of almost any of the hearth furnaces would be less per unit of capacity than the Scott, and it would be better adapted to intermittent service. The operating cost of the hearth type would probably be higher. Such furnaces would require a higher class of labor to operate than the Scott, would be liable to cause long delays on account of repair parts, and would have a considerably shorter life.

Whether the fixed charges against a hearth type furnace, being less on account of smaller investment, would offset the increase in operating expense, is a question. It is difficult to estimate what the maintenance of one of these furnaces would be, for the reason that all available costs are based on operating several of the furnaces in one plant, thus reducing the maintenance cost to the minimum. The question is, what would the conditions be if one of these furnaces were placed away off from the source of supplies, how much skilled labor would have to be kept on tap for emergencies, and what would the delays caused by lack of parts and time securing same, cost?

The matter of reducing the investment is important, for it is evident that the average furnace outlasts the life of the average mine, so that a small increase in operating cost against decreased investment would ultimately work out in favor of the hearth type of furnace. On the other hand, the Scott furnace is almost 'fool proof,' can be counted to deliver day in and day out, and the maintenance cost is small.

Flotation.—Some experiments that I made on flotation as applied to cinnabar ores may be mentioned. The mineral occurred in a soft decomposed tufa, too soft to run through a furnace, and was of such low specific gravity that very low capacity could be obtained in any type of furnace. The experiments determining the cinnabar floats very readily. An extraction of 92% was obtained by running the pulp through the machine twice. It is not likely that similar conditions exist in many places, therefore it is not likely that flotation will ever take an important part in the metallurgy of quicksilver. On the average cinnabar ore, it would be cheaper to roast the ore direct.

A Wet Process.—The excessive loss of mercury in 'high-grade' treatment at the Buffalo Mines at Cobalt led to careful studies of possible methods of recovery and development of a process for wet treatment. Details of the process have not been made public as yet, but experiments on mercury ore are said to indicate the probable availability of the process for general purposes. Details are promised later.

U. S. Geological Survey Quicksilver Estimates

According to preliminary figures collected from individual producers by H. D. McCaskey, the output was 16,568 flasks, valued, at the average price at San Francisco of $49 per flask, at $811,832. This is a decrease of 3645 flasks and $1339 in value compared with the previous year. There were 33 mines worked, against 24 in 1913. California showed a decrease of 4122 flasks. Arizona, Nevada, and Texas yielded 477 flasks more than in 1913. Exports during the past two years were 452 in 1914 and 1140 flasks in 1913; and imports, 9140 in 1914 and 2290 flasks in 1913.

Zinc Estimates Not Available

The U. S. Geological Survey has found it impossible to obtain estimates of output and stocks of zinc for 1914 from a number of producers. It is not likely that any statistics of zinc output will be published until the Survey's annual chapter on zinc from 'Mineral Resources' is made public.

MINING DECISIONS

MINERAL OIL AND GAS NOT 'FRUITS OF THE LAND'

The statutory right of a possessor in good faith of land to reap the benefit of the fruits of the land until it is claimed by its owner, does not permit such possessor to extract the mineral oil and gas from the land and retain the proceeds.

Elder *v.* Ellerbe (Louisiana), 66 Southern, 337. November 16, 1914.

COAL LEASE—LESSOR NEED NOT OWN LAND AT TIME OF LEASE

In an action by the lessor to recover stipulated royalties under a coal lease, the defense made was that the lessor did not own the land at the time he leased it. Held, that inasmuch as the lessee was given possession under his lease, and no fraud, accident or mistake in its execution alleged, or ejectment of the lessee by the owners of the land or surrender of the lease to the lessor, or covenants against defective title proved, the recovery of royalties could not be defeated.

Lazarus *v.* Lehigh Wilkes-Barre Coal So. (Pennsylvania), 92 Atlantic, 121. July 1, 1914.

PLACER LEASE—CONSTRUCTION

Where a lease of mining ground required the royalties to be paid during the year, the whole amount of the annual rent matured at the end of the year, and, if not paid, an action would lie, whether the rent was payable in money or in gold dust. If the lease did not specify the place of payment, it is presumed that they were payable on the premises and omission to designate a place of payment is no defense. Where such a lease provided for work steadily from the date of the lease, weather and season permitting, a custom that, in the absence of a contrary provision, the lessee might cease work whenever he chose was irrelevant. In case of a breach by nonperformance of such working conditions, the lessor is neither required to enter and work the ground or re-let to another as a condition to recovery of damages from defaulting lessee.

Northern Light Mining Co. *v.* Blue Goose Mining Co. (California), 143 Pacific, 540. August 7, 1914.

Beginnings of the Tata Iron & Steel Company of India—By C. M. Weld, page 97

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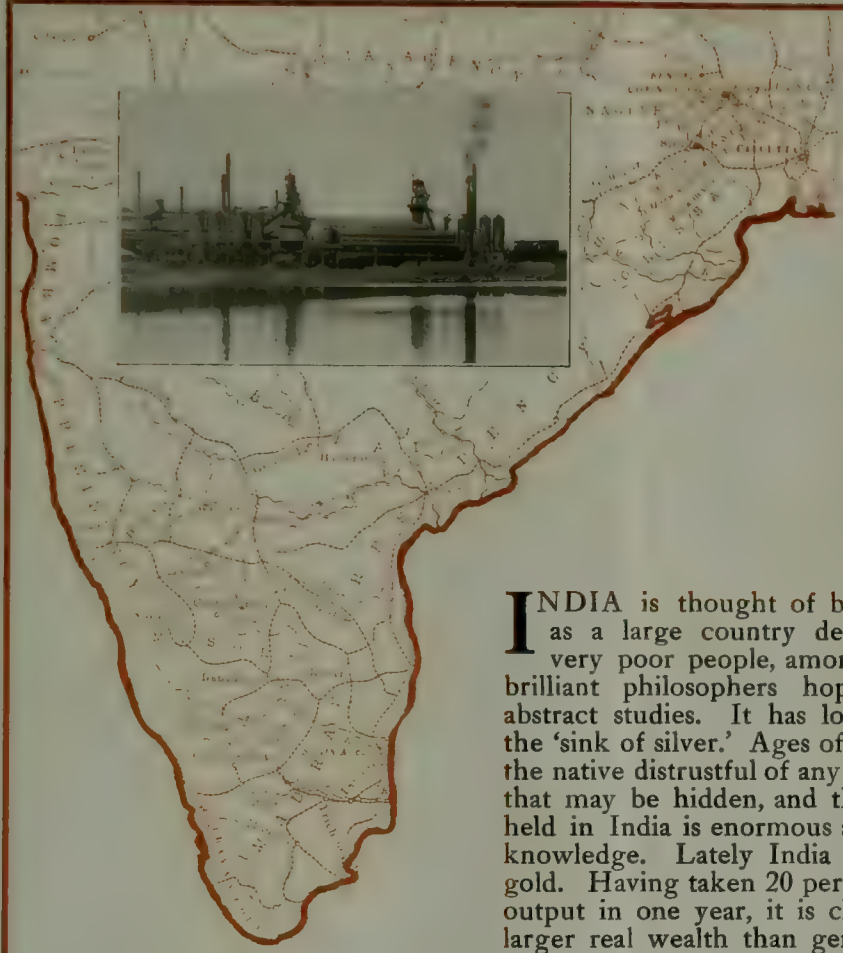
Contents Page 4
Buyers Directory Page 26
Advertisers Index Last Page



A New Industry In an Old Country

INDIA is thought of by most Westerners as a large country densely populated by very poor people, among whom are a few brilliant philosophers hopelessly wedded to abstract studies. It has long been known as the 'sink of silver.' Ages of misrule have made the native distrustful of any but tangible wealth that may be hidden, and the amount of silver held in India is enormous and beyond positive knowledge. Lately India has been absorbing gold. Having taken 20 per cent of the world's output in one year, it is clearly a country of larger real wealth than generally appreciated. Now a new condition has arisen. Under stable government the people of India are laying aside their mistrust, and under the wise guidance of far seeing leaders, such as Messrs. J. N. Tata and B. J. Padshah, India is bringing her money out of hiding and setting it to work. This is a phenomenon of more interest to the West than the mere shipment of a few thousand tons of pig iron annually. A great modern iron and steel works has been put in operation. It was built and is officered by American engineers, but the workmen, the capital, and the initiative came from India itself. It is a genuine expression of the determination of the leaders of India to re-establish the ancient industries of their country. How carefully and how wisely it was planned is told most interestingly in this number by Mr. Weld.

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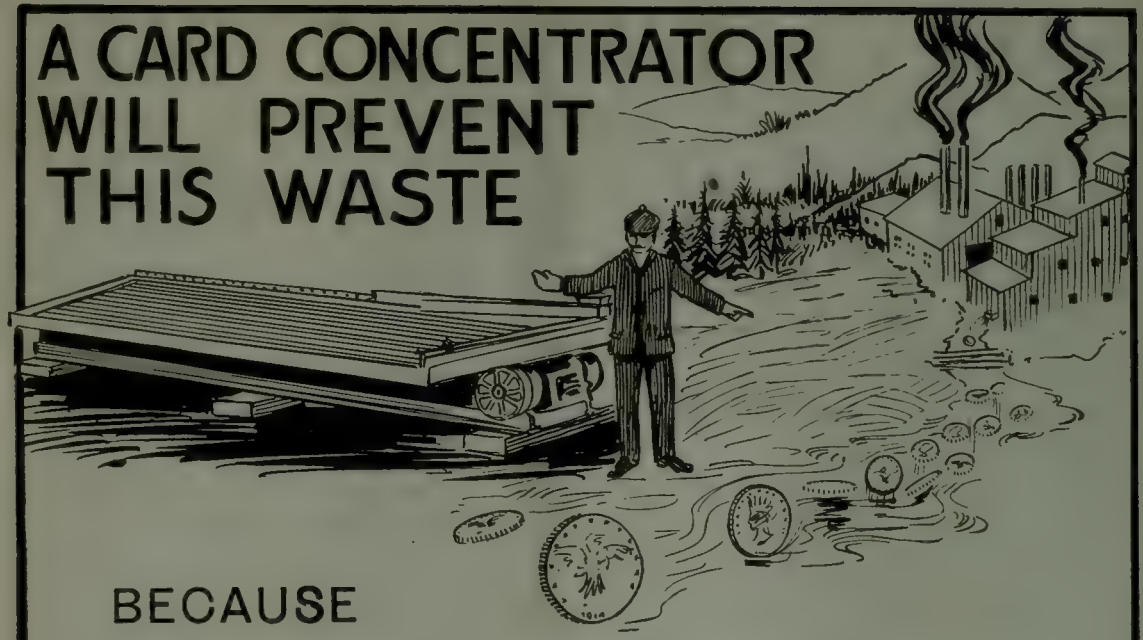

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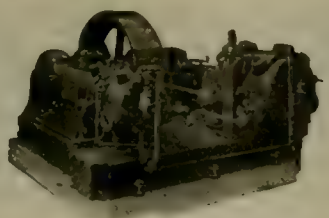

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VOL. 110 SAN FRANCISCO, JANUARY 16, 1915 NO. 3

TABLE OF CONTENTS

EDITORIAL Page.

News 93
The Engineering Congress and Mining Men 94
The Rubber Famine 95

ARTICLES

LOOKING FORWARD 96

In an interesting address before the American Mining Congress, Mr. W. G. Swart pointed out that prospecting and development are two different things, and that, whatever might be true of the former, the latter needed stimulation. In this, mining engineers should be leaders. Small companies had already proved that, by conservative action and adoption of the principle of distributed risk, a good business could be built up.

BEGINNINGS OF THE TATA IRON & STEEL COMPANY OF INDIA.

By C. M. Weld 97

India was one of the countries in which iron working began, but in recent years it has been an inconsiderable producer. J. N. Tata, a wealthy and patriotic Parsee merchant, who established cotton spinning in that country, undertook to re-establish the iron and steel industry. Being disappointed in the first deposits brought to his attention, he commissioned Mr. Weld, acting under Mr. C. P. Perrin, to study the whole field and find the best place in India for establishment of works. This was done, and a fine modern plant is now delivering high-class product. Mr. Weld tells the story of the survey with its disappointments, peculiar difficulties, and final triumph.

TUBE-MILL PEBBLES—THEIR CHARACTERISTICS AND COST.

By Edwin C. Eckel 103

In order to compare tube-mill pebbles as to efficiency, it is necessary to determine the physical and chemical properties essential to them. This Mr. Eckel does, bringing out especially the importance of their specific gravity. He then considers the various materials available in the United States and elsewhere, and their relative efficiency. Mr. Eckel is an engineer particularly familiar with the portland cement industry and speaks from wide observation and study.

MINING IN BRITISH COLUMBIA DURING 1914.

By W. M. Brewer 104

Contrary to predictions, British Columbia mines did fairly well in 1914. The total decrease in output as compared with 1913 was 14 to 15%, and the total output worth $26,000,000. The big event of the year was the opening of the Anyox smelter of the Granby company

MAGNESITE DEPOSITS AND POSSIBILITIES IN CALIFORNIA.

By Samuel H. Dolbear 105

Inquiries for magnesite have been pouring upon California producers since the war checked imports, and inquiries have also poured in on the *Press*. In response to request, Mr. Dolbear has written briefly but accurately regarding the trade in general, production and uses, grades, and California sources of magnesite. The industry is one that warrants further development.

STAMP-MILL TEST.

By E. S. King 109

Abstract from *The Mining Magazine* of a record of a test between Nissen and Sandycroft stamps, made at Tincroft, Cornwall.

THE HARDENING OF METALS 112

Note on an address by Sir Robert Hadfield delivered before the Faraday Society.

DEPARTMENTS

DISCUSSION:

Amalgamation in Hardinge Mills.

By F. J. Girard, M. W. von Bernewitz 110

Mr. Girard raises some questions over contradictory results at Plymouth and Incaoro. Mr. von Bernewitz speaks of experience in Australasia.

Valuing Placer Ground. *By Edmund Bonella* 111

A further contribution to the discussion running in the *Press* through the past several months.

Precision of Thought. *By J. Nelson Nevius* 112

One man, at least, who agrees with the editor.

CONCENTRATES 113

MINING IN THE FAR NORTH.

The Outlook for Quartz Mining in the Fairbanks District. *By Emil Edward Hurja* 114

Lode mining at Fairbanks is still an industry of small units, but there are many of them. Mr. Hurja gives some account of virtually all.

REVIEW OF MINING: Special correspondence from New York; Houghton, Michigan; Washington, D. C.; Leadville, Colorado; Platteville, Wisconsin; Carson City, Nevada 116

THE MINING SUMMARY 120

PERSONAL 124

MINERAL PRODUCTION IN 1914:

Gold and Silver 124
Iron Ore 124

THE MARKET PLACE:

Metal Prices 125

COMPANY REPORTS: Mt. Elliott Copper Co., Ltd.,; St. John del Rey Mining Co., Ltd.; Champion Reef Gold Mining Company of India, Ltd.; The Consolidated Mining & Smelting Company of Canada, Ltd 126

RECENT PUBLICATIONS 127

NEW MACHINES AND DEVICES:

An Automatic Aerial Tramway for Carrying Ore 128
Commercial Paragraphs 128

EDITORIAL

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DREDGE TAILING from Natoma is being tested at the Plymouth mine as a substitute for tube-mill pebbles.

EMBARGO on the export of ores, concentrate, and metals from Australia to the United States has been lifted by the Commonwealth government, provided the authorities there are satisfied that these products will not be transshipped to any of the countries at war with England.

TUBE-MILL pebbles have received but little systematic study, though all users know that they vary greatly in value. Mr. E. C. Eckel's discussion will, therefore, be received with especial interest. We shall follow it with a more elaborate study by Mr. Jay A. Carpenter of the pebbles he has been using at Tonopah.

SUIT is to be begun at Los Angeles next Monday to recover for use as a naval reserve, oil lands in the Elk Hills region now held by the Southern Pacific and claimed to have been acquired as agricultural lands by fraud. This is considered to be the strongest of the various cases that the Washington authorities have, and much will hinge on the decision.

AT the meeting of the San Francisco section of the American Institute of Mining Engineers, held at the Engineers Club last Tuesday evening, the proposed amendments to the constitution were discussed at length. At the close of the meeting a call for expression of opinion showed that among those present, some twenty members, the sentiment was unanimously in favor of the amendments.

ALIEN labor laws received a setback last week when the United States District Court of Arizona, sitting at San Francisco, held the Arizona statute unconstitutional. It was held that if an 80 per cent restriction could be enforced, any other percentage up to the whole could be equally well applied. This introduces discrimination, against which the laws guarantee both citizens and aliens. The case has been appealed to the United States Supreme Court.

OUR attention has been called to an error in the statement of the outstanding first debenture bonds of the Mond Nickel Company, Limited, which amounts to £375,000, and not £3,750,000. The mistake was in the original cable. The total of the old and new bond issues is £875,000, not a large amount for a company possessing such excellent properties as the Mond company holds, particularly when the able management of the concern is taken into account.

FIRMS in neutral European countries complain that in addition to other handicaps they are unable in instances to buy American goods because the foreign agencies are lodged in London, and for any one of several reasons the British firms handling the business are not prepared to sell or ship. Evidently this war will lead to readjustments of foreign trade far more numerous than is even yet realized. Neutrality without commercial independence is less valuable than it sounds.

A CYNICAL onlooker replied recently to the question, what, in view of present unfavorable conditions, mining engineers would have to do to make a living, by remarking that he was afraid they would have to go to work. The Mexican troubles, coupled with the European war, have hurt mining engineers as much as any class of professional men. Mr. W. G. Swart, in the address of which we present an abstract this week, points out one way that they may occupy themselves to advantage.

ESTIMATES of gold-silver production of the various states, as made by the Bureau of the Mint and the U. S. Geological Survey, are presented on another page. It is comforting to note that there has been a substantial increase. The silver output was one of the greatest yet realized, despite the disorganization of markets in the latter part of the year. Demand from India and China was disappointingly small and stocks accumulated, but on the whole, the year's results were better than had been feared.

MAGNESITE, chromite, manganese, and many other of the minor minerals found upon the Pacific coast are now in exceptional demand, owing to disturbance of usual trade relations by the war. We present this week a discussion of the California magnesite industry, written by Mr. Samuel H. Dolbear, a chemical engineer who has gone into the active work of production, and who brings out a number of points not generally understood. This article will be followed by others of similar character giving information greatly in demand at the present time.

MINERAL EXHIBITS of the United States and some foreign countries will be displayed in the Palace of Mines and Metallurgy of the Panama-Pacific Exposition. Those from Australia and New Zealand will only be shown in the respective buildings of those countries, which are situated in the grounds near the Presidio. The war, in which these British possessions are taking an active part, has caused a considerable reduction in the extent of the buildings and exhibits as originally planned. However, good samples of rocks, ores, metals, rare earths, and gems, with mine models and other interesting features of the industry which has produced approximately £810,000,000 in Australia and £125,000,000 in New Zealand, will be on view.

SOME of the difficulties of mining operations in European countries, even in districts outside the war zone, are reflected in the report of the Chairman of the Board of the Tanalyk Corporation, who relates that the first mobilization of the Russian army took away the manager of the mine and smelter, three mining engineers, the chief chemist, thirty-five members of the office and administrative staff, and nearly one-third of the workmen. The second and third calls for men made a further reduction in the working force. Fortunately, a nine months' supply of ore for the smelter was already on the stockpile, and ore reserves had been developed much in excess of the daily requirements, so that even if the war should last four years, the present smelter unit can be kept in operation. The Tanalyk has made an excellent showing to date, and it is pleasant to be able to record that recent exploration indicates that several additional valuable orebodies can be developed.

COMPLAINT of unfair exactions of ore buyers is as old as the trade, and it is not likely that it will altogether cease so long as ore is sold. It is to be remembered, however, that similar criticism is leveled at buyers of other commodities, and is apt to continue until human nature changes materially. One of the most vigorous protests we have seen was published recently in *The Norwood Post*, and relates to carnotite buying in Colorado. Mr. Frank Silvey shows that the producer receives but $145 per ton, and must wait five to six months for the greater part of that, for ore in which the uranium and vanadium content is worth $939. Allowing for losses and transportation, Mr. Silvey estimates the ore as worth $734. Such figures are deceptive, since there is no apparent allowance for treatment and since, furthermore, the market for both uranium and vanadium is extremely uncertain. None the less, there is doubtless foundation for the charge that in this trade the middleman has, as is the custom of middlemen, exacted large profits. In view of the wide difference of opinion that exists as to the policy, and the criticism that has come from Colorado against the Bureau of Mines going into radium refining, it is interesting to add that both Mr. Silvey and *The Norwood Post* look upon government purchase of the ore as the only solution.

CHINA has been considerably affected by the war, directly and indirectly. The decline in silver and the consequent fall in exchange since the start of the war would, in normal times, tend to stimulate exports and curtail imports; but the demoralization of financial and shipping facilities, and the falling off in the European demand for China's most valuable exports, namely, silk, tea, hides, skins, and beans, has, until recently, according to a *Commerce Report* of November 5, resulted in an almost complete cessation of shipments to markets that formerly absorbed a large portion of the country's production. In consequence of the loss or restriction of outlets for native articles, the purchasing power of the Chinese has been seriously curtailed, while the rapid decline in exchange has increased the difficulties of the situation. Prior to the war, the value of the Shanghai *tael* was, in United States money, about 65 cents, compared with 53 cents early in November. During the same time the value of the Mexican dollar, which is the coin that is actually in use, has declined, in terms of *taels*, from 73.3 to 71.85. This is due to the fact that the natives are receiving almost no money against export cargo that they have to sell, and the country merchants are sending down dollars from the interior. The amount from any one place is not large, but the total receipts of those added to a stock of dollars at Shanghai that was already large has depressed the price. This means that up-country buyers have to pay more for any purchases they may make, and naturally this has a tendency to restrict their buying. When these interior points become over-drained of actual money, the pendulum is likely to swing the other way; furthermore, the lower the dollar rate goes the more likely is the up-country holder of produce to be able to dispose of his stock at a price that must find a market for it.

THE ENGINEERING CONGRESS AND MINING MEN

Mining engineers have been strangely slow about joining the International Engineering Congress which is to be held at San Francisco in 1915. Although the American Institute of Mining Engineers is one of the five societies underwriting the project, less than 300 mining engineers have, as yet, sent in their applications for membership. Despite the fact that many thousand circular letters have been sent to mining men, it seems probable that there is some misapprehension as to their relations to the Congress. Membership in any or all of the five great societies that have organized the latter, does not include membership in the Congress itself. On the advice of the governing boards of the societies, the Congress was organized independently and upon the basis of individual memberships. The parent societies have merely guaranteed expenses up to certain agreed amounts, to which total has been added some $11,000 raised by engineers on the Pacific coast. It is hoped to pay the necessary expenses of organizing and directing the Congress and of publishing the proceedings, in large part at

least, from membership fees, and to return to the societies the money advanced by them. Each member of the Congress is charged $5, which entitles him to participation and to receipt of the general or index volume of transactions and to any one of the other volumes that he may select. Additional volumes may be purchased at prices fixed to cover the cost of publication. No engineer will receive any volume unless he becomes a member of the Congress and pays the necessary fee.

While the program of the Congress has been somewhat disarranged by the war in Europe, it will none the less be comprehensive and fairly complete. In general, it is planned that the series of papers shall, as a whole, depict the present state of the art in the various branches of engineering. It is expected that the volumes will constitute a working encyclopedia of present practice and a datum plane for all future investigations. The subjects to be included range from the Panama canal as a concrete example of modern engineering, through waterways and irrigation, railways, municipal engineering, materials of engineering construction, mechanical engineering, electrical engineering, mining engineering, metallurgy, naval architecture, and marine engineering, to educational and miscellaneous topics. It was originally planned to print 10 volumes, but, owing to the withdrawal of papers from Germany, and to a less extent from other countries now busy with other matters, the number will probably be reduced to eight. The topics relating to mining and metallurgy that will be discussed are: economic and social influence of mining; valuation of mines and prospects; valuation of oil lands and properties; exploration and development; financing mining properties; organization of operating staffs; the government and mines; mine inspection; mine taxation; metallurgy of iron and steel, of copper, of zinc and cadmium; cyanide practice; lead smelting and refining; metallurgy of minor metals; metallography; electro-metallurgy; utilization of fuels; ore dressing. Each topic has been assigned to a prominent engineer, who, in most instances, is acting essentially as the chairman or sub-editor for the section, assembling data secured through co-operation of many fellow workers. Among those who have accepted this responsibility are Messrs. W. H. Shockley, W. W. Mein, R. V. Norris, M. E. Lombardi, Sidney J. Jennings, A. Chester Beatty, D. C. Jackling, H. V. Winchell, J. A. Holmes, J. Parke Channing, H. M. Howe, E. P. Mathewson, W. R. Ingalls, C. W. Merrill, H. O. Hofman, W. W. Campbell, E. F. Roeber, C. H. Fulton, and R. H. Richards. This by no means exhausts the list, since not only are many engineers and metallurgists actively co-operating with the men mentioned, but many topics under other heads, such as materials of engineering construction, are being treated by men equally well known to the mining profession, including Messrs. Thomas T. Read, E. C. Eckel, C. K. Leith, and others. Both the meetings themselves, which will be held September 20 to 25 inclusive, and the printed volumes will be well worth the attention of any mining engineer who cares to keep in touch with his profession in a broad way. It is important that each should realize that the papers are now coming in and that plans and contracts for printing must be made now. In order to act intelligently, the committee in charge must know what measure of support to expect from the mining engineers as well as from others. If you have mislaid or lost the application blank already sent you, send word to the International Engineering Congress, 1915, Foxcroft building, San Francisco, and a duplicate will be sent. The important thing is to act promptly.

THE RUBBER FAMINE

In the discussion of British interference with American trade, the attention of mining men has been so concentrated upon the acute troubles of the exporters of copper and importers of cyanide, that the danger of a famine in rubber, among other things, has been largely overlooked. The situation was discussed briefly by our New York correspondent last week, but its importance warrants a few words more. Briefly, the larger portion of the rubber now used in the United States normally comes from plantations within the British Empire. Much of it is handled in London, but some is sold direct. England has laid an embargo on all rubber exports and has so far refused either to raise it or to state that it will be maintained for any definite period. The result is that crude rubber has been piling up at London, Singapore, Colombo, and in Canada, and selling in London at 51 cents per pound, while in New York it commands 87 to 91. Furthermore, a considerable part of the accumulated stock had been bought and paid for by American manufacturers in the normal course of trade, who now find themselves unable to bring in their own rubber. The estimated consumption in the United States for 1915 is 65,000 tons. There is available in this country and Brazil but 35,000 tons. A shortage is inevitable, but even if manufacturers accept the situation and plan to pass on the increase to the consumer, they must face risk of the embargo being raised and the market flooded after they have stocked up and before they are able to sell their manufactured products. Vigorous protests have been made at Washington, but, so far, without satisfactory results. There is a suspicion, how well founded we are unable to say, that the British government desires to exact as compensation for permitting export to the United States, a *quid pro quo,* which Washington is unable or unwilling to give. Mr. B. G. Work, of the Goodrich Rubber Company, has gone to London on behalf of an American committee to consult direct with British rubber handlers in an effort to find a *modus operandi.* It is sincerely to be hoped that an amicable adjustment may be promptly found, since one of the alternatives suggested is an act forbidding any importations of rubber or rubber goods from the British Empire so that the uncertainties hanging over the manufacturers may be removed. The mining industry uses large quantities of rubber, and the interest of mining men in this situation is therefore far from being academic.

LOOKING FORWARD

In the course of an interesting address on 'The First Move,' delivered before the recent meeting of the American Mining Congress, Mr. W. G. Swart made some pertinent constructive suggestions. After pointing out that there was a general impression that the lucky prospector finds a mine ready made, he showed that what was usually found was a 'prospect,' that is, simply the surface indication of possible ore beneath. It generally takes both time and money in liberal amount to ascertain whether this is of possible value, and this is 'development.' It is the part of mining which involves the greatest risk and offers the greatest reward. It is distinct from prospecting, though that fact is not generally understood by the public. "Mining," Mr. Swart said, "is more apt to suffer from lack of development than from lack of prospecting." Continuing, he said:

In spite of all unfriendly criticism of pretensions to see underground, use of yellow leggings, or partiality toward offices in the high buildings, the fact remains that nearly every successful mining operation of consequence, old or new, is today in the hands of experienced technically trained men. These are the men who select, who reject, who discriminate, who decide on the place, time, direction, and amount of expenditure, and who plan and execute the work. No man does these things for any considerable time successfully without becoming a business man of high order. Leadership is his by every right.

In one of the classes recently graduated from a certain mining school were four young men who resolved to pool their efforts and go to mining directly, instead of accepting salaried positions as assayers or surveyors. At the end of five years they are in far better financial condition than the average of their classmates, they have had more real experience, and they understand what accepting responsibility means; but above all, they stand absolutely at the head of mining affairs in their community and are reaching out steadily for larger things. They have made good, and in making good they have secured an unhesitating local following in every mining enterprise they will take over. This is the kind of leadership I have in mind. No irresponsible promoter can capture that community. The one necessary thing is to guide and systematize local activity, and it can be done properly only by the trained men. They must first show confidence in themselves, then build up the confidence of the community in their ability, integrity, and unselfishness, and the rest is easy.

A company of ten engineers was recently organized in Colorado with modest capital, and this company is already successfully operating selected properties. When these men began systematically to put faith behind their works and money behind their judgment, they took the first necessary step. They have already secured the confidence and following of the communities in which they operate. No one believes that ten experienced men can be seriously misled, or that they will ever adopt anything but a policy of absolute fairness and integrity. Everyone believed they would win, and they have.

While this is not the place for details, it may be well to point out briefly several interesting features of this first move: (1) The proposal is not that the movement be restricted to mining engineers and operators—simply that it must be organized and directed by them. (2) The movement probably cannot succeeed without the confidence and co-operation of the business and professional men of the respective communities. Mining has usually been only a side issue, an incident, a speculation, if you like, with most such men. Investing without proper guidance, their activity has been spasmodic and unsatisfactory. (3) The movement must not only be started, but be made systematic and continuous, otherwise it has no real future. (4) The organizers must be prepared to make sacrifices of time and energy, to say nothing of money, and to sink any petty professional jealousies; but at the same time the idea must not be allowed to creep in for one moment that it is in any sense a philanthropic move. There can be just one underlying aim, and that is to make mining pay. (5) No such organization can hope to succeed permanently which does not propose to be fair and more than fair to its non-technical associates and stockholders. The plan rests solely on confidence in the ability and fairness of technical men. It is useless to start on any other basis. (6) It is not expected nor necessary that every engineer and operator take an active part in such an organization; some are overburdened now; some are honorably bound to organizations already existing; some are more efficient working alone; but there is plenty of available material in every mining district. (7) It is a 'get together' plan with indirect as well as direct benefits. (8) It requires no large amount of capital. It is better to start modestly and well within the means of the primary associates. It is particularly necessary to assume no financial responsibilities beyond the actual capital in sight. Success in even the smallest way brings possibilities of growth far faster than they can be properly cared for. A good set of brakes is more essential than the high gear. (9) The mining men will have to start this themselves. No one is going to do it for them. No one ought to do it for them.

This paper is not an inquiry into what is wrong with mining. It suggests that if something *is* wrong with mining, here is one constructive remedy. This is a workable plan, details of which will vary with location and conditions. It is already in successful operation, but it is possible only to a body of trained men. Undoubtedly there are other good methods, but, as I see the situation, the underlying idea must be the same in all: the qualified mining men ought to be in better control of the industry than they are; and they can be, but the first move is theirs.

Beginnings of the Tata Iron & Steel Company of India

By C. M. WELD

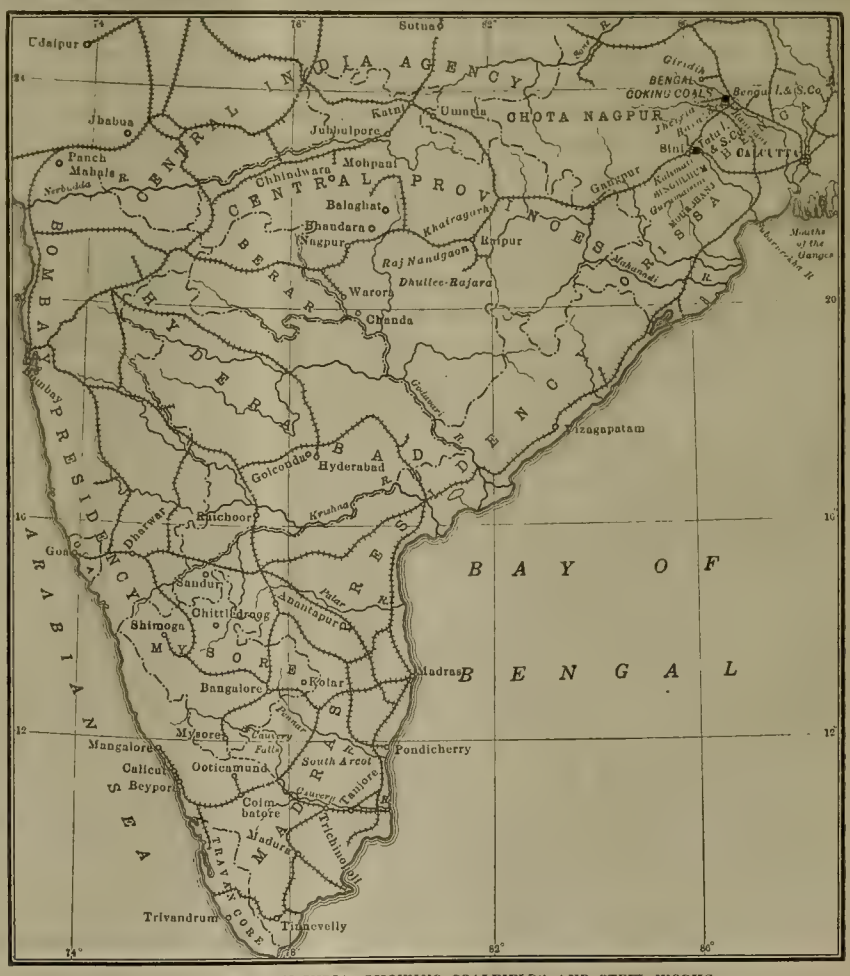
Recently from time to time the trade journals have discussed a threatened invasion of our Pacific coast by Indian pig iron; as a matter of fact, one small shipment has actually reached Seattle. Large amounts of this same iron have of late years been shipped to Japan and to other markets in the Far East. Whether or not the markets of our Far West will likewise be invaded is an open question, and one not within the scope of this paper to discuss. This pig iron comes from the works of the Tata Iron & Steel Co., Ltd., situated in Bengal, British India, 155 miles west of Calcutta. The works include by-product coke ovens, blast-furnaces, steel furnaces, and rolling mills, with all accessories. A number of descriptions have been published in the trade journals and need not be supplemented here. (*Iron Age*, July 12, 1906; September 28, 1911; April 11, 1912; January 13, 1913. *Iron Trade Review*, September 23, 1909; July 23, 1914.) An assembled view of the plant as it was in 1911, when practically completed, is shown on pages 98 and 99.

It was my good fortune to be intimately connected with the early history of this project, and it is thought that the following notes, dealing with its beginnings and the manner of its gradual development, will be of interest. I propose to tell the story from a human and personal point of view rather than from a technical one.

This project was by no means the first attempt to make iron in India. The existence of iron ore in that country has been recognized for many centuries, and in times past a flourishing native smelting industry existed. It is said that the famous Damascus swords were manufactured from bars of Indian 'wootz' or steel, made in the Deccan (Hyderabad) and transported by caravan across Persia. The forged iron column discovered in recent years at Delhi is another monument to the skill of these ancient ironmasters. Even today, a few hundred tons of iron annually is produced in nearly as many little mud blast-furnaces, blown with goat-skin bellows, scattered about remote parts of India, more particularly in the jungles of the Central Provinces. By way of contrast with the Tata works, one of these native furnaces is shown on page 101. A brief description of a village of native smelters was published by me some years ago. (*Iron Age*, September 13, 1906.)

The earliest attempt to make iron in India by European methods was due to Josiah Heath of the Madras civil service, who constructed small charcoal works at Porto Novo in the South Arcot district of Madras Presidency, in 1830. This industry was continued by the Porto Novo Steel & Iron Co., and later by the East India Iron Co., other works being erected at Beypur on the Malabar coast and in the Coimbatore district. All came to an end about 1867 after an intermittent and unprofitable existence. Further unsuccessful attempts along similar lines were made in Chota Nagpur and in Kumaun.

In 1874 a small blast-furnace was built at Barakar,



MAP OF SOUTHERN INDIA, SHOWING COALFIELDS AND STEEL WORKS.

THE COMPLETED WORKS OF THE

in the Raniganj coalfield, to run on coke fuel and iron ores from nearby ironstone shales. This furnace ran intermittently, at one time under the direction of Ritter von Schwartz, until 1890, when it was scrapped. At that time it had produced about 43,000 tons of pig iron, at a financial loss.

First Successful Iron Making

The next year marked the beginning of the only successful iron venture in India up to the time of the Tata project. A new and larger furnace was built at Barakar on the site of the first furnace, and was run on the same raw materials. A second stack was added in 1899. In 1903, the Barakar Iron & Steel Co. had produced about 250,000 tons of pig and castings and had made money. Shortly after, a heavy loss was suffered through an ill considered attempt to make steel; this was soon abandoned, and the Company has since recuperated its losses and has added to its blast-furnace plant. Hematite ores from Singhbhum are now drawn upon in conjunction with the leaner high phosphorous local ores; flux comes from Sutna, 500 miles distant, and coke is obtained from the neighboring coalfields.

The Tata project first began to take definite shape in 1902, although it had been brewing for some time before. Other projects were broached at about the same time. In 1899, an elaborate report by Major R. H. Mahon, R. A., 'Upon the Manufacture of Iron and Steel in India,' was published by government, wherein a plant to produce from 300,000 to 400,000 tons annually and to be placed near Calcutta was recommended; ore was to be drawn principally from Madras, coke from Bengal coalfields, and flux from Burma. Investigations were also being carried out in behalf of the Right Honorable Sir E. Cassel, based on certain iron ore deposits near Jublulpore. Neither of these prospects came to anything.

J. N. Tata, a wealthy and philanthropic Parsee merchant of Bombay, head of the firm of Tata & Sons, was particularly well known in the Central Provinces on account of the enormous success of his cotton mills, situated at Nagpur. The Central Provinces were reputed to be rich in iron ores and were known to contain coal. Many years before, in 1882, Ritter von Schwartz had reported favorably upon a proposal to manufacture charcoal iron in Chanda district of the Central Provinces. Certain government officials brought the matter before Mr. Tata and aroused his interest. Coal and iron ore concessions were granted to him, and in 1902 he came to Europe to employ technical advice for carrying out his plan. By chance he was turned from Europe to America, and ultimately employed C. P. Perin of New York. Mr. Perin carefully studied his various documents and advised him against building an iron and steel plant till far more was known about his concessions. I was selected to examine the latter, and reached India on this mission in January 1903. One Bravo diamond hand-drill had been sent out ahead of me.

I proceeded at once to Chanda district, where I found the drill already at work a few miles south of Chanda on the coal concession; in charge of a former government irrigation engineer. The latter had had absolutely no experience with diamond-drilling. He had dropped his tools in the hole, and, being more ingenious than practical, was experimenting with an impromptu invention which he called a microphone to find their top. I spent two days vainly fishing, the hole having partly filled with sand. I then started a shaft to recover the bit, which I knew to be not more than 30 to 40 ft. beneath the surface, and while this was going on, I investigated the concession. From distant outcrops and government boreholes on a neighboring area, I determined that the coal was not less than 700 ft. deep. As the capacity of the drill was at most 350 ft., I abandoned the drilling. I got samples of the coal from the nearest openings and found it to be a stratified material, high in ash, and absolutely non-coking.

Then I investigated the iron ore deposits. In this and in all of my subsequent work I was most efficiently helped by a nephew of Mr. Tata, Shapurji Saklatvala, who acted as interpreter and in many other capacities. The deposits were situated from 15 to 50 miles east and southeast from Chanda. We toured the jungle, travel-

TATA IRON & STEEL CO., LTD., IN 1911.

ing on horseback, with our camp equipment in bullock carts. Needless to say, progress was exceedingly slow. I examined a number of deposits and found several of these rich but of apparently limited extent. This was later confirmed by some exploratory work.

In the meanwhile I visited other coalfields in the Central Provinces and central India, at Warora, Mohpani, and Umaria. The product of all of these was found to be non-coking. Therefore, after two or three months' labor, I made an adverse report to Mr. Tata in relation to the proposed iron and steel plant based on Chanda iron ores.

Mr. Tata was disappointed. I then learned what I had not known before, that while naturally requiring the proposed scheme to be a sound one financially, he further looked upon it as an opportunity for developing a big industrial training school for the natives of India. It was in this direction that he was more particularly disappointed, and he was very loth to give up the project. The upshot was that I was commissioned to develop, if possible, a feasible project for the manufacture of iron and steel in India, irrespective of its locality.

My work henceforth was on far broader lines. My first care was to learn where coking coals could be obtained, and I soon determined that only those of the Bengal coalfields, and indeed not all of those, would yield good metallurgical coke. This was afterward fully confirmed by thorough coking tests.

We then started on an iron ore campaign, the hope being to discover large bodies of rich ore, accessible in themselves and at the same time reasonably near the Bengal coking coals. I first toured considerable portions of the native states of Nandgaon and Kairagarh, looking up reported ore deposits, and then located a deposit of great promise in the western part of Raipur district. This work carried me through the hot season into the rains, when it was necessary to abandon horses and bullock carts and take to light traveling on elephants, owing to the heavy condition of the roads and jungle tracks, and the swollen streams. Elephants could generally be borrowed from the native rajahs, who were glad to help, for their keep and the pay of their attendants.

Really excellent maps, on the scale of one inch to the mile, are available for large portions of India. It was my practice at this time to study these maps with great care, searching for places with names related to the vernacular words meaning iron or iron working. I found many such and visited them, or sent native assistants. I was able to obtain good assistants, trained in geology at the geological school of the state of Mysore. I also employed untrained scouts who had been taught merely to recognize the heavy 'black stones.' Of course I met with frequent disappointments, but together we covered and eliminated in this way large areas.

During the rainy season of 1903 we got out three more Bravo diamond-drills. We opened the fall campaign of that year by establishing the four drills on the promising deposits discovered in the western part of Raipur, in the Dhullee-Rajara hills; in charge of an experienced drillman sent out by the Sullivan Machinery Co. The orebodies, in lenticular form, cropped along a tortuous ridge, extending for several miles and rising about 400 ft. above the general level of the surrounding country. Our drills were placed along and near the outcrop of the ore, and the necessary water supply at once became a problem, especially since every hole promptly lost its water. The nearest spring was about two miles away, at the foot of the ridge. At first we tried pack-bullocks for carrying water, but ultimately we fell back upon coolie women and the omnipresent five-gallon kerosene can. We employed nearly a hundred women on this work. A group of these women is seen on the following page, as is also a drill at work.

Fighting Mosquitoes

Our Dhullee-Rajara explorations developed large bodies of exceedingly rich ore. Incidentally we had a serious experience at this camp with the anopheles mosquito, and learned, too late, that the most vicious of his kind in India is a little brown fellow who rarely sings, and breeds among grasses along the banks of running

WATER COOLIES AND DRILL CREW.

streams. The work of our staff was continuously crippled by malarial fever; a fact which was the more unfortunate because a little more knowledge and experience would have enabled us to avoid much if not all of this sickness.

In the meanwhile continued field reconnaissance along the lines described above in many other quarters, principally eastward, failed to develop any other ore deposits of promise; and when the Dhullee explorations were completed, I had about concluded that our proposed iron and steel project must be predicated upon these Raipur ores in conjunction with Bengal coke. The fuel and ore were over 500 miles apart, but under the circumstances it was concluded that this was not prohibitive. I therefore set about determining upon the best site for assembly of the raw materials and their manufacture into finished products.

In relation to this inquiry we had many factors to consider, one of great importance in India being water supply. During the nine dry months, from the middle of September to the middle of June, all but the largest streams go practically dry, the river beds turning into great wastes of sand. Then, too, existing railway lines, relative distance from markets, the hitherto undetermined source of flux, the distances of the several raw materials in relation to their importance, and questions of available cheap land, foundations for heavy structures, labor, and climate, all had to be taken into consideration. A thorough search for suitable flux was undertaken, and the Bombay office investigated with great care and thoroughness the iron and steel markets of India. A number of possible sites were studied and rejected. Also the Bengal coalfields were carefully gone over and large samples were taken and shipped to Europe and America for washing and coking tests.

All these various investigations, following upon the iron ore campaign, carried us well into the hot season of 1904. In the meanwhile, to our great sorrow, J. N. Tata, the initiator and the soul of the enterprise, had died. The work was, however, taken up by his two sons, Sir Dorab and Ratan Tata, almost as a matter of inheritance, and pushed with as much vigor as before.

It was in May of 1904, when we were winding up our work and preparing to submit the results to the expert criticism of Mr. Perin, that we first heard of the existence of iron ore in the jungles of Mourbhanj state. It was then too near the rains to start a new field campaign, and I sent my native assistant geologist to make a brief reconnaissance. He examined the Gurumaisini deposit, and made so favorable a report that we promptly arranged for concessions covering this new find and revised all our plans regarding point of assembly and manufacture so as to admit this new source of iron in conjunction with our proved-up Raipur ores.

SURVEY PARTY IN CAMP, FEBRUARY 1908.

WOMEN COOLIES AT WORK.

METHODS OF TRANSPORTATION ON SURVEY, AND NATIVE IRON FURNACE.

I then went home, taking with me four volumes of reports, statistics, and maps resulting out of our 18 months' labor. On the way I conducted elaborate washing tests on the large samples of Indian coals sent to Germany, and later we made coking tests in America on the samples which had been sent there.

The following January 1905 I was back in India, this time with Mr. Perin. Together we examined the Mourbhanj ores, which we found even better than we had hoped. We also visited the coalfields. As a result we presented a joint report recommending an iron and steel industry to be situated at Sini on the Bengal Nagpur railway, to run on Bengal coke and Mourbhanj ore. It was understood that land was available, and that any one of several good damsites near Sini would serve to impound sufficient water to carry the plant through the dry season.

Here, I may say, ended the first chapter. The project remained in *statu quo* for over two years, vain efforts being made in England and elsewhere to float it. Finally during the summer of 1907, in the heat of a patriotic movement, known as the Swadeshi, whose object was to encourage home industries in India, capital was raised for the proposed iron and steel plant almost overnight and entirely among native Indians. The new Company was named the Tata Iron & Steel Co., in honor of J. N. Tata, the founder of the enterprise.

I was called back to India—I was in China at the time—and arrived in November 1907. Work had been started at Sini, but unexpected difficulties had been encountered, first with the purchase of land (not only for the works, but also for the reservoirs), and secondly with the foundations for the dams. After going over the field once more most carefully, I selected a new site a few miles eastward, just north of Kalimati station, on the Bengal Nagpur railway. Here we arranged to expropriate about four square miles lying between the railroad, the Kharkai river, and the Subarnrekha river, and we secured a 25 years' lease on an additional tract of about 20 square miles. We found a good place for a pick up weir in the Subarnrekha river, where a more resistant trap dike stood out above the river sand, forming almost a natural weir; and an excellent site for a supplementary reservoir in the hills just north of the river. Foundations proved to be sound, and good deposits of brick-clay were at hand.

On Christmas day of 1907 we pitched our first tent on a site which I had selected for our construction camp, near the native village of Sakchi, lying about two miles north of Kalimati and close by the Subarnrekha river. My assistant at this time was B. B. Willcox. We immediately assembled a corps of native engineers under the direction of K. R. Godbole, and by the end of January, when Axel Sahlin of Julian Kennedy, Sahlin & Co. (who had been appointed construction engineers), arrived on the ground, with his resident engineer, W. O. Renkin, we had already contoured a large area. Work on grading began at once, and before May there were several thousand coolies, men, women, and children, at work.

From this time on, my connection with the enterprise gradually diminished. I spent one more winter in India, working up the raw materials end of the enterprise and many other matters not directly in the hands of the construction engineers. A general manager, R. G. Wells, was appointed and came out in January 1909, and I made haste to turn over my duties to him as soon as practicable. As representative of the consulting engineer, my position was now somewhat anomalous, and my earlier experiences in India, while roughing it in the jungle, had not contributed to my health.

Furnaces Put in Blast

The plant grew in due course to its present proportions under the direction of Kennedy, Sahlin & Co., the first blast-furnace being blown in December 1911. The second followed in September 1912, and the steel furnaces a few months later. Marked commercial success has already been attained, and the great works, flanked by a town of several hundred bungalows and coolie lines, with water supply, lights, ice plant, soda water factory, institute for the hundred or more Europeans, bazaars and recreation grounds for the several thousand natives, etc., all sprung up out of the jungle in the course of a few years, stand as a lasting monument to the far-seeing and progressive enterprise of a single broad-gaged Parsee merchant. His dream of a great successful industrial works, and with it a great industrial school for the natives of India, has been consummated.

To me, however, the accomplished fact is not so full of fascination as the formative period, with its long months of work and study, the weary days in the jungle, the many disappointments, and the exhilaration of occasional successes. I fear the foregoing sketchy account

will have conveyed a very inadequate idea of the immense scope of our investigations, the ground we covered, and the thoroughness, largely due to B. J. Padshah, with which we did it all. At the last we felt that whatever might be the intrinsic merits of our scheme, at least we had the best that could be devised for India; and it is a matter of satisfaction to all those connected with its development to see it succeed.

The Native Point of View

As supplementing the various technical descriptions which have been published from time to time and already referred to, I append a description translated from a Bengali weekly paper of April 1910.

"It is known to all now that Tata & Co. are having a steel factory in the district of Singhbhum, close to the Kalimati station on the B. N. railway. This is the outcome of the late J. N. Tata's whole life toil. Had he been spared to live now, we know not how his heart would have glowed with joy. The seed of his indomitable perseverance for the fruition of which he traveled the world over is now about to grow into a tree. We call it ours—because it is Swadeshi, and we wish it all success.

"The name of Kalimati has spread far and wide among the working classes, and the name having excited my curiosity, I proceeded there on leave to see the grand new project. Luckily I met a friend of mine who had been staying there for over a year, and I felt no inconvenience during my stay with him; rather I could see all that is going on there, in detail—the big iron foundry, the wonderful cooling tank, the new half-built town, the murrum roads, all of which tended to please my eyes. The place is a charming one, being rich with natural scenery in all directions. Here the two rivers, Subarnrekha and Kharkai, flow at the foot of a range of high hills. Tata & Co. have purchased this vast tract of land through the government from the Midnapur Zemindary Co., Puttnidars under the Dhalbhum raj.

"The contract for the building of this factory has been given to an American company of engineers known as Julian Kennedy, Sahlin & Co., who, as I understand, are to have a 5% commission on the total expenditure. This Company has posted one sahib by the name of W. O. Renkin, whose messing expenses are, I hear, borne by the Tata company. He is a competent man and has kept everything under his thumb, so much so that none can or has the courage to even put in a peg in his absence. There is a general manager here by the name of Mr. Wells. He is an expert in iron works and has been brought out on a high pay. Since his arrival the work is making a rapid progress, and in fact he has finished almost half the work in four or five months; he has an amiable look about him. There are many more Americans occupying various other posts, the details of which I propose to publish at length in a future issue.

"But how is this? It is an Indian concern. Mr. Tata took so much pains all his life in order to teach his own countrymen, but instead of that we see foreigners have crowded in. In such a big factory I could not find a single jewel of India. Has not Bengal, Bombay, Madras, Punjab, and the United Provinces produced a son who is fit to work in the Tata's factory? All this sight is depressing my heart and I am afraid lest this also turns into the same darkness it was in before. After spending so much money, if your countrymen do not get a place there in the factory from the beginning, God alone knows what is to happen in future."

What of the Future?

This is interesting in giving us a native point of view, which I may say is no doubt fairly generally held. In the meanwhile the management and directorate, who are themselves natives, are in fact working in the direction suggested, namely, that of replacing European with native talent, but are making haste slowly, and are well advised in doing so. Already J. N. Tata's ideal of a native industrial school has been realized, but it would be particularly unwise in a venture of this sort to promote the scholars into the places of their teachers with undue haste.

THE COMPLETED FURNACES.

Gold and silver received at the San Francisco mint in December amounted to 227,571 and 126,141 oz., respectively, with a total value of $4,779,888. Coinage executed was $1,075,000 gold, 31,200 nickel, and ₱106,000 silver for the Philippines. Coin, bullion, etc., on hand at the end of the year was as follows:

Gold coin	$ 15,972,800.00
Silver coin	61,716,089.51
Nickel coin	48,161.10
Bronze coin	12,129.85
Checking balance, Treasurer United States	649,678.45
Gold certificate bars	140,453,529.97
Gold bullion	39,866,996.53
Silver bullion	918,788.60
Total	$259,638,174.01

Gold output of the Mt. Boppy mine, New South Wales, in November, was $57,600 from 6631 tons of ore. The leaching plant treated 1314, and the slime plant 4388 tons respectively.

Tube-Mill Pebbles—Their Characteristics and Cost

By EDWIN C. ECKEL

Ever since the tube-mill first came into extensive use as a fine-grinding machine in the portland cement industry, there has been a wide interest in the character and source of the pebbles that are or can be used as grinding media in this type of mill. More recently, the adoption of the tube-mill in many gold and other ore-concentrating plants has increased the number of engineers to whom this subject is of interest. Most recently of all, the European war has given an immediate interest to the question, since it threatened to raise difficulties in the way of securing the flint pebbles which had been the most important part of the supply. Under these circumstances, a discussion of the present and probable future sources of the pebble supply for tube-mills, and of the character of materials available for such purposes, is justified.

Before the different types of pebbles which are available can be compared, it is necessary to come to some conclusion as to the physical and chemical properties which such pebbles should possess, in order to be serviceable for the tube-mill. The main factors may be summarized as follows:

Shape.—To secure the maximum of grinding efficiency, the pebbles or other media employed should be as nearly spherical as possible.

Size.—Other things being equal, the maximum grinding effect is probably secured by small pebbles, which give more grinding surface per ton of pebble.

Density.—Other things being equal, a dense or heavy pebble will grind more effectively than a pebble of lighter material. In practice it may be assumed that the materials ground, in cement or metallurgical practice, will have specific gravities about as follows: cement clinker, 3 to 3.15; dense trap, etc., 2.9 to 3.1; granite, gneiss, etc., 2.6 to 2.8; limestone, 2.3 to 2.9; shale, 2.1 to 2.6; and sandstone, 2.1 to 2.7.

As will be seen later, these materials are being ground with flint or quartzite pebbles in most cases, and sometimes with granite pebbles. Flint, quartzite, and granite all range around 2.6 to 2.8 in specific gravity, so that in many cases the pebble used is lighter than the material undergoing the grinding. It is obvious that in such cases there is a loss in grinding effect, which might conceivably go to the point of grinding up the pebbles faster than the ore or clinker.

Toughness and hardness.—What has been said as to the advantages of a heavy pebble must not be allowed to cover the fact that in general practice the most important physical properties are toughness and hardness, in the order named. The pebble should be harder than the material to be ground; and it should also be tough, for otherwise there will be a heavy loss in breakage of pebbles, with reduced efficiency as a result for a time at least.

Chemical composition. Since the pebble, no matter how tough and dense it may be, is finally ground and enters the mixture, its chemical composition is of interest in some cases. An iron ball will increase the iron content of the ground material, and in some metallurgical work this is undesirable. Nearly all of the natural pebbles are either almost pure silica (flints, quartzites, etc.) or high in silica (granites and other igneous rocks), so that the natural pebbles will increase the silica content of the mixture to some extent. This does not matter when cement is being made, as the addition of finely ground flint or granite will improve it rather than otherwise. Still, there will be some instances where the composition of the pebble is a matter of moment.

Cost per ton of pebble and product.—The various pebbles will show different costs per ton of pebble, at most points where they are to be used; and this will enter into the question of comparative availability. But generally, particularly if chemical composition is of no importance in the decision, the availability will be determined, not by cost per ton of pebble, but by cost per ton of ground ore or cement.

Having summarized the characteristics which are desirable in a tube-mill pebble, different kinds of pebble material which are actually available in most regions may be compared. This can, of course, be done in only a general way, as each locality should be studied as a separate problem; but there are some general features which serve to limit or indicate the choice that can be made.

Flint.—Flint pebbles were the first materials used in tube-mills, and still furnish the bulk of the supply, so that they must be taken as a basis for all comparison. Flint is very tough, so that the pebbles will wear down smoothly without much breakage. In composition they contain from 80 to 95% silica, as shipped, which does no particular harm in cement manufacture or in most metallurgical practice. As against these advantages, flint is lighter than most ores or cement clinker, and in most regions it is expensive per ton of pebble. Since the whole supply is imported, and no large water-worn deposits of flint are known to exist anywhere in North America, flint pebbles are expensive at most interior points. Several cement manufacturers have estimated that flint pebbles are about 50% more efficient, that is, more durable, than the next best pebble available in any large tonnage; so that considerable difference in cost per ton of pebble can be allowed before flint can be displaced on the Atlantic seaboard. Elsewhere, however, freight rates soon make up for the original advantage.

Quartzite.—Next to flint, a fine grained quartzite probably ranks second in all-around efficiency. The quartzites are somewhat harder than flint, and of essentially

the same chemical composition. They are, however, less tough, and a charge of quartzite pebbles will show a greater percentage of broken fragments at the end of any given time than would a charge of flint pebbles. Quartzite pebbles are abundant along the Lake Superior and Newfoundland coasts, and are marketed now on a moderate scale.

Granite.—Granite and the other acid igneous rocks are less hard than quartzite, and usually are deficient in toughness, breaking along a more or less apparent grain in the rock. Granite pebbles occur along the New England and Newfoundland coasts, and could be made an article of commerce. They also occur in many western stream valleys, and have been used for over 10 years by at least one California cement plant.

Trap.—The basic igneous rocks of the type of trap are usually somewhat softer than either quartzite or granite; but they are, on the other hand, often tougher and more durable, and they are notably heavier than any of the other types of pebbles. Basic pebbles are found in quantity at certain points on the Lake Superior and Newfoundland coasts, as well as in many stream valleys in the interior. To my knowledge they have not been used in any cement plant.

Mining in British Columbia During 1914

By W. M. BREWER

All things considered, the end of 1914 shows that the mining industry in British Columbia has not been affected as much by the war in Europe as many of the best authorities predicted. An estimate made carefully and conservatively by the Provincial Mineralogist gives the total decrease below the returns for 1913 as being between 14 and 15%. The total production, including all metals and minerals, for that year was reported in the Report of the Minister of Mines at the value of $20,296,398, while the estimate for 1914 is $26,000,000 in round figures. It should be remembered that the value of the production for the year 1913 was the greatest for any, except 1912, since the discovery of placer gold in Cariboo in 1852, and according to the estimate the year 1914 will only fall about $6,000,000 short of the banner total value, less than 20 per cent.

The most notable event in the mining industry in this province during the year 1914 was the 'blowing in' of the Granby company's smelter at Anyox, Observatory inlet. The Company has expended nearly $4,000,000 in development of the mines and construction of the smelter, power plant, docks, railway, buildings in both the smelter and mining camps for all of the employees as well as for the Company's purposes, and water and sewer systems. The fact that operations have been continuous since the furnaces were put in blast in March speaks volumes for the future prosperity of the enterprise. When a company is able to continue active operations during a period of such unusual disturbance in business, with so many enterprises closed, it is *prima facie* evidence that under normal conditions the results will be highly satisfactory.

The production from the placer mines in the Cariboo and Cassiar mining districts, which include Atlin, Quesnel, Omineca, Dease Lake, and Barkerville, is estimated at $500,000 for 1914 as compared with $560,772 in 1913. The production of lode gold, silver, copper, lead, and zinc will be about $14,000,000 during 1914, as compared with $17,700,838 in 1913. In connection with this decrease it must be remembered that the market price of each of the metals except gold has been considerably lower during 1914 than it was during 1913; in fact, the lower market price will account for $1,250,000 of the decrease in the value of the production.

The value of the production of coal and coke for 1914 is estimated at about $9,000,000, as compared with $9,197,460 for 1913. There are two reasons for this, the first being the decreased demand for coke at the Trail and Boundary smelters owing to the closing down of the Granby and Mother Lode plants at Grand Forks and Greenwood and the part closing down of the Trail plant at the commencement of the war; the second being the disorganized conditions of labor on Vancouver island following the strike during 1913. It is gratifying to be able to announce at the beginning of 1915 that on Vancouver island the collieries are running at their normal capacity, and that the Trail and Granby plants are running almost up to capacity, so that the new year is commencing under favorable auspices.

The value of miscellaneous productions such as building stone, gravel, and sand, is estimated to reach $3,000,000 for 1914, or about the same as for 1913, when it was stated in the Report of the Minister of Mines at $3,398,100. Although the building industry has been quiet in the province during the past year, as it has been the world over, yet the enormous quantity of broken rock used in the construction of the breakwater and piers at Victoria has at least offset the decreased quantity of building stone used in 1914 as compared with the quantity used in 1913.

The prospects for the coming year, despite the continuance of the war in Europe, can be considered to be fairly bright so far as the mining industry is concerned in British Columbia, as there are good prospects that some properties hitherto unknown as producers will have reached the stage of development that will place them in the lists of shipping mines, and among these should be properties along the line of the Grand Trunk Pacific railroad. Lack of transportation facilities has retarded development in that part of the province tributary to the Skeena river, where there are several promising gold-copper, as well as silver-lead, and silver-lead-zinc properties partly developed. Some of these are within a short distance of the new railway, in fact within less than three miles from established stations, and but 500 to 1500 ft. higher elevation. No great investment of capital is needed to place them in a position to ship ore to a smelter.

Magnesite Deposits and Possibilities in California

By SAMUEL H. DOLBEAR

At the outbreak of the war, inquiries for thousands of tons of magnesite poured into the mails of the owners of California magnesite deposits.* Austria-Hungary leads the world in the production of the commodity, its exports to the United States alone amounting to about 143,000 tons in 1911, about 100,000 tons in 1912, and 172,500 tons in 1913. As the United States imported only 4880 tons in 1911, 3834 tons in 1912, and 8876 tons in 1913 from other sources, it is readily apparent why the participation of Austria-Hungary in hostilities led American consumers of magnesite hastily to seek other sources. California is the only one of the states producing magnesite, and its greatest output in 1910 was less than 13,000 tons. Practically the entire production is consumed on the Pacific coast, and the largest portion is shipped to the paper mills of Oregon and Washington. The limitation of its sale to the Pacific coast has been due primarily to the high freight rates prevailing to eastern points and the high cost of labor at the mines. Lower freight rates through the Panama canal should assist the California producer materially in reaching eastern markets. Wages for labor of all classes are, in most cases, higher on the Pacific coast than in other parts of the country, and the influx of Europeans through the canal would, it has been believed, eventually reduce labor charges to a more normal basis. In the meantime, the flames of war are being fed with the blood of thousands of peasantry who might otherwise emigrate into this country, and any radical change in the labor situation will doubtless be long delayed on this account. With these two factors innuring to his advantage, the California magnesite producer should be in a position to command a portion of the present import consumption.

*In all the following paragraphs, the word magnesite should be taken to mean the calcined product, unless otherwise specified.

Uses of Magnesite

The highly refractory quality of magnesite and its ability to form a hard vitreous body when combined with magnesium chloride has led to its adoption for a large number of purposes. The largest consumption is in the manufacture of magnesite firebrick, crucibles, and in bedding steel furnaces. As magnesium bisulphite it is used extensively in digesting and whitening wood pulp in paper mills. It is used in a mixture with sand, sawdust, ground quartz, talc, and other substances, in the manufacture of tile, plastic flooring, roofing, sinks, wainscoting, in scagliola or artificial marble, and on the exteriors of buildings as a plaster. The manufacture of so-called 'cold water' paints and concrete waterproofing also involves the use of magnesite with $MgCl_2$. It also enters into a preparation for insulating boilers and steam pipes, mixed with such substances as asbestos and infusorial earth. It has been introduced into boilers to prevent scale when sulphurous water is used.

A misapprehension exists that there is no market whatever locally for crude magnesite. I am aware of at least three carloads which have been taken within the last two or three years by local steel manufacturers. This ore is crushed to pea size and mixed with the calcined product. Less amounts are consumed by the dynamite manufacturers, and some is ground to a fine mesh with buhrstones for use in preparation of tooth-paste. In times past, finely crushed magnesite has been sold as chicken grit. Small amounts, finely ground, are sometimes used in oxychloride mixtures and as an adulterant in paint. Of late, certain dealers in photographic supplies have tried to persuade local magnesite shippers to undertake the manufacture of metallic magnesium, offering to contract for their entire consumption for a period of two years.

Much magnesite was formerly burned for the double purpose of securing a calcined product and to recover

SWINDELL MAGNESITE MINES AND WORKS.

FRESNO MAGNESITE CO. AT PIEDRA.

the carbon dioxide content. The reason which led to a discontinuance of this practice was that efficiency in the production of one product was had at the expense of the other. The magnesium oxide residue contained variable quantities of carbon dioxide, and when the rock was burned with care, difficulty was experienced in securing a maximum yield of CO_2 for the period. For several years limestone has taken the place of magnesite, although recently attempts have been made at a carbonic-gas plant situated at Berkeley to revive the practice.

The plastic floor industry has grown to considerable proportions within the last few years. When properly mixed and laid, magnesite makes an excellent floor, it having many advantages not possessed by other materials. It takes a good polish, is fireproof, waterproof, and will not dust. Unfortunately, however, it is never certain that a good job is going to result, and in many cases magnesite floors have bulged, cracked, and have required complete relaying. This is due, in all probability, entirely to chemical differences in the mixture. The presence of lime (CaO) in too large a quantity always results in failure, although it has been suggested that climatic conditions may influence the success of the set. The business has suffered many reverses and adverse criticisms through the work done by irresponsible workers who understood little of the mechanical practice of oxychloride cement and nothing of the technical side. It is worth observing that those who understand the work, use care in selecting their materials, and stick faithfully to formulas which have been found most successful, have only occasional failures. Magnesite used in plastic work usually carries from four to eight per cent carbon dioxide.

California magnesite is purer and consequently more refractory than that of Austria-Hungary. The latter product carries variable amounts of iron which reduces its point of fusibility. In spite of this fact, the iron-bearing variety is preferred for use in steel furnaces. At a given temperature, the magnesite becomes plastic and may be molded into place, and later sets or hardens. I have never seen any attempt made to explain this fact, but it is perhaps through the formation of a double salt of magnesium and iron.

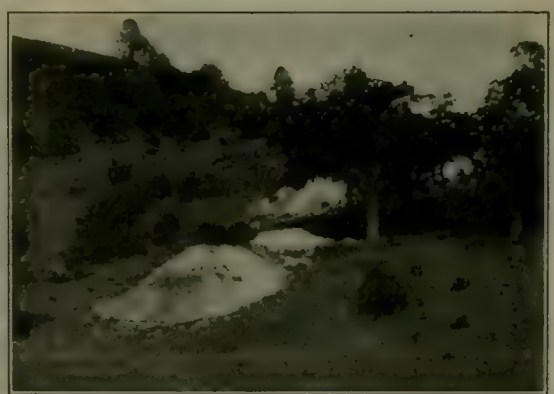
Calcined magnesite when exposed to air takes up carbon dioxide. A statement has recently been made that it will completely carbonize in six months. Such a statement should not, of course, be given credence. A gain of 10 or 15% CO_2 in that period would be large under circumstances favorable to its recarbonization. Nevertheless, there is every advantage in the use of a freshly calcined product both in steel practice and plastic work. Too much CO_2 renders it entirely unfit for floor work, and when placed in a furnace a loss of 10% CO_2 represents a shrinkage of an equivalent cubic amount, leaving patches in the bed to be refilled.

Prices

The price which has been paid for domestic magnesite has varied from $16 per ton on contract for large quantities f.o.b. rail at the point of shipment to as high as $50 for small lots of a ton or two ground and packed in barrels at San Francisco. Normally the price for carload lots unground in bags is $25 to $30 per ton and $40 per ton for the ground product in barrels. Light burned magnesite has been recently offered for local consumption, ground, in barrels, at $35 per ton f.o.b. San Francisco. At the outbreak of the war, Chicago consumers of light burned magnesite offered to contract for 1000 tons, unground, in barrels weighing 300 to 400 lb., at $33.50 per ton, f.o.b. rail California. Some European product is again coming into this country, and somewhat lower prices prevail. Quotations f.o.b. New York are now from $30 to $35 per ton.

Magnesium Chloride

As the industrial uses of magnesite, aside from its refractory applications, are dependent largely upon the ability to secure magnesium chloride, a word regarding this product should be said. In San Francisco, the fused or crystalline chloride in iron drums is normally sold at $22.50 to $25 per ton ex-shipside. Practically all the chemical used in this country comes from Germany, where it is produced as a by-product in the manufacture of potash from the Strassfurth deposits. At



CEDAR MOUNTAIN BEFORE DEVELOPMENT.

the opening of the war, prices soared to $60 per ton with little apparent supply. Eastern consumers, foreseeing a famine of German product, wired to California urging that it be produced here and offering to purchase in liquid form in tank cars. This action stimulated investigation, and experiments have been conducted along three different lines: (1) that of direct production from magnesite and hydrochloric acid; (2) that involving the use of dolomite as a source of magnesium; (3) through the recovery of $MgCl_2$ from the bitter brines of local salt works. These bitter brines contain as high as 17.8% $MgCl_2$ at 30 Baumé. Shipments from Europe are again coming into this country, and recent tenders are at a price of $27.50 per ton f.o.b. New York in carloads, which is equivalent to about $40 per ton at California ports.

Magnesium chloride has been manufactured in limited quantities in San Francisco and Alameda by dissolving magnesite with hydrochloric acid. No attempt was made in either case to reduce it to a crystalline form. It is said to have cost about $24 per ton, the price being estimated on a crystalline basis. In one case this was done to secure a colorless product, as the magnesium chloride of commerce is frequently badly discolored through the presence of iron rust.

California Production and Sources of Magnesite

Tulare Mining Co.—For several years the Tulare Mining Co. has been the largest individual producer in California. Its production is used largely by the paper manufacturers of Oregon and Washington, the magnesite company being a subsidiary of the Willamette Pulp & Paper Co. The deposits of this Company are on the south fork of the Tule river and about ten miles east of Porterville in Tulare county. A spur track two miles long connects the mine with the Southern Pacific railroad, and from a point of transportation makes this mine more easily operated than other deposits in the state. Much development work has been done on these deposits, and an apparently large body of ore is exposed. The mine is equipped with a vertical or stack calcining furnace, having a capacity of 500 or 600 tons per month, and this furnace is worked continuously at about 80% of its capacity. Two grades of magnesite are produced, one of selected white rock for plastic use, and another somewhat discolored through the presence of iron. The calcined product is placed in sacks, a portion of the output being shipped to San Francisco, ground and barreled, and sold to local industries.

MINE AND MAGNESITE AT CEDAR MOUNTAIN.

Western Magnesite Co.—The deposits of this Company are in the northeastern part of Santa Clara county near the boundary lines of Alameda and Stanislaus counties. The mine is connected to Livermore by a good road about 35 miles long with no heavy grades. The deposits have been operated from time to time for the past ten years and accredited with a considerable tonnage. The rock is exceptionally pure and white. The ore exposures are sufficient to warrant the assumption that the deposits are extensive. The equipment consists of two stack furnaces which are connected to the mine workings by a tramway about 2700 ft. long. Warehouse facilities have been provided, and living quarters, blacksmith-shop, and other accessory improvements made. For the past year or more the plant had been operated only in a small way, but recently resumed activity with a crew of 20 men, and has produced and shipped several hundred tons within the past three or four months.

Fresno Magnesite Co.—This deposit is conveniently situated, so far as its transportation facilities are concerned, being about one mile from the Santa Fe railroad terminal station Piedra, in Fresno county. The mine is reached by a road across the county bridge over the Kings river. The deposits are in the rather low, rolling, barren hills on the north side of this stream. The vein, where exposed, is said to vary in width from a few inches to about eight feet. It is reported that much of the ore contains rather high percentages of lime. The equipment, aside from the stack furnace, includes crushers, a steam plant, engines, dynamos, etc., and mine buildings. Most of the magnesite produced was sold to paper mills, but the plant has been idle for about two years.

Swindell Magnesite Co.—The presence of magnesite on the western arm of Cedar mountain, in Alameda county, has been known for some years, and development work has been done from time to time since 1905. The deposits, which are about 13 miles southeast of Livermore, were leased by the James H. Swindell Magnesite Co. in 1912 and construction of a furnace commenced, intended primarily to produce dead-burned magnesite for the steel mills. The mine is at an elevation of 3500 ft. above sea-level, and the roads leading to it have several heavy grades. The plant was operated but a short period this year, producing less than 100 tons during the trial run. Operations ceased owing to lack of sufficient capital. The extent of the deposit is not shown by the present development work. The

principal exposure is in a circular pit of about 30 ft. diameter and 25 ft. deep. The bottom of this pit is provided with a chute about 8 ft. deep, connecting with the tunnel below. Through this, which is about 75 ft. long, the ore is trammed to the crusher, where it is broken to pieces not exceeding two inches in length. The furnace is of the shelf or chamber type. When the crushed ore is delivered to the furnace, it passes first into the uppermost chamber, and when the furnace is in full operation a charge is kept on each hearth. When the calcination of the charge in the lowest chamber is completed it is discharged upon a floor of firebrick below the furnace, and is cooled, preparatory to sacking. The charge on the second hearth is then raked down to replace that just drawn, the charge of each of the upper hearths progressing downward by steps in this way.

Magnesco Refractories Products Co.—Practically the entire output of this Company has been consumed for plastic and insulating purposes. The deposits are situated near Winchester, a station on the Santa Fe branch railroad extending between Highgrove and San Jacinto in Riverside county. The deposit comprises a network of small veins for the most part, although one vein has been uncovered of considerable width. Much of the ore mined has required hand sorting, and the larger part of the material mined is thrown on the waste dumps. The plant of the Company, which is at Los Angeles, is not in operation at the present time, and it is reported that no further operations are planned at the mine.

Sonoma Magnesite Co.—A good deal of interest has been aroused lately in the statements which have appeared in the daily press with regard to extensive improvements of the magnesite deposits of the Company, about 8 miles north of Cazadero in Sonoma county. It is reported that construction work has been commenced on a spur leading toward the deposits, which are not as yet provided with calcining facilities. The Company plans production in a large way with the view of competing for business on the Atlantic seaboard. The Company will doubtless be able to secure a low freight rate to tidewater at San Francisco, whence it plans shipments *via* the Panama canal. Several veins of magnesite have been exposed, but the claims are not extensively developed.

Miscellaneous Activities

It is reported that some crude magnesite has recently been shipped from the vicinity of Cazadero and Cloverdale in Sonoma county, and from Coyote station, near Morgan Hill, in Santa Clara county. This ore has been calcined at the plant of the Pure Carbonic Gas Co. in Berkeley, the carbon dioxide content being recovered. Most of the calcined product is said to have been taken by an Oregon paper mill. In the foregoing, mention has been made of only those deposits that have been equipped for production or that will possibly become producers shortly. Deposits of this mineral are found

SWINDELL FURNACE USED AT CEDAR MOUNTAIN.

at many points in the Coast Range and in some places in the Sierra Nevadas. Some of these are apparently of considerable extent, and much of the ore is of excellent quality. *Bull.* 355 of the U. S. Geological Survey, entitled 'The Magnesite Deposits of California,' by Frank L. Hess, supplemented by *Bull.* 540-3, entitled 'Late Developments of Magnesite Deposits in California and Nevada,' by Hoyt S. Gale, will be found by those interested in making more careful investigation of this subject, to be excellent references and very complete.

Platinum is practically all recovered from placer deposits, mainly in Russia. It is now found in the Boss mine, Nevada, and the Rambler Copper & Platinum Co.'s property at Holmes, Wyoming. The mill was remodeled, and preparations were made to continue the operations through the winter. This mill in recent years has produced platinum concentrate, and the mine is one of the first in the world to contribute to the platinum production from lode deposits.

Cyanide imported into Canada in 1913 totaled 708 tons. In the first half of 1914 there was only 227 tons, or 38 tons per month, but in August this increased to 130 tons, due to mining companies getting in large stocks. No cyanide is made in the Dominion.

The Chisos mine at Terlingua, Texas, continued the important output of quicksilver maintained for many years, and was again in 1914 one of the largest producers in the country.

Stamp-Mill Test

By E. S. KING

*Stamp-milling has been receiving considerable attention during recent years, and several improvements and patent stamps have been placed on the market with some success. In view of the claims made for various types of mill, I decided to make a test between two of them. The plant was erected at Tincroft, which has the distinction of possessing one of the oldest reduction works in Cornwall. Accordingly, two Nissen single-stamp mills were obtained, also a Sandycroft (English make) five-head ordinary mill. These two units started crushing in June 1914, and the figures of the comparative test are now available. Each Nissen stamp weighed 2000 lb., while the five others each weighed 1250 lb. The two batteries were driven by independent motors, the consumption of power being carefully checked and tabulated by the Cornwall Power Co. Only the coarse material that passed over the grizzly was sent to the breakers feeding the mills, the fine being diverted to the old Cornish battery for treatment. Both mills, of course, would have shown higher capacities had the fine been included. In each case, the screen was of 10-mesh standard.

Result of test from June 18 to July 16, 1914, showed the following:

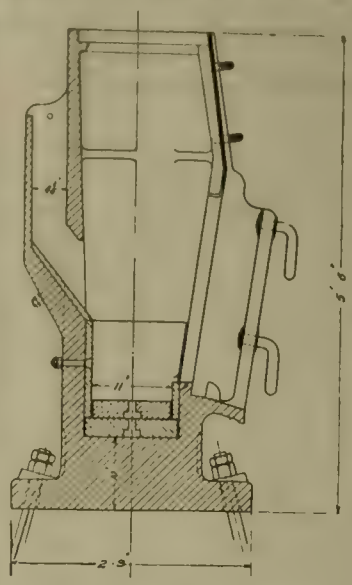
	Ordinary.	Nissen.
Ore crushed, tons	854.44	562.03
Total run, days	23.89	24.61
Duty per day, tons	35.765	22.837
Stamp duty each, tons	7.153	11.418
Total horse-power consumed	16.231	12.176
Horse-power per ton crushed per hour	10.959	12.796
Tons per horse-power per day	2.19	1.875
Cost of power, cents per ton	10.638	12.422

The average grading analysis of the product was as follows:

Mesh.	Ordinary, per cent.	Nissen, per cent.
+ 20	13.37	15.63
+ 30	15.61	15.97
+ 40	9.21	8.30
+ 60	12.08	11.88
+ 100	10.55	9.94
+ 150	9.43	8.13
+ 200	3.03	3.20
— 200	26.40	26.63
	99.68	99.68

These figures do not show any great difference in the grade of the pulp from the two mills. The duration of the trial being under a month, the cost of maintenance could not be estimated accurately.

The five-head mortar-box was specially designed by myself in accordance with previous experience in Western Australia. The box was of the straight-backed type with detachable front, rounded corners (to strengthen), cast-steel liners standing 12 in. above the dies and bolted in position with countersunk headed bolts. The high crushing capacity is mainly due to the small area between the shoes and the box, this being only one inch and insures a quick return of the uncrushed pulp to the dies. The screen was made to fit so that the bottom was flush with the inside liner. This was done by putting a filling piece at the bottom of the screen-frame, with the sides tapering to nothing at the top. The object is twofold: (1) it puts the screen nearer to the stamps, and stops any clogging on the inside lip of the box; (2) it gives a greater angle to the screen, thus allowing for a quicker discharge of sand than if the screen were vertical.



SECTION OF MORTOR-BOX DESCRIBED.

The stems used were of 4 in. diameter, and were shorter than usual by 4 to 5 feet, and this, I would point out, reduced the vibration and friction to a minimum. The order of the drop was 1, 3, 5, 2, 4.

The success of an ordinary stamp-battery, I contend, is due principally to having a properly designed mortar-box, the stamps falling exactly on the dies well under the cam-shaft. This cannot be secured, unless there are strong iron guides (same as were used in this test), and dies made to fit the box.

Many mill-men make the mistake of having the base of the dies too small, and putting pieces of iron between them to keep them in position. This is bad practice, for in the event of one piece of iron getting dislodged, it throws the whole of the dies out of place, thereby at once reducing the crushing surface and efficiency. Hitherto, the necessary space for inside gold and silver amalgamation had generally somewhat influenced the standard design of the usual mortar-box; but in this case, in view of obtaining the greatest capacity, it was entirely disregarded.

In Western Australia, the use of cyanide in place of amalgamation brought about this welcome improvement, and the old boxes packed with hardwood and steel plates gave the following capacities, equal to an increase of over 50% on previous results:

Screen, mesh.	Weight of stamps, pounds.	Duty, tons.
30	1050	4.76
20	1050	6.27
10	1050	8.90

These results were obtained on ore containing 50 to 60% granite, therefore on clean quartz, it can be assumed, a much better duty would have been obtained.

*Abstract from *The Mining Magazine*, December 1914.

DISCUSSION

Readers of the Mining and Scientific Press *are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.*

Amalgamation in Hardinge Mills

The Editor:

Sir:—There being a difference in the results obtained in two mills by amalgamation, both Hardinge, I would like an explanation of this difference. Mr. Caetani, in his article, 'The Design of the Plymouth Mill' (the *Press*, October 31, 1914), states, in his discussion of amalgamation, that when amalgamation inside the Hardinge mill was employed "It was found that if the amalgam was kept sufficiently soft it would build up on the pebble lining, filling up the depressions of the mortar between the pebbles. It was hopefully expected to find large amalgam balls rolling around with the pebbles, but this was not found to be the case; at the bottom of the mill there was a slough of amalgam, sand, and metallic iron, which in rolling, caused the coarse gold to amalgamate and, as the amalgam was formed, it became plastered upon the lining. Whenever the feeding of quicksilver was stopped, the amalgam would dry up, crumble, and be thrown out of the discharge opening of the Hardinge, where it would build up in thick layers. * * * Inside amalgamation has now been discontinued, solely for the reason that the quicksilver losses were enormous, due to the flouring inside the mill." R. B. T. Kiliani, in his article, 'The Incaoro Mill, Bolivia' (the *Press*, November 21, 1914), says, in regard to amalgamation in Hardinge mills: "Mercury is fed in at the head end of the ball-mill, amalgamated in this machine, and passes through to the pebble mill, which catches the greater portion of the coarse gold. The machines are shut down once a day to make a clean-up of the amalgam in the mills, from which approximately 75% of the total recovery is made. The amalgam in these machines is very hard, containing slightly over 50% gold. This is attributed to the fact that the pounding of the balls and pebbles in the mills squeezes out all the free mercury, leaving a hard amalgam, which balls up and tumbles around." Will Mr. Caetani and Mr. Kiliani kindly explain these different actions and results? At the Incaoro mill, hard balls of amalgam formed; at the Plymouth they did not, though expected; the amalgam being ejected from the mill if allowed to become hard by ceasing to feed quicksilver. Mr. Caetani says soft amalgam would cling to the mill lining, the surplus quicksilver forming a pool of thin amalgam in the bottom. Mr. Kiliani says the surplus quicksilver is squeezed out and hard balls formed, but does not say what becomes of the excess, nor does he mention any soft amalgam as clinging to the lining. Why should hard balls form in one case and not in the other? I judge the difference to be due to the different amounts of quicksilver fed, one millman probably feeding more in proportion to the amount of gold present than did the other. Had Mr. Caetani fed less quicksilver, he would have obtained hard amalgam, though it might not have remained in the mill and formed balls. Of course when no quicksilver was added the amalgam became very hard, crumbled, and was ejected. As the interior of the mill is not visible, the operator probably would have difficulty in determining the proper amount of quicksilver to add to secure and maintain the desired consistence of amalgam. I do not think there could be any surplus quicksilver at the Incaoro mill, only enough being added to form a hard amalgam. At the Plymouth mill the amalgam was pasty and all the coarse gold ground fine so that the amalgam contained only 22% bullion. At the Incaoro, 50% of the amalgam was gold, the difference probably being due to grinding of the gold being prevented by the hardness of the amalgam.

At the Plymouth mill a large amount of quicksilver was floured, but Mr. Kiliani does not mention floured quicksilver, so we must suppose that an objectionable quantity was not formed. Why the difference? Is it due to the character of the ores? The Plymouth ore consists of quartz, slate, pyrite, and arsenopyrite. The concentrate forms 1.8% of the ore, a large percentage of it being arsenopyrite. In the article, 'The Incaoro Gold Mine and Mill' (the *Press*, April 4, 1914), F. C. Lincoln states in regard to the ore: "The principal vein mineral is quartz, always accompanied by some white mica and native gold, and occasionally also by arsenopyrite, pyrrhotite, and pyrite. * * * The arsenopyrite and pyrite * * * are present in such small quantities as to be relatively unimportant." The country rock is described as being a "black non-fossiliferous slate." The only difference in the ores seems to be the greater proportion of sulphides in that at the Plymouth, but perhaps there is a difference in the character of the slate, some of which necessarily goes to the mills. The motion of the pebbles would tend to produce the same amount of flouring in both cases if all conditions were the same, but as the amalgam at the Incaoro was kept harder than that at the Plymouth, I judge there would be a smaller percentage of quicksilver floured and not a sufficient amount to make its loss important.

Perhaps there is nothing in the Incaoro ore to cause 'sickening' of the quicksilver, and hence the globules formed by the pebbles readily unite. The respective

amounts of arsenopyrite present may account for the difference in the quantities of quicksilver floured, there being almost none at the Incaoro and an appreciable amount at the Plymouth. There may be a difference in the slate that has an influence on the flouring, that at the Plymouth contains graphite, and perhaps that at the Incaoro does not, which may account for some of the differences in flouring. I do not know that graphite will 'sicken' quicksilver, but it may in the finely divided condition in which it occurs in the slate of the Mother Lode. I know that the dirt that is acquired during a day spent in a Mother Lode mine cannot be washed from the hands as can ordinary mud or dust, but that, like grease, soap is required to remove it. Perhaps it clings to the surface of a globule of quicksilver as tenaciously. Perhaps if Mr. Caetani and Mr. Kiliani would give more details of the methods employed at the two mills the differences in results could be readily explained.

Aside from the above, please ask Mr. Caetani to describe the amalgamating device that he states is to be attached to the Hardinge mill at the Plymouth and tell what results are obtained. Also ask Mr. Kiliani to describe the method of cleaning-up the ball and the pebble-mills at the Incaoro.

F. J. Girard.

Dedrick, California, December 28, 1914.

[With great pleasure we send these inquiries on to Mr. Caetani, who happens to be now in Italy, and Mr. Kiliani, who is in Bolivia. This interesting discussion of their papers by Mr. Girard, in California, emphasizes the world wide brotherhood of technical men, at the same time that the circumstance excuses delay in reply. In the meantime Mr. von Bernewitz is good enough to suggest possible answers to the questions, based upon experience in New Zealand and Australia. Who else has a suggestion?—Editor.]

The Editor:

Sir—Mr. Girard's discussion of the peculiarities of amalgamation in Hardinge and other mills raises some interesting points, which seem quite as difficult of explanation as they are interesting. There seems to be little difference in the ores treated at the Plymouth and Incaoro mills, although the gold may be finer in the former than in the latter. Any large difference in the pebble load would also affect amalgamation, and possibly the speed. Graphite in the slate mixed with the ore forms a greasy scum when crushed, and most likely would tend to 'sicken' the quicksilver, although I did not hear on the Mother Lode that it affected plate amalgamation. It may be argued that amalgamation in a mortar-box is subjected to great scouring action, when the stamps splash the pulp violently against the inside, yet when properly done there is little loss from flouring at this point. Apart from recovery of gold in the box, a steady flow of pulp over copper plates is about the best medium in amalgamation. Candidly, I would not try amalgamation in a Hardinge, tube, or ball-mill, in which the action of grinding is violent, and where little else than flouring of the mercury could be expected.

The effect of graphite in cyanidation is still a matter of dispute, some metallurgists being convinced that it does precipitate gold from solutions, while others say it does not and whatever precipitating is done is by occluded gas in the graphite. However, this is another discussion.

I never had much use for any amalgamating device, preferring to stick to the old methods. The theory advanced by inventors of amalgamating machines is generally to have better contact between the gold in pulp and mercury, therefore they try to force the pulp through, or on to, a mix with it. Flouring often results from this treatment. Electro-amalgamators work on the principle of keeping wells of quicksilver in an active condition, thereby inducing amalgamation.

Grinding pans are extensively used in Australia and in New Zealand, and with them amalgamation. The action in these is violent enough, but mercury losses are always low. The only system of amalgamation in tube-mills that I think well of is that used in the high-grade mills of the Nipissing and Buffalo mines at Cobalt. But that is another matter, as it involves the treatment of a few tons of 2000 to 3000-oz. silver ore with a strong cyanide solution, and a greater weight of quicksilver than there is ore in the mill. The process is satisfactory, but mercury losses are admitted to be high, and steps are being taken to recover the metal. The different results obtained at the Plymouth and Incaoro mills bears out what I often say, that what applies in one plant is not necessarily successful in another, even with similar ores, and no hard and fast rule can be laid down. Peculiar results occur, and often they are not always explainable.

M. W. von Bernewitz.

San Francisco, January 9.

Valuing Placer Ground

The Editor:

Sir—In regard to the correspondence in your paper upon the above topic, your contributors are in agreement in one respect—that calculations shall be based upon the assignment to each borehole of a definite superficial area. It is over the relative claims of an 'outside,' an 'inside,' or a 'corner' hole that they are at variance. There is also a tendency to regard the matter as exclusively one of values and to lose sight of the secondary element of capacity. In dealing with 'units' and 'half units,' or the values at opposite ends of a single diameter, as is advocated by Mr. Jennings, it is well to remember that the engineer might be making calculations for a large and irregular field instead of the restricted area given in the example.

In the following attempt I have assumed that the solid body of the deposit has been tested in five vertical sections; and on the assumption that the untested is also the unknown, and that the average is accepted as the best guess that can be made at the probable. I have

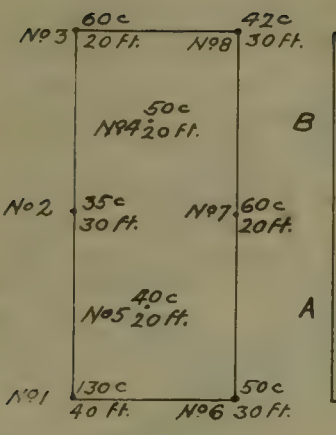


Diagram 1.

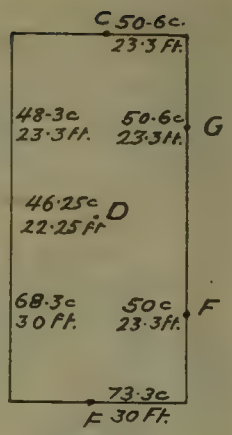


Diagram 2.

supplied the missing values by an average of all the nearest equidistant boreholes. The first diagram represents the ground as tested, the second the calculated averages required to complete the data for each section.

The results may be tabulated thus:

Averages

Avg. of holes.

Point A—2, 5, 1 = $\frac{35 + 40 + 130}{3} \times \frac{30 + 20 + 40}{3} = 68.3 \times 30$

Point B—3, 4, 2 = $\frac{60 + 50 + 35}{3} \times \frac{20 + 20 + 30}{3} = 48.3 \times 23.3$

Point C—3, 4, 8 = $\frac{60 + 50 + 42}{3} \times \frac{20 + 20 + 30}{3} = 50.6 \times 23.3$

Point D—5, 2, 4, 7 = $\frac{40 + 35 + 50 + 60}{4} \times \frac{20 + 30 + 20 + 20}{4}$ 46.25×22.25

Point E—1, 5, 6 = $\frac{130 + 40 + 50}{3} \times \frac{40 + 20 + 30}{3} = 73.3 \times 30$

Point F—6, 5, 7 = $\frac{50 + 40 + 60}{3} \times \frac{30 + 20 + 20}{3} = 50 \times 23.3$

Point G—7, 4, 8 = $\frac{42 + 50 + 60}{3} \times \frac{30 + 20 + 20}{3} = 50.6 \times 23.3$

Inserting these values we obtain:

(At unit distance apart)

Sections 3 C 8 = $\frac{60 + 50.6 + 42}{3} \times \frac{20 + 23.3 + 30}{3} = 50.86 \times 24.43 = 1242.5$

B 4 G = $\frac{48.3 + 50 + 50.6}{3} \times \frac{22.3 + 20 + 23.3}{3} = 49.63 \times 22.2 = 1101.8$

2 D 7 = $\frac{35 + 46.25 + 60}{3} \times \frac{30 + 22.25 + 20}{3} = 47.08 \times 24.08 = 1133.7$

A 5 F = $\frac{68.3 + 40 + 50}{3} \times \frac{30 + 20 + 23.3}{3} = 52.76 \times 24.43 = 1289$

1 E 6 = $\frac{130 + 73.3 + 50}{3} \times \frac{40 + 30 + 30}{3} = 84.43 \times 33.3 = 2811$

128.44 7578

$\frac{7578}{128.44} = 59c.$ Average depth 25.7 ft.

This value may seem to be higher than that obtained by some methods, but the quest for a system is governed by accuracy and adaptability rather than conservatism. It is obvious that the desirability or otherwise of using calculated averages and the selection of the elements of these guesses at the truth are matters determined on any field by the placing of the borings.

Edmund Bonella.

London, October 26, 1914.

Precision of Thought

The Editor:

Sir—Mr. Prosser's letter in your issue of December 5 vehemently criticizing the use of the singular form of the verb in your statement "• • • 600,000 tons was crushed," quotes "a fundamental rule of grammar, 'plural noun, plural verb'," and, further on, excoriates grammar as the worst of "the various kinds of trash" taught in our schools. Why anyone who holds grammar in such contempt should attempt to insist that his construction is the correct one is not clear, but the correctness of your use of the verb is beyond question.

The subject under discussion was *ore*, and there is nothing plural about ore except in the case of a mine which produces more than one kind, as the Shattuck Arizona does. The ore *was crushed* to the amount of 600,000 tons. The tons mentioned measured the quantity of ore, but they were not crushed into pounds or ounces. Mills crush ore, not tons, and doubtless this plant was designed for that purpose. The only occasion that I think of where the tonnage itself is "crushed" is when a capable engineer examines a mine in which the amount of ore has been overestimated.

J. Nelson Nevins.

Los Angeles, December 10, 1914.

The Hardening of Metals

At the 74th meeting of the Faraday Society in London, on November 23, the above was the subject of a general discussion. The chairman was Sir Robert Hadfield of steel fame. Referring to the history of the most important hardened metal in the world, namely steel, he said that the world's future progress literally depended upon understanding correctly and in a scientific manner the hardening of metals. The accurate determination of the hardness of steel alloys was now being investigated by a special research committee of the Institution of Mechanical Engineers. Having referred with deep regret to the great loss sustained by the science of metallurgy in the death of Dr. Martens, in whose honor Osmond had invented the metallographic term 'martensite,' he concluded by showing a specimen, probably the first to be exhibited in modern times, of an ancient piece of high carbon steel which had been hardened by quenching. It was taken from beneath the stone pillar of Heliodorus at Besnagar, India, and it contained 99.2% Fe, 0.70% C, 0.04% Si, 0.008% S, 0.20% P, 0.02% Mn, and traces of nickel and chromium. This specimen, perhaps more than 2000 years old, was the first example of ancient steel which he knew of that contained sufficient carbon to be called steel.

CONCENTRATES

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

GOLD AND SILVER producing mines in the United States and Alaska, but not including several silver-producing copper mines in Michigan, any zinc mines in the eastern and central states, a few in the far West, or lead mines in the central states, totaled 5276 in 1913. These consisted of 1774 placer and 3502 deep mines. The figures in 1912 were 2044 and 3567 respectively.

THE INDUSTRY OF THE COAL-TAR DYES was the subject of an address delivered before the board of directors of the General Chemical Co., New York, on October 23, by Bernhard C. Hesse. The full paper appears in the December issue of *The Journal of Industrial and Engineering Chemistry*. The industry yields no less than 1200 different products, includes as many or more processes of manufacture, and requires many hundred different sets of apparatus of varying capacities; therefore the complexity of the manufacture is evident. These 1200 products are made from 10 products obtained from coal-tar by distillation, refrigeration, expression, or the like.

A DOUBLE-DECK AMALGAMATING TABLE has been devised by E. V. Davies of Folsom, California, and tried by him in a mill in Plumas county. The upper or movable table can be set at a position just under the lip plate, a little ahead or behind the discharge point of same, to take any amount of the total pulp flow. The table could set or rest on the stationary table when in working position and be arranged to be raised or rolled away from it when necessary, or hung by rods from the building above. A short length of such an upper table was tried with good results in amalgamating float gold. It was set in a position with the lip plate to catch only the lighter pulp; bringing it more to rest on this table and in better contact with the mercury than could be done if carried down with all the pulp. Such a table will divide the pulp, and more water may be used in the battery, resulting in a more rapid discharge with less slime and an increased stamp-duty, and it may be of use where floor space is limited.

THE WATSON-DENNY GRINDING PAN is used in certain mining districts of New Zealand with satisfactory results. It is somewhat similar to the pan as used at Kalgoorlie, but the shoes and dies are cast with small corrugations, so as to afford a greater grinding surface than the plain ones. The overflow is discharged through a number of 1-in. holes at the top of one side of the pan into a lip attached. At the bottom of this lip is a hole through which the coarser material is returned to the pan to be further ground. In front of the discharge holes is a board placed to check the flow and aid the heavy sand to sink. According to D. B. Laurie, who operated these pans on the Thames goldfield, six of them ground 50 tons per 24 hours, the clean sand feed being 25 mesh, with no slime, and the discharge passing a 100-mesh screen. When fed too fast the surface of the pulp in the pan was 'dead', and the overflow lip contained a quantity of sand. These pans are 5 ft. diameter, and are gear driven.

THE DEEP LEADS, or gravel channels, of Victoria, have produced a great deal of gold in the past, but this form of mining is very quiet now. Water has always been a detriment to economical work. The system is to sink a shaft to bedrock, drive under the 'wash' and then put

A DRAINAGE BORE IN A VICTORIAN DEEP-LEAD MINE. NUMBERS OF THESE ARE PUT UP TO THE GRAVEL FROM WHICH COMES THE HIGH PRESSURE SHOWN. THE SCREW-JACK IS USED FOR FORCING UP THE TUBING. MINERS AT FACE 20 FT. BEYOND.

up boreholes to drain it. The Langi Logan company, in the Ararat district, has been pumping for three years, and has reduced the pressure of the water in the ground from 145 to 14 lb. per square inch. Pumps used are one 20 and one 22-in. lift, with 9-ft. stroke. Another pair of 18-in. lifts have recently been started also. The gold in the gravel is shotty, the deepest being at 350 ft. The accompanying picture shows the flow of water from the Loddon Valley Goldfields property, another deep lead scheme.

MINING IN THE FAR NORTH*

The Present Outlook for Quartz Mining in the Fairbanks District

By EMIL EDWARD HURJA

Lode mining is a comparatively new industry in the Fairbanks district. The first quartz claim in the district was located by John C. Rose on Chatham creek on August 28, 1903. It was known as the Blue Bell lode. The next year saw several more claims staked, but real lode development did not start until the Rhoads-Hall property, consisting of the Free Gold claim on Bedrock creek, was opened in 1908-9. Then many claims were staked, and whole hillsides were blanketed with locations. As many of the locations were not followed by active prospecting or development work, the lode-mining industry did not fare beyond the nursing bottle stage.

In the last few years Fairbanks has experienced some real healthy development, although in 1913 and 1914 the growth has been less than in the two years preceding. Many mistakes have been made, ore has not been sampled carefully, mills have been placed without careful enough investigation of conditions, and expensive equipment has been installed without sufficient ore in sight to justify reduction plants, but progress has none the less been substantial.

The development of lode mining in the Fairbanks district came with the depletion of the richer placer deposits of the creek bottoms. Previous to 1911 about $60,000 was taken out; in 1911, the production was $64,100; in 1912, $200,000; in 1913, $175,000; and in 1914, about $250,000 or $300,000. In 1912 there were six mills in operation; in 1914, five operated, three of them at intervals only. The reason assigned is the fact that many of the mills were installed before sufficient underground development had been done. Water conditions often have caused some of the mills to close down, especially during the winter time. It is only by drilling that a permanent water supply has been obtained at some of the claims. Most of the properties of the district have been opened up with local capital and by local men, and the mistakes made in the mining have been due largely to inexperience and lack of knowledge as to quartz mining.

Gold-bearing quartz has been found in the Fairbanks district in many widely scattered areas. The main belt appears to be centred in the region between the Cleary and Fairbanks creek watersheds. Most of the prospects occur along the headwater tributaries of Cleary and Fairbanks creeks, although some very promising properties have been developed along Twin and Pedro creeks, on Fox gulch, a Goldstream tributary, on Dome and Little Eldorado creeks, tributaries of the Chatanika river. Then there is another belt surrounding the Ester Dome region, where quartz has been found on Eva, Ready Bullion, and Sheep creeks.

There are a number of locations on Fairbanks creek. The easternmost prospect is the Charles claim, near the head of Walnut creek. An 18-in. vein has been found on the claim, but development is at a standstill. On Moose creek, Crites & Feldman have done considerable prospecting on their holdings between that stream and Too Much Gold creek. Two veins have been uncovered and traced for a distance of about 1500 ft., ranging in width from one to four feet. During the summer of 1914, a reduction plant, consisting of a five-stamp Hendy battery, was moved from the Pioneer Mining Co.'s millsite on lower Chatham creek to a new millsite on Moose creek, below the tunnel site of Crites & Feldman. The mill started crushing in September.

At the head of Too Much Gold creek, the Anderson, Nars & Gibbs property is being developed slowly by Gibbs, who has purchased the interests of the other two. The Cook holdings, near the mouth of Too Much Gold creek, and consisting of the Governor, Plumbum, Excelsior, and other claims, have been idle during the past year, because the owners stampeded to the Chisana. On the Mizpah claim, owned by A. Hess and Charles Thompson, considerable work has been done. A resumption of sinking was planned for the fall of 1914. Joe Connors and Bert Stevens are prospecting the Ohio group of claims, opposite No. 13 and No. 14 Above, left limit, placer claims. They have an 80-ft. shaft on a vein averaging 2½ ft. in width, and have 20 tons of ore on the dump. On the Mayflower claim, a 50-ft. shaft has been sunk and driving is being continued along the vein at that level. The vein is 20 in. wide. A shipment of 7½ tons was milled in May 1914 and gave returns of $60 per ton. Kellen and Vanarsdal are prospecting the Thanksgiving claim, below the Connors-Stevens prospect. A shaft is down 36 feet.

Farther upstream, Chris Foss and Louis Fairvain have taken a lease on the American Eagle quartz claim and have started prospecting it. The claim has but recently been released from litigation which lasted for three years. L. J. McCarthy, an old-time prospector of the district, who has a number of claims on the divide between Fairbanks and Wolf creeks, recently took a lease on the Pioneer claim, owned by Clark, McGowan, McDougall, and associates. In July 1914, 32 tons was milled, having a value of $2200. An incline shaft is down 160 ft., and adits have been driven 80 ft. each way on the vein. On the 50-ft. level, 80 ft. of adits has been driven. The most recent work has been done at the 50-ft. level. The vein is highly mineralized and is from 7 to 8 in. wide. A cross-stringer 7 in. wide was found recently, and attention will be devoted to it soon.

The Pearl Creek valley, tributary to Fish creek, has several prospects, the most promising of which are owned by Murphy & Perrault and Mike Steipovich.

On Wolf creek are a number of claims which have been worked during recent years. The Homestake tunnel site, owned by the Homestake Mining Co., is under lease to George Nightingale. The main adit has a length of 750 ft., in which it cuts ten different stringers. One of these is being worked, the drift along the stringer starting 315 ft. from the portal of the main adit and running northeastward. The tunnel has been driven 300 ft. Stoping of the five-inch vein has yield-

*[Previous articles in this series by Mr. Hurja on mining in Alaska and the Yukon have been 'Mining Revival in the Ketchikan District, Alaska,' July 4; 'Wrangell, Alaska,' special correspondence, July 11; 'Developments of the Alaska Gold Mines Co.,' July 18; 'Juneau, Alaska,' special correspondence, July 25; 'Cordova, Alaska,' special correspondence, August 8; 'Valdez and Prince William Sound,' August 15; 'Seward and the Kenai Peninsula,' August 29; 'The Koyukuk Mining District,' September 12; 'Operations of the Yukon Gold Co.,' October 10; 'Skagway-White Horse Mining District,' October 17; 'Operations of the Canadian-Klondyke G. M. Co.,' November 14; 'The Klondike, the Treadgold Placers, and Outlying Districts,' November 28; 'The Upper Yukon: Circle City, Eagle, and Woodchopper,' December 5; 'Placer Mining in the Fairbanks District,' December 19 and January 2.—EDITOR.]

ed wonderfully rich ore. Thirty-three tons was milled in November 1913, with an average value of $170.59 per ton. In July 1913, 28 tons was milled with an average value of $109. Twenty-five tons was on the dump in September ready for shipment down the creek to the Rexall mill. On the Rexall claim, adjoining the Homestake on the downstream end a two-stamp Hendy mill, operated by a gasoline engine, was erected in 1912. The installation of the equipment was not made wisely, as the stringer which was being worked suddenly pinched out. Still, a new lease on life has been taken at the Rexall, with the granting of a lease a few months ago to Fred Crouch and associates. Their lease has a term of ten years, with a 10% owners' royalty on all ore milled. The vein on which they plan to work has a width of four to seven feet. Operation of the mill costs $9.50 for fuel each 24 hours, a great saving over steam boilers in use at other mills in the district.

In the Chatham Creek valley, work has been temporarily suspended on the Chatham Mining Co. and Pioneer Mining Co. properties because of the high cost of supplies and labor. E. L. Scrafford is in New York attempting to float a company to take over the Chatham property. The claims have considerable work done on them; the mill on the property, two 2-stamp Hendy batteries, is idle at present, although it has produced several hundred thousand dollars. The pioneer holdings include the first lode location of the district, the Blue Bell claim. The Jupiter-Mars and Quenboe properties are on the ridge between Chatham and Wolf creeks. No work is being done on them now.

Perhaps the best property in the district is the Free Gold claim, owned by L. B. Rhoads and W. C. Hall. The claim was located in 1908 and from the first it paid development costs. Rich ore was found near the surface and the first returns came from ore which was crushed with mortar and pestle and then panned for the free gold. Later small shipments were sent to a 3-stamp customs mill which had been erected at Fairbanks. In 1911 shipments to a 10-stamp mill at Chena, 12 miles below Fairbanks, were made. One hundred forty-seven tons yielded $17,645, or an average of $120 per ton. Mining is done from a main adit with a length of about 1200 ft. An intermediate adit 140 ft. farther up and a third one, the Penrose, 50 ft. higher, together with smaller adits, bring the total on the claim to over 5000 ft. A winze has been sunk to a depth of over 100 ft. The 70-ft. level has been developed a distance of 872 ft. and the 100-ft. level a distance of 890 ft. along the vein. The adits drain the workings, the water being flumed to furnish the mill supply. A 2-in. Buffalo pump operated by a 7-hp. General Electric Co. motor keeps the winze workings free of water. Hendy cars—1600 lb.—are used to tram the ore to the mill, which is situated several hundred feet below the mouth of the main adit. The ore is crushed with a 7 by 9 Blake crusher, fed to the single battery of five 1000-lb. Hendy stamps with an automatic feeder, and the pulp discharged through a 40-mesh screen directly to the plates. The stamps approximate 100 drops per minute, with a 5-in. drop. The plates are 16 ft. long and 4½ ft. wide. No vanner is used, as over 90% of the gold is recovered in the mortar box and on the plates. The mill has a capacity of 17 tons each 24-hr. day, or an average of above 400 tons per month. The chrome steel shoes are replaced every four months; the dies every three months. A 50-hp. battery of boilers operates two American Blower engines, one of which operates the mill and the other a General Electric Co. motor and lighting plant. A Hendy clean-up barrel is included in the mill equipment. The 1913 output of the mine has not been made public, but 48,000 sq. ft. of vein matter was worked, the vein having a width of from a few inches to 3 ft. 4 inches.

There is some small-scale mining being conducted on the claims of the Tanana Quartz & Hydraulic Mining Co., situated on the ridge between Bedrock and Chatham creeks. The discoverer of the claims was Antone Goessman. The Tolovana property, which has a 2-stamp Nissen mill and a small Huntington in connection, is on Willow creek. The claims in the group stretch between Bedrock and Willow creeks. Work at the Tolovana has been suspended indefinitely because of financial difficulties. The Emma claim at the head of Willow creek is being worked by I. Overgaard. The Newsboy claim at the extreme head of Cleary creek, on the ridge between it and Little Eldorado creek, has about as much work done on it as any claim in the district, but because the ore did not average above $15 to $20 per ton, the plant was forced to suspend operations. A five-stamp Hendy mill is situated one-half mile below the shaft.

The north slope of Dome creek is almost entirely covered with the holdings of the Reliance Mining Co. There is a 2-stamp Nissen mill on the creek, immediately below the claims, but it was not operated much during the past year. Some very rich ore has been found on this claim. A one-half interest in a year's lease on the property sold in 1912 for $30,000.

The Friedrich property on Vault creek is idle, as are several other prospects on smaller tributaries of Vault. At the head of Sheep creek, tributary to lower Goldstream and heading into Ester dome, the discovery in 1912 of a boulder literally plastered with free gold led to a revival of prospecting there. Nothing of great importance has been found, however.

The Rainbow mine is the principal property in the Twin Creek valley, although Martin Harrais and others are working on the Moonshine and Sunshine claims nearby, with hopes of ultimate success. The Rainbow shaft is 131 ft. deep. At the 100-ft. depth, 209 ft. of drift has been driven west and 135 ft. east on the vein. Five hundred tons of ore has been stoped from the vein. The failure of a Straub mill which was erected two years ago but did not operate successfully has delayed development of the property. L. M. Drury recently took a lease on the claim and plans to continue the development work on a big scale. A 25-hp. Lidgerwood hoist, with 50-hp. boilers, blacksmith-shop, and buildings are on the claim. Because of the non-fulfillment of option and lease provisions, the claim had reverted to the original discoverers, Herchberger & Zimmerman.

In the Ester district, the Tyndall & Finn discoveries on St. Patrick creek are said to be the most important. They were made early in the year. The Hudson brothers made good finds on Ready Bullion creek, in the same vicinity, in 1911, and after a little development they erected an expensive milling plant, made up of two Nissen stamps, concentrating tables, and a mill building considered the best in the interior. The mill operated only a short time when it became evident that there was not enough ore to justify continuous operation.

Another property which is considered of importance to the Fairbanks district is the Dempsey-Linden property on Sourdough creek, a tributary of the upper Chatanika waters. It is being developed each winter. Other districts in which quartz mining is carried on are the Kantishna, the Big Chena, and Tenderfoot districts. Considerable lode gold mining also is carried on in the Chandlar district, north of the Arctic Circle. There are a few silver-lead properties in the Koyukuk. The general future of quartz mining in the district depends on a general reduction in mining costs. Fuel costs are too high, and, until cheap power is obtainable, there can be no real healthy general development. This seems to be assured with the probable construction of the government railroad through the Nenana coalfields. Then there is the factor of wages. A general reduction of living costs in the district would tend to reduce wages to the point where many properties which have orebodies proved up on them could be worked with profit.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

NEW YORK

THE COPPER SITUATION.—BRADEN MINE AND MILL.—CHUQUICAMATA PROGRESS.—INTERNATIONAL NICKEL CO. AND EXPORTS TO GERMANY.—BARTON SEWELL.

Last week showed a marked improvement in the market for copper. December sales had been lower than November, and the year opened with a rather gloomy outlook. Whether because it appeared that England would make a conciliatory reply to the American note in regard to the detention of shipments, or for whatever reason, there was a marked improvement in the buying during the first week of the new year, and at the end of the week there were signs that there would again be an upward movement in price. Exports for the preceding week had been about 12,000,000 lb., more than half of it consigned to France and most of the rest to England. Early in the week T. J. Walsh, senator from Montana, made quite an important speech in the Senate in dealing with the question of interference with American ships by British cruisers, and especially referring to copper shipments. He said: "The exigencies of the war, in which we are in no wise concerned, will necessarily entail hardship and suffering on the laborers in the copper mines and in industries more or less dependent upon them. It may reasonably be assumed that the government of Great Britain, with which we happily are in amity, would not wantonly add to the detriment which is occasioned by the destruction of the German market the discomfiture and distress that must ensue from the closing to our trade of the ports of the neutral nations of the Continent."

The estimated figures for the output of copper last year compiled by the U. S. Geological Survey have been given out and show a decrease of 8½% as compared with 1913. The latter year showed a small decrease as compared with 1912, so that the 1914 figures of 1,129,000,000 lb. are quite a little smaller than those of two years ago. As most of this decrease is due to the voluntary reduction of output by the various producers, it is probably uniformly distributed, and is not confined to any particular group of states. Utah, however, will show about the same output as last year, because up to the time the reduction in output was made it had been turning out considerably more copper than the year before.

The Braden is making an improved showing lately. It will be remembered that while the amount of ore reserves estimated in the first report on the property have been greatly exceeded, working costs have also been greater. This is a cause for congratulation rather than the reverse, because while the ore reserves are fixed, there is a good possibility that the cost can be reduced, and indeed good progress has been made toward reducing them. The total ore reserves are now estimated at 108,000,000 tons containing 2.5% copper, and the somewhat unfavorable showing which the mine has been making so far has been in part due to the fact that it has been operating on material which is considerably lower in grade than the average. The average material treated in November was 2.18% copper, and this was the highest of all recent months. However, the reduction in November was not so good as in October, when the new mill made a recovery of 77.7% and the Minerals Separation plant made a recovery of 76.95%, a net total of over 81%. The net total recovery in value was 73.9%. During the first half of December the total was 76.5%. The plant could produce much more than it is producing at present, but it is being held down in order to correspond with the reduction in output which is being made at the mines in the United States. The plant has been running for some time, and the leaching process has also been in operation and has shown a recovery so far of 93.3%. The usual delays and difficulties in starting a new plant like this have not failed to appear, and the electrolytic equipment for the recovery of copper from the leaching solution was started at the end of December. Probably results from this will not be available for some time until it gets in regular working order. Working costs have already been reduced to 7.5c. per pound, and Pope Yeatman is of the opinion that there is a good possibility of eventually reducing the cost to 6.5 cents.

Good progress is also being made at Chuquicamata. Both the metallurgical and mining plants are practically completed. The work on the power plant has been delayed because the machinery was being supplied from Germany, but the steamer carrying the last of it had safely sailed from Germany before the war started, and the Company hopes that before long it will be safely landed in Chile. The expectations of the management are that the plant will be in operation by April 1. E. A. C. Smith is leaving for Chile at the end of this month, and will be on the ground to supervise the starting of the plant which he has designed.

ELECTROLYTIC TANK HOUSE, CHUQUICAMATA, CHILE.

The International Nickel Co. has declared its regular quarterly dividend of 1½% on its preferred stock, payable February 1. No action will be taken on the common stock until next month. The Canadian government has issued a memorandum in regard to the affairs of the International Nickel Co., and the question of exports of nickel to Germany. The Company has allowed free access to its books to representatives of the government, and all exports have been investigated so that it can be certain that no nickel has gone through to Germany or Austria. The alarm which the Cana-

dians have exhibited over the possibility is rather exaggerated, because the nickel mines in Norway which produced several million pounds last year could easily supply the demands of Germany and there would be no need to depend once on the Canadian nickel. In attempting to take any vigorous action, the Canadians are more likely to injure themselves than anybody else, since nickel production is an important industry in Ontario.

All the plants and offices of the American Smelting & Refining Co. stopped work for an hour at 11 o'clock last Saturday, when the funeral of Barton Sewell, vice-president of the organization, was held. He was a quiet man and was so much overshadowed by the publicity which the Guggenheim Bros. receive that few people nowadays realize that he had much more to do with the formation of the Company than they had, since he put through the various consolidations which led up to the formation of the American Smelting Co., in which he was the chief factor and which became the nucleus for the A. S. & R. Company.

WASHINGTON, D. C.

BILL TO REGULATE AREA OF COAL LANDS CONTROLLED BY CORPORATIONS.—WORK OF THE SESSION.

A bill of interest, possibly prophetic of legislation to come in some future Congress, is that of J. F. Shafroth, senator from Colorado, to regulate the quantity of coal lands which may be entered or controlled by associations or corporations. The bill provides that any qualified corporation or association of persons or municipality shall on application to the register of the proper land office have the right to enter by legal subdivisions any quantity of vacant coal lands in the United States, within any state of the Union, not otherwise appropriated or reserved by competent authority, not exceeding 2560 acres, on payment to the receiver of not less than $10 per acre, should the land be situated within 20 miles from any railroad, and not less than $20 per acre if within 15 miles of a railroad. The Secretary of the Interior is to offer such coal lands through advertisement and by competitive bidding, or by such other method as he may by general regulation prescribe, reserving the right to reject any and all bids that he may deem unfair. Improvements or development work to the extent of $10,000 must be made within one year after the award, when patents shall issue therefor. It is further provided that such corporations and associations may not own an area in excess of that prescribed in the act, directly or indirectly, although extra area may be acquired by descent, will, judgment, or decree, but only for two years thereafter and no longer, and in the case of minority or other disability may be held during such time as the court may decree. Violations of the foregoing are punishable by a fine of $10,000 or imprisonment not exceeding 10 years, or both. Furthermore, if such coal lands should come into the control of a trust or other combination illegally operating in restraint of trade, or when excess acreage is acquired contrary to law, the same is to be forfeited to the United States. Half of the money received from the lands entered as described is to go to the state wherein the lands are situated.

Only seven weeks more remain of the short session, and legislation is becoming so clogged, principally on account of the determination of the President to procure the enactment of the shipping bill, that the outlook for the passage of the conservation measures, inclusive of the so-called leasing bill, offers no encourageemnt whatever to those who would like to see the measure passed by the Senate.

Interference with American shipping by England continues to attract considerable attention here. T. J. Walsh, senator from Montana, made a vigorous protest, and said that every detained ship against which a *prima facie* case had not been proved, should be released.

HOUGHTON, MICHIGAN

TONNAGE TAX—COPPER SHIPMENTS—ISLE ROYALE NEW MILL—TAMARACK REGRINDING PLANT—MOHAWK MINE—SILVER FROM CALUMET & HECLA—WOLVERINE OUTPUT.

The ruins of the Isle Royale stamp-mill are being removed rapidly, a large number of men being at work. To the numerous Copper Country people who visited the place shortly after the fire, the clearing away of the large bent girders, twisted pipe, and wrecked tables, jigs, and stamps seemed a hopeless task. As is characteristic of all work in the district, every possible means is being used to clear the site as soon as possible for the erection of the new mill. The Worden-Allen Co., of Milwaukee, which is to build the new three-stamp mill, is facilitating this work by the use of the oxy-acetylene blowpipe. The process of rapidly cutting through huge beams and girders by means of the intense flame generated, is something new, and of great interest to the engineers of Houghton. The Isle Royale is sending 2000 tons of rock per day to the Centennial-Allouez mill at Point Mills. This is a subsidiary property of the Calumet & Hecla.

Employees of the American Bridge Co. who have been constructing the new regrinding mill for the Tamarack Mining Co. at Hubbell have completed their work, and have gone to Hibbing, Minnesota, to construct a 300,000-gal. water tank for the city. When the workmen arrived in Hubbell early in November, it was reported that the construction work on the new plant would be rushed with all possible speed. It is interesting to note that the men spent only six weeks on the contract. The building is 100 ft. wide and 186 ft. long, and 307 tons of steel was used. The building is now ready for the installation of the machinery. The Tamarack regrinding plant is one of the few pieces of construction work which was not delayed by the general curtailment of all operations in the district.

The Mohawk mine is producing the best 'rock' tonnage in its history, and shipments average better than 3600 tons per day. Furthermore, the grade of ore is higher than before, yielding 20 lb. of refined copper per ton.

A shipment of 100,000 oz. silver bullion, valued at nearly $50,000, was made January 8 from the Calumet & Hecla smelting plant at Hubbell. This is the first large shipment from the district. Formerly all the Calumet & Hecla copper was sent to the plant at Buffalo for refining. This eastern plant has been disposed of, and a new electrolytic refinery at Hubbell is now efficiently treating the Calumet & Hecla output, which carries undesirable arsenic and considerable silver.

The Wolverine Mining Co. shows a total of 3935 tons of 'mineral' produced for the last 10 months of 1914. The largest monthly production was 472 tons in June, and the lowest 314 tons in March.

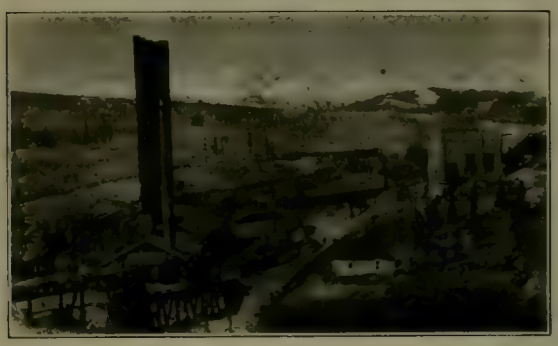
The total shipment of copper by way of the Great Lakes during the past season, from April to the close of navigation, November 18, amounted to 53,933 tons. The copper country ports and the amount shipped from each are as follows: Houghton, 17,514; Hancock, 5329; Dollar Bay, 11,260; and Torch Lake, 19,830 tons. Included in this is one shipment of 101 tons of western electrolytic copper which was sent to Dollar Bay for re-treatment.

There has been a great deal of concern shown recently, both in the iron and copper districts of Michigan, over the proposed state tonnage tax. A large number of upper peninsula delegates met at Marquette early in December to form a permanent organization to oppose the tonnage tax bill. At a recent meeting of the State Grange, however, the advocates and initiators of the bill failed to secure sufficient signatures to force the legislature to consider the proposed law. The defeat of the tonnage tax campaign as far as the present term of the legislature is concerned, is certainly pleasing news to the people of the iron and copper countries.

LEADVILLE, COLORADO

ENCOURAGING RESULTS EXPECTED THIS YEAR FROM THE DOWN-TOWN, PROSPECT MOUNTAIN, TWIN LAKES, AND LACKAWANNA, AND DEEPER SINKING SCHEMES.

The new year begins with four features in mining progress in and around Leadville standing out as the important factors of the future activity of the district. Of these, the one having the most influence upon local conditions is the unwatering of the down-town area, an enterprise that is now in the preliminary stages and rapidly being prepared for operation. At the present time, all of the surface work has been completed, and the plant at the Penrose shaft, through which the water will be pumped, is ready for work. The contractors are timbering the shaft from the surface down to a shallow depth, while the Colorado Power Co. is erecting transmission lines, etc., to get power to the property. The hoist will then be driven by a motor, and the work of timbering down to



YAK MINE, LEADVILLE, COLORADO.

water-level will be started. All of this will be completed early in 1915. The machinery, pumps, motors, and other equipment is expected to be delivered during January, and it is planned to have everything in shape for installing the pumps as soon as they arrive.

The prosperity of the district for the current year and for several years to come is based directly on the success of this scheme. The Company controls a vast area of ground, including such well known producers as the Coronado, Midas, Sixth Street Shaft, Weldon, Bison, Bon Air, P. O. S., and Penrose. The last named, the base of the operations, lies directly on the large vein of zinc carbonate ores that extends from the Maid of Erin southwest through the Bon Air. During the time when this property was last active, many tons of the now valuable zinc was thrown over the dump as waste. It was from this abandoned material that the first shipment of carbonate from the Leadville district was made. It is expected that the ore will be found most extensively in the Penrose and adjoining properties, at the same depth it was found in the Maid, between 700 and 800 ft. The formations in both are about the same, and both are on the ore-shoot, south of the most extensive faulting. Some idea of the extent of this great deposit may be estimated from the developments that have been brought to light by the Western Mining Co., which has been working the northern parts of the vein through the Wolftone shaft on Carbonate hill. This property, which has been the largest producer of zinc carbonate in the world for the past year, has maintained an output of 350 tons for 365 days, a total of 127,750 tons. Mining men who are familiar with the formations in the Penrose and other properties controlled by the Down Town Mining Co., state that the output of the Wolftone will be equalled, if not surpassed, by the production that will be taken from the now drowned area. For these reasons the opening of the Penrose is considered the dominating factor in the future prosperity of Leadville. It will mean an addition of from 600 to 700 men to the present payroll of the district, and an increase of from 500 to 1000 tons of ore produced each month. In addition to the zinc deposits that are to be found in this territory, there are large deposits of silver and iron ores which will prove of great value.

Another large development project is to be launched which will make a great increase in the future possibilities of Leadville. The area lying immediately north of the Big Evans, and the many properties on Fryer, Yankee, and Breece hills known as the Canterbury Hill and Prospect Mountain section, is to be explored by an adit. The territory has been mined slightly near the surface, and some good shipping ore has been produced from the Canterbury and Rosevale properties. No extensive work has ever succeeded, because of the water that has always been tapped at a shallow depth. All of the big ore-shoots that were mined on Fryer hill in the Matchless, Pittsburg, Robert E. Lee, Discovery, and other famous mines of the early eighties, dip to the northeast, directly in a line with the Canterbury ground. The same is true of the veins cut in the properties on Breece hill. This leaves little doubt of their presence under the formations to the north, but they will be found only at considerable depth.

The plan that is now under way to open this large district is to organize a company of local mining and business men, and drive the adit under the territory from the Arkansas valley for a distance of about 5000 ft. This would cut all the veins from Fryer and Breece hills, or make it possible to reach them with a minimum amount of interior shaft work. A depth of from 700 to 2000 ft. will be gained by the bore, and the water question will be easily solved. The proposition is a big one, and one that demands a large amount of capital. However, under the share system, and with men known to be capable and trustworthy for the direction of the work at the head, there is every reason to believe that the undertaking will prove a success. Already a great part of the shares has been spoken for by the active men of the district, and everyone is interested in the enterprise. After the first of the year the work of formally organizing the company will be taken up by the promoters, and it is expected that results will be obtained within the month.

The third feature of the prospective era of prosperity that will dawn in 1915 is the remarkable advance that is being made in the Twin Lakes and Lackawanna districts, in the western range of mountains that have long been overlooked as mining territories. Three large properties are being worked this winter, and all of them are producing some of the best gold-bearing ore that has been found in the vicinity. Along with this the report that there are large deposits of molybdenite ore in the district has recently come in, and no little interest is being taken in this new discovery. During the summer of 1915 good developments are expected from this area, and there is no doubt that a number of mines will be opened and a great deal of milling plant installed.

The last factor of importance that has the appearance of a lasting and beneficial result on the future, is a move on the part of the larger companies in the district to sink their shafts into the lower formations. Four mines are now being put down from 100 to 150 ft. deeper than their present workings. These are the Monarch shaft of the New Monarch Mining Co., the Big Four shaft of the Big Five Operating Co., the Garbutt shaft on Jonny hill, and the President on Breece hill. The fact that good ore has been found deep in the Cripple Creek and other districts of the state gives the impression that the same will be true at Leadville.

Everything points to a banner year for 1915 in the way of opening and developing new ground, which after all is the real test and measure of the life of a mining camp.

PLATTEVILLE, WISCONSIN

Satisfactory Results in the Zinc Districts in December. Course of Prices, Legislation, Ore Production, Buyers, Operators' Views of the Future.

From two points of view especially, December proved the banner month of the year in the zinc mining industry of this field, namely, a much enhanced value received for raw ore, and a decided increase in output regardless of severe winter weather, which hampered deliveries from outlying mines.

The prediction freely made by several of the leading ore buyers of the field that spelter would reach higher prices, possibly 6c. per pound, was nearly verified, the middle of the month witnessing firm quotations at 5.7 to 5.8c. at St. Louis. This condition followed some buying for foreign consumption, and insistent inquiries in the first half of the month, which were lacking toward the close and with which was coupled an almost stagnant demand for metal for home consumption, with the result that prices fell and were well under 5.4c. at the end of the month. With its 'characteristic penchant for pyrotechnical stunts' at unexpected moments, zinc ore reversed itself under declining metal markets, and instead of showing declines, actually made substantial gains, closing out of all proportion to metal quotations, at $48 to $51 per ton for 60% ore, as compared with $36 to $39 per ton at the beginning of the month. A heavy production from the districts of the southern half of the field responded promptly to the improved offerings, although buyers evidently labored under instructions to avoid competition, and deliveries were made through the usual channels of outlet. An increased movement of raw concentrate, the heaviest for any single month of the year, was shown on the weekly car reports published for the field, while a reserve was carried over conservatively estimated at 3000 tons.

Lead ore was in poor demand all the month; pig lead receded from an already weakened position and closed the month on inside business at 3.6c. at St. Louis. Very little ore cleared and production was nominal. About 1000 tons was carried over in anticipation of better markets.

Pyrite was off price, and production and shipments both took a decided drop. The production for the entire year shows a large reduction over the figures published for the output of 1913.

Carbonate of zinc ore producers of the northern districts were given a good market at the beginning of the month, and a fair quantity of ore cleared at excellent prices, the base being $24 per ton for 40% ore, all of which was secured by the New Jersey Zinc Co. The demand was sporadic, and miners were left with an accumulation of several months' active operations. This condition exercised no discouraging influence over those who have placed increased working forces underground for the winter, and a large tonnage of mill feed is piling up. Small operating concerns increased in number and leases were anxiously secured, the incentive being only the hope of a good demand at some future date.

A recent act of the legislature in taxing orebodies has excited a great deal of adverse comment among mining men and capitalists, who might become interested in the field. Many valuable mining properties are now languishing for want of a little financial backing, all because the new law is considered to levy assessments on ore deposits yet undeveloped, and to impose an unfair burden. This has had the direct effect of driving capital out of the field, and operators have been driven to adopt various subterfuges to escape the full effect of this piece of legislation.

The gross production of concentrate for the month aggregated 28,888,782 lb., and net refined ores from separating plants and wet concentrate direct to smelter 16,392,330 lb. The Mineral Point Zinc Works shipped 54 cars of calcined ore to Depue, Illinois, equal to 4,222,500 pounds.

Ore production for the field in December was reported as follows, by districts:

Districts.	Zinc, pounds.	Lead, pounds.	Pyrite, pounds.
Benton	8,006,000	160,000	1,306,700
Galena	6,940,000	61,400	
Cuba	3,826,000		
Hazel Green	3,606,000		
Livingston	3,076,000		
Linden	2,034,000	60,000	
Shullsburg	1,894,000		
Mifflin	1,256,000		
Platteville	1,022,000		
Highland	650,000		
Mineral Point	84,000		
Total	32,364,000	281,400	1,306,700

Sales were distributed among the following buying concerns: Mineral Point Zinc Co., 7763 tons; National Separating Works, Cuba, 2166 tons; Grasselli Chemical Co., 1263 tons; Empire Roasters, 1149 tons; American Metals Co., 865 tons; Illinois Zinc Co., 952 tons; M. & H. Zinc Co., 787 tons; Linden Zinc Co., 446 tons; and Campbell Separating Works, 584 tons.

The northern areas of the field, including the Platteville district, showed up indifferently all through the month, and both output and shipments were unsatisfactory. No prospect, mine development, or construction work was noted here except in the Mifflin district, where two new concentrating plants were started; but even then the production was curtailed, and more than 1000 tons of choice ore was carried over at the end of the month. In marked contrast to all this was noted the activity in the southern half of the field, where new ground was being explored with drills, new mines developed, and new equipments being provided. Operators interviewed at several points in the field appear optimistic as to developments of the future. They expect a higher metal market, and even better prices for ore, within the next 60 days, and apparently this has some backing, as plans are being laid for more elaborate exploration work, mine development, and power and mill construction. The year, despite low prices, has been one of the best experienced by Wisconsin miners, since all operated conservatively, and while profits were small they were carefully husbanded, and left the different concerns in fair condition financially. All look toward a season of prosperity.

CARSON CITY, NEVADA

The report of the state inspector of mines, Edward Ryan, covers the year ended November 30, 1914. It consists of 52 pages, and covers the state generally. There are about 190 mining districts irregularly scattered throughout the state. In the Great Basin, of which Nevada forms the larger part, are a number of north-south ranges of complicated structure, separated by almost an equal number of fertile valleys and some desert. Nearly all of these ranges are mineralized more or less. This makes prospecting attractive. In 1913 there were 786 producers, 82 more than in 1912, yet the value of the total decreased $1,261,022. There was 5,367,211 tons of all ores treated for 570,589 oz. gold, 16,090,083 oz. silver, 90,693,751 lb. copper, 16,344,023 lb. lead, and 14,419,671 lb. zinc, worth a total of $37,097,710. The report deals with mining legislation, mine-rescue and first-aid work, county notes, notices issued to companies to rectify certain necessary points in the mines, details of accidents, and expenditure of the inspector's department, which amounted to $9331. James W. Gaughan is deputy inspector.

There has been some active prospecting and development of quicksilver ores in this state in recent years, and the output increased in 1914, according to the U. S. Geological Survey. The Nevada Cinnabar mine at Ione made a large yield.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press.

ARIZONA

Gila County

Although the Miami Copper Co. has enough money to pay its quarterly dividend, the full amount was not earned during the last quarter, and the directors on January 4 decided not to make any distribution. This is the second dividend to be passed. Operations are still at 50% capacity.

The Old Dominion at Globe produced 1,710,000 lb. of copper in December. The total for 1914 is 30,448,000 lb., against 30,810,000 lb. in 1913.

Mohave County

At 350 ft. in the Gold Ore mine, near Goldroad, a rich streak of ore has been cut, showing plenty of free gold.

Pima County

The Calumet & Arizona company is employing about 400 men on its property at Ajo. It is said that 8 or 10 copper claims of T. Childs have been acquired by the Company for $122,000.——A 4-in. vein of high-grade wolfram ore has been opened by M. G. Levy in the Young American claims in the Ajo district. Some of the ore has been sent to Pittsburgh.

CALIFORNIA

Legislation enabling oil producers to organize and protect the various fields against underground water will be the subject of a meeting called by state mineralogist, F. McN. Hamilton, for January 15, at one o'clock at the State Capitol at Sacramento. There will be representatives from the State Mining Bureau, and a number of prominent oil operators who will aim to present the needs of the oil industry to interested legislators. W. F. Chandler, senator from Fresno, has taken an active interest in the matter. A bill has been drafted by the Mining Bureau, under the supervision of R. P. McLaughlin, who, during the past year directed an investigation of the oil industry.

According to the United States Geological Survey, there were 33 mines and prospects producing quicksilver in the United States in 1914, of which 23 were in California. In 1913 there were 24 producers, of which 18 were in California. The estimated output for California in 1914 was 11,469 flasks, valued at $561,981, against a production of 15,591 flasks, valued at $627,228 in 1913. The output in California in 1914 was the smallest since 1860. The chief producers in 1914 were the New Idria mines of San Benito county, Oceanic of San Luis Obispo county, New Guadalupe and New Almaden of Santa Clara county, St. John of Solano county, and Helen of Lake county. Among smaller producers were the Cloverdale, Little Panoche, Acachuma, Los Prietos, Alpine, Reed, Aetna, Oat Hill, Hernandez, Little Bonanza, Summit, Wall Street, and Knoxville. The output of the famous New Idria, New Guadalupe, and New Almaden mines again showed decreases, but the Oceanic and Helen mines were slightly more productive than in 1913, and the revived Oat Hill and St. John mines, working old material under new managers, made relatively large increases in yield. From present information the production of California will not immediately regain the average output of 21,361 flasks for the period 1902-1913.

Gold output of the state last year was $21,138,500.

Butte County

The Oroville Dredging Co. for the 15 months ended September 30, 1914, shows a profit of $154,000, and $16,000 brought forward from the previous term. Two 12c. dividends absorbed $152,000. Owing to trouble at the Pato property, Colombia, Central America, dividends were suspended for a time, but dredging has been started again. The cost of dredging there is 10.25 to 11.52c. per yard.

Calaveras County

The Oro Water, Light & Power Co. is constructing another dredge on the Mokelumne river, near Camanche, and it will be ready about March 1. The boat, with 6-cu. ft. buckets, was designed by C. G. Leeson, manager of the dredging department of the Company, and a description will be pulblished in the *Press* later on. The 9-ft. boat is averaging 150,000 cu. yd. per month. This was described in this journal of December 13, 1913.

Eldorado County

The old Big Sandy mine at Kelsey has been sampled by A. Crafton, recently in Mexico, and on his report depends whether it will be reopened.——The Rocky Bar gravel claims, on the middle fork of the Cosumnes river in the Mt. Pleasant district, are to be worked on a royalty basis by J. E. White, of Fort Wayne, Indiana, who has a bond from C. E. Wilbur and W. R. Kelly, of San Francisco.

Kern County

According to advice from El Paso, Texas, Phelps, Dodge & Co. has purchased the Pearl and Zenda gold mines in the Amalie district from Joseph Fauset and others of southern California, for between $75,000 and $100,000. A 10-stamp mill and cyanide plant are in working order.

In the news of December 26 it was stated that the Weringer copper mine at Woody had ore reserves amounting to 4000 tons. This really is the quantity on the dump, and sampling underground shows ore worth about $500,000. Cross-cuts from two shafts show wide shoots.

Mariposa County

At the Mountain King mine, in the Merced River cañon, eight miles above Bagby, a new 500-hp. water-power plant is being erected, and the 20-stamp mill is to be replaced by one with 60 head. Improvements will cost about $50,000. Fifty men are employed at the mine, and an equal number on construction. Alexander Hamilton is superintendent and Rudolph W. Van Norden, chief engineer.

Nevada County

From the Jerry Goodwin gravel mine the You Bet company is reported to be extracting rich gravel. There are 16 men employed.——Near Lake City the El Oro Mines Co. is sinking a shaft to open the blue gravel channel at 200 ft. Machinery has been ordered. Fred Phelps is manager.

Shasta County

Assessment work to the value of $4400 has been done on 44 asbestos claims on Mears creek, near Sims.——J. G. Barber, William R. Scott, George Gameble, E. M. Wilkinson, William Holland, E. C. Montgomery, James Bowe, and John Brown, all of San Francisco, have located 1160 acres of placer ground between Gas Point and Igo.——The Shasta Dredging Co. at Horsetown, near the places mentioned, has bonded several farms along Cottonwood creek.

Sierra County

(Special Correspondence.)—The Pacific mine, two miles south of here, has been bonded to the Greenwood Mining & Development Co. of San Francisco. The Pacific and St. Elmo,

the latter mine owned by the Greenwood company, is estimated to contain 2½ miles of lava-capped channel. A double track adit more than 2500 ft. long is to be started in the latter part of May. This adit will eventually reach a length of three miles. Electric locomotives of General Electric Co. make are to be installed after the channel is reached. F. T. Heacock of San Francisco is secretary of the Company, and L. Ferdinand Johnson is consulting engineer.

Table Rock, January 5.

(Special Correspondence.) An examination of the Gray Eagle mine, at Gold Point, was made last week by F. Love and W. H. Hooper of San Francisco, and a large amount of new work has been arranged. A six-foot vein of fair-grade ore was recently cut in a winze, and is being prospected. W. H. Arbuckle is superintendent.——'Pay' gravel has been opened in the Cold Spring mine, near Mount Vernon. The back channel was intersected by a 75-ft. rise from the 350-ft. adit, and considerable gold is present. The gravel is being stored on the dumps until sufficient water can be obtained for washing. ——The shoot of ore recently cut in the Keystone mine, near Sierra City, continues to improve. About two feet of the vein

MAP OF SIERRA COUNTY.

is said to average $10 to $50 per ton.——Work has been resumed at the Gold King mine by C. M. Weldon and associates. The property is in the Alleghany district, and produced rich ore 30 years ago.——The Sixteen-to-One mine is producing good ore, with considerable work progressing in the lower levels. Twenty men are now on the payroll.——An electric power-line is being completed to the Twenty-One mine, and erection of the small mill is making good progress. Crushing will start in the early spring.——The mill at the Kate Hardy mine, in the Forest district, is running steadily on good ore. A. D. Grant is superintendent.——The Brandy City and Neocene companies are operating their hydraulic mines with large crews, and the abundance of snow in the hills favors a long season.

Downieville, January 3.

Siskiyou County

The Gray Eagle mine at Oro Fino has been optioned to Seattle people. The shaft is to be unwatered.——The Oom Paul mill is to start when water is available. A. C. Renfrew is manager.——James Doyle, formerly with the Gladstone and Midas in Shasta county, is examining the McKeen mine near Callahan.——Cold weather has frozen up ditches and flumes in numerous Siskiyou county districts, and many mines are idle because of lack of water.

Tuolumne County

Lee Hamm, working on the Ida Kline claim near Sonora, recently panned $8000 in 10 days from a quartz formation.

COLORADO

Lake County (Leadville)

The mineral production of this district in 1914 is estimated by the *Carbonate Chronicle* as follows:

Ores	Tons
Lead carbonate	181,348
Galena	74,627
Zinc carbonate and sulphide	204,427
Iron	13,415
Silicious	28,800
Total	502,617

Metals:	
Gold, ounces	74,610
Silver, ounces	3,851,695
Lead, pounds	25,043,570
Copper, pounds	2,523,763
Spelter, pounds	79,398,172
Total value (9,040,359 in 1913)	$9,087,628

The output to date is valued at $415,538,688.

A vein of molybdenite is reported to have been cut in the Twin Lakes district.——The Western Mining Co., through its manager, S. D. Nicholson, gave each of the 250 employees a turkey for Christmas. A bill in equity has been filed against this Company and others for $6,252,000 damages, by R. E. Elder and F. E. Mann, executors of the will of G. W. Elder. The damages are for minerals and ore claimed to have been taken from the mines by the respondents during a period of years from 1899 to December 3, 1914, during which, it is charged, the lease was void.——The Yak Mining Co., at Christmas, presented each of over 125 employees with a postal savings bank book crediting his deposit with a sum of equal to 2% of his annual wages.

San Miguel County

It is reported that the Tomboy company has purchased the Revenue claims near Telluride.

Summit County

This county's branch of the Colorado Metal Mining Association has elected R. M. Henderson, W. H. Green, E. C. Sutton, G. H. Gibson, and O. K. Gayman to represent the county at the state convention held at Denver on January 11. Mine legislation and taxation, bureau of mines, school of mines, and state geologist were subjects to be discussed.

All dredges at Breckenridge save one, *Tonopah No. 3*, are stopped on account of the cold weather.

Teller County

The Portland company will pay 2c. per share on January 20, amounting to $60,000. The annual meeting will be held at Cheyenne on February 15.——Lessees at the Abe Lincoln mine are extracting a good tonnage of ore.——Allen L. Burris, president of the El Paso Consolidated company, has resigned. He has issued a report on the Company's condition and cause of his retirement, the latter being a question of policy. The equipment to replace that destroyed by fire should be ready for work on February 1.

IDAHO

Shoshone County (Coeur d'Alene)

The suit of Jonathan Bourne, Jr., and the Ontario Mining Co. *v.* the Stewart Mining Co., started before Judge John M. Flynn at Wallace on January 4. Extralateral rights are the issue, and a great array of legal talent and mining engineers are in attendance. The Stewart has admitted a trespass of 3353 sq. ft., leaving 3560 sq. ft. to be settled.——The Interstate-Callahan company is looking for a suitable site for the mill contemplated.

MISSOURI

Jasper County

A 350-ton mill is being erected for the Dog Mining Co. on the Sucker Flat area. The shaft is 152 ft. deep, and the 25% ore is opened by five drifts.

MONTANA

Fergus County

The Barnes-King company's December output was 5500 tons for $40,000.

Jefferson County

The Elkhorn adit of the Boston & Montana Development Co. is in about 1200 ft., and at 1170 ft., 15 to 18 in. of ore containing molybdenite is being opened. Other veins in the mine carry this mineral.

Silverbow County

The Great Falls refinery is operating again, producing copper on order for the Chicago, Milwaukee & St. Paul railroad for the electrification of its line. On account of an accident at the Leonard mine of the Anaconda, the Original will continue until the trouble is overcome, in about two weeks. Two diamond-drills of the Anaconda are boring to 200 ft. in the Butte-Duluth, the latter being under option to the former. Soft ground is hindering drilling.——At 2400 ft. in the Pilot-Butte 12 in. of 6% copper ore has been cut near the shaft.

NEVADA

Esmeralda County

The estimated production of the Goldfield Consolidated Mines in December is as follows: ore treated, 29,050 tons; gold yield, $359,239; operating expense, $186,000; net realization, $173,239. The output for the year was approximately 337,391 tons worth $2,093,820, with a profit of $1,829,159. The yield to date is 2,115,695 tons for ore valued at $63,773,003, and dividends $27,932,087.——On March 1 the Jumbo Extension company will distribute 5c. per share. The estimated yield in December was $125,000, leaving a profit of $100,000. Cash and ore in transit on January 1 was worth $220,000.

Humboldt County

Some specimen ore is being extracted from the National mine at National.——Gross receipts from the Seven Troughs Coalition mine in December were $55,000. Cash on hand amounts to $100,000, and a dividend, probably 5c. per share, or $70,000, will be paid on March 1.

Lincoln County

The total output of the Pioche district in 1914 was about 2200 cars of ore. The current year's production is expected to be much greater. Two new mills are proposed, one for the Amalgamated Pioche Mines & Smelting Co., and the other for the Yuba Leasing & Development Company.

Nye County

Five mines at Tonopah produced 10,282 tons of ore valued at $211,036 last week.——The Tonopah Mining Co. is to acquire the White Caps mine at Manhattan if it proves of sufficient value on examination.——As most of the miners at Tonogold have not enough capital to install hoists for deeper work, prospecting has been almost suspended for some time. The Arizona Leasing Co., W. J. Bathurst in charge, has cut 6 ft. of ore at 80 ft. Two inches of this assays $49.70 per ton.

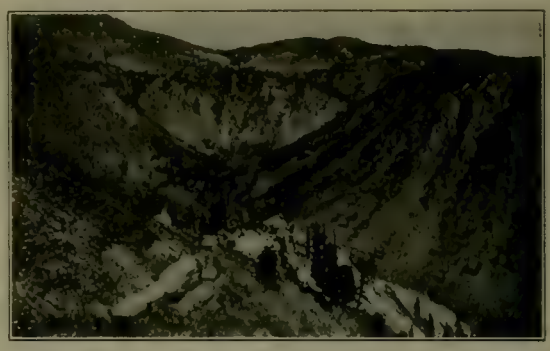
White Pine County

The Ely district is quiet, the Nevada Consolidated continuing on a 50% basis, and only a few lessees working, probably more than in the past. The Hayes claim, near Star Pointer, shipped a car of $40 gold-silver ore recently. Guy Gallagher sent out a car of $67 gold ore from Camp's claim in Heath cañon, Railroad valley, Nye county, and Peddler Bros. are extracting zinc ore, averaging 35% metal, from just above Lane City, near the Consolidated Coppermines property.

OREGON

Baker County

The Baker Mines Co.'s mine and mill, 18 miles west of Copperfield, on the Snake river, are described by Will C. Higgins in the December 30 issue of *The Salt Lake Mining Review*. The property is in precipitous and picturesque country. The Last Chance is the principal mine worked. It is one mile from, and 1700 ft. above the mill. The main adit is in to a vertical depth of 700 ft. A Bleichert aerial tramway, 5500 ft. long, carries ore from the portal to the mill. The prevailing rock is greenstone, and the two veins of oxide ore are four feet wide.



LAST CHANCE MINE OF THE BAKER MINING CO., AT CORNUCOPIA.

The 20-stamp mill contains also amalgamating plates, Dorr classifier, 30-ft. sand leaching vats, 30-ft. Dorr thickener, two 16 by 20-ft. Dorr agitators, two Moore thickeners, 20 and 30 ft. diameter, a Portland filter, and Merrill precipitation plant. John M. Baker is general manager.

Josephine County

According to G. T. Thrasher, of Phoenix, Jackson county, the placer districts of southern Oregon show increased activity, especially in the northern part of Josephine county. Gravel bars of many creeks are being sluiced.

SOUTH DAKOTA

Lawrence County

Shaft sinking has been started at the Echo mine at Maitland, A. J. Simmons being in charge. Men are employed erecting buildings, and the machinery to be installed includes a motor-driven hoist and air-compressor. New Hampshire people are interested in the Company.——At the Heidelberg, in Two Bit gulch, east of Deadwood, according to the manager, A. T. Ross, $12 ore has been opened 500 ft. across the gulch from the workings which have produced good ore.——Good progress is being made with construction of the Rattlesnake-Jack mill near Galena. C. S. Ruth is in charge.——Water has been drained from the Hidden Treasure shaft and cross-cutting is under way at 200 ft. Stewart Thompson is manager.

UTAH

In its issue of January 3, *The Salt Lake Tribune* devotes several pages to a detailed review of mining in the state in 1914. Including $6,962,003 paid in dividends last year, the total of all mines to date is $110,716,321. The Bingham district produced 8,077,856 tons of ore, against 9,190,374 tons in 1913. Judging by the growing inquiry regarding several districts, a revival of the mining industry is predicted.

Juab County

The Eagle & Blue Bell mine is producing about 2000 tons of ore per month. At 275 ft. from the shaft, at 1700 ft. depth, the shoot being mined at 1550 ft. has been cut.

PIUTE COUNTY

The potash and alunite deposits near Marysville are to be the scene of greater development this year. The Florence Mining Co., of Philadelphia, has let a contract for the extraction and haulage of 350 tons of alunite from its property to the D. & R. G. station at Marysville. The ore will be sent to Cincinnati, Ohio, for testing purposes.

SUMMIT COUNTY

The Snake Creek tunnel is in about 10,500 ft. The progress in December was only 296 ft., due to holidays and installing a new compressor. During 1914 the advance was 3751 ft. The face is now in diorite dipping south, with a course-grained calcite hanging wall.

WASHINGTON

Within a radius of 150 miles north and east of Spokane nearly $35,000,000 of metals was produced in 1914. The figures are as follows:

Coeur d'Alene (Idaho) mines	$24,130,900
Trail (B. C.) smelter	5,848,478
Grand Forks (B. C.) smelter	2,389,620
Greenwood (B. C.) smelter	910,895
Sundry mines of Washington, northern Idaho, and British Columbia (estimated)	1,250,000
	$34,529,893

Smelter productions are official from the managements of the three companies. The Coeur d'Alene output is based on figures by Stanly A. Easton, manager of the Bunker Hill & Sullivan company, and by Frederick Burbidge.

CANADA

BRITISH COLUMBIA

Rossland mines in December shipped 27,012 tons to the smelters, an increase of 2527 tons over November.

At 900 ft. below the surface, and 1200 ft. from the portal of the adit, over 10 ft. of ore assaying $39 per ton gold and 75c silver has been cut in the Argo mine. This property is in Greenwood and near the British Columbia Copper smelter.

At Surf Inlet, the Tonopah Belmont company, with F. W. Holler in charge, continues considerable development. This will cost $150,000 up to July of this year, when the option expires. About 50 men are employed. Adits have proved over 200,000 tons of $8 ore. If the mine is bought, the Company will erect a hydro-electric plant and a 500-ton mill.

ONTARIO

At Porcupine the Hollinger produced 18,645 tons of $13.22 ore during the period ended December 2, with a profit of $152,664. Costs were $3.40 per ton. Bonuses paid to employees during 1914 amounted to nearly $12,000.——Plans are being prepared by J. Houston, manager of the Schumacher, for a 50-ton mill to be constructed in the spring.——Faulting displaced the Porcupine Crown vein 50 ft. at the 500-ft. level, but driving has opened ore equal to that in the upper levels. Work for the current year includes shaft-sinking to 800 ft. and a winze on the vein below 500 ft. Broken ore at 200 and 300 ft. amounts to about 25,000 tons. The mill treated 125 tons per day in December. The average monthly output last year was $50,000.

At Cobalt the Nipissing high and low-grade mills treated 175 and 6919 tons of ore, respectively, in December, yielding silver worth $204,034. Bullion shipped was worth $535,864. Mine development was satisfactory.

COLOMBIA

The Pato dredge recovered $62,500 from 60,500 cu. yd. during the two weeks ended December 8.

A cablegram from the American consulate at Barranquilla states that the commercial situation is slightly better, financial situation unchanged, exports normal, and many unemployed.

KOREA

The Oriental Consolidated company's output in October was $110,450, from 21,505 tons of ore. The net profit above operating, development, and improvements was $56,871. The Tabowie 80-stamp mill was hung up 10 days on account of general repairs, the Kuk San Dong 40-stamp mill was closed for the full month through a shortage of ore, and the East Candlestick 10-stamp mill was down 13 days for the same reason. The output in November was $151,425 from 28,056 tons, and in December $148,216.

The Seoul Mining Co., operating the Suan concession in Whang Hai province, reports the following results for December 1914:

Stamps working	40
Time, days	28
Ore crushed, tons	6,320
Total recovery	$82,400
Operating expenses	26,000
Net earnings	56,400

The 2000-kw. steam-turbine electric generating plant, erected by the Company at tidewater, 52 miles from the mine, has been completed, and commencing with January 7 the mill and mine plant will be operated by electricity instead of by steam as heretofore. A reduction in operating costs is anticipated.

JAPAN

(Special Correspondence.)—The most disastrous coal mine explosion in the history of Japanese mining occurred at the Shin-Yubari mine, Hokkaido, November 28. The total number killed was 422, including a number of engineers, assistant engineers, and foremen. The colliery includes two mines, the explosion being in the Wakanabe, which is in a Tertiary coal and is opened by an adit 6000 ft. long, and a slope 2000 ft. long at 10° dip. The explosion occurred in an entry off this slope and wrecked the workings throughout. The compressor house at the entrance to the slope was burned, and men repairing brickwork in the incline were blown to the surface and into unrecognizable fragments. Of the dead, 166 bodies were recovered before December 3, when all entrances to the mine were closed and water from the river turned into the lower workings to drown the fire which followed the explosion. The latter is believed to have been caused by fire damp.

Tokyo, December 15.

MEXICO

SONORA

Six inches of rain fell at Nacozari during the third week in December, this being about equal to the annual precipitation in that district. Considerable damage was done to the railway and property of the Moctezuma Copper Company.

NACOZARI AS SEEN FROM MOCTEZUMA MILL, SHOWING TIMBER YARD OF THE COMPANY, ROUNDHOUSE OF THE NACOZARI RAILROAD, AND THE POWER HOUSE.

PERSONAL

J. D. Irving is at Butte, Montana.

J. W. Neill was in San Francisco this week.

Robert Nye was in San Francisco this week.

M. K. Rodgers was in San Francisco Wednesday.

C. M. Eye has been down to Manila from Benguet.

Robert Stichr has been at Long Beach, California.

Arthur Gibson has returned from Sonora, California.

W. E. Saunders passed through San Francisco this week.

C. W. Purington was in New York last week and has gone to Boston.

Ernest Levy, general manager of the Le Roi No. 2, British Columbia, left for England on January 9.

W. W. Johnson, of the Union Construction Co., was in New York last week and has returned to San Francisco.

J. C. Pickering, formerly of the Ernestine Mining Co., at Mogollon, New Mexico, is now at San Remo hotel, New York.

E. Gybbon Spilsbury has returned to New York from Arizona, his plans for work having been interfered with by floods in the desert.

Wakamatsu Yokoyama passed through San Francisco, on his way to Boston, where he will take up special studies at the Massachusetts Institute of Technology.

C. G. Leeson, formerly manager of the dredging department of the Oro Water, Light & Power Co. has been made manager of both the Oroville and Mokelumne divisions and the New York machine shop.

A complimentary dinner was given to F. G. Cottrell at Hotel Plaza, New York, on January 15, by the American Institute of Mining Engineers, American Electro-Chemical Society, and Mining and Metallurgical Society of America.

Officers for 1915 for the San Francisco section of the A. I. M. E. elected last Monday evening were as follows: chairman, G. H. Clevenger; vice chairman, C. W. Merrill; secretary-treasurer, J. C. Ray; additional members of the executive committee, F. W. Bradley, A. C. Lawson.

A. E. Drucker has gone to Colombia to superintend construction and starting of a 30-stamp mill for the Frontino & Bolivia G. M. Co., Ltd. The stamps will be followed by leaching and a counter-current decantation slime-plant on the Dorr system. It is expected that the work will occupy nine months.

Frederick Laist has been made metallurgical manager for the A. C. M. Co. at Great Falls and Anaconda. He will have general supervision of construction and technical affairs. The local operations and business at the plants will be in charge of C. W. Goodale and E. P. Mathewson as heretofore. L. V. Bender becomes general superintendent at the Washoe plant, with Harry S. Ware as assistant.

Schools and Societies

The Institution of Mining and Metallurgy held the first general meeting of the 24th session in London on November 19. The paper, 'Persistence of Ore in Depth,' by T. A. Rickard, was discussed.

The University of California announces a series of lectures on mining and ore treatment in lieu of the course, Mining 102. The following will be the lecturers: H. Foster Bain, J. A. Burgess, F. G. Cottrell, Lindsay Duncan, William Durbrow, James M. Hyde, R. A. Kinzie, F. C. Lincoln, C. W. Merrill, Fred Searls, Jr., Whitman Symmes, C. E. van Barneveld, and George J. Young.

MINERAL STATISTICS

GOLD AND SILVER

Preliminary estimates by the Mint and U. S. Geological Survey as to the production of gold and silver in the United States during 1914 are as follows:

State or territory.	Gold, fine oz.	Value.	Silver, fine oz.
Alabama	590	$ 12,200	100
Alaska	766,744	15,850,000	398,500
Arizona	218,113	4,508,800	4,306,600
California	1,037,537	21,447,800	1,744,500
Colorado	961,748	19,881,100	8,612,900
Georgia	552	11,400	100
Idaho	51,568	1,066,000	12,689,500
Illinois	.....	.....	1,800
Michigan	.....	.....	404,500
Missouri	.....	.....	60,000
Montana	190,361	3,935,100	10,746,000
Nevada	532,309	11,003,800	14,814,200
New Mexico	58,418	1,207,600	1,682,100
North Carolina	5,752	118,900	1,300
Oregon	77,134	1,594,500	126,700
South Carolina	295	6,100	100
South Dakota	353,621	7,310,000	180,500
Tennessee	285	5,900	95,400
Texas	498	10,300	601,000
Utah	153,842	3,180,200	11,397,500
Virginia	48	1,000	1,000
Washington	29,383	607,400	54,100
Wyoming	106	2,200	100
Philippine Islands	51,282	1,060,100	9,700
Porto Rico	150	3,100	1,500
Total	4,490,336	$92,823,500	67,929,700

In 1913 the gold output was valued at $88,884,400, and silver 68,801,500 ounces.

IRON ORE

The quantity of iron ore mined in the United States in 1914 is estimated to have been between 41,000,000 and 42,500,000 long tons, and the quantity shipped from the mines to receiving ports and iron manufacturing centres between 39,500,000 and 41,000,000 tons, according to E. F. Burchard, of the Survey. These estimates are based on reports from 52 of the important iron mining companies which represent the principal iron producing districts, and whose combined output in 1913 was more than 90% of the total tonnage of iron ore mined in that year.

In the Lake Superior district, where about 85% of the domestic iron ore is mined, the average decrease in production was about 37%, thus indicating a total production for that district of about 32,915,000 tons in 1914, compared with 52,518,158 tons mined in 1913. The shipments of ore from this district apparently decreased about 34%, and accordingly the shipments should approximate 32,790,000 tons in 1914, compared with 50,168,134 tons in 1913.

According to the preliminary reports, stocks of iron ore at the mines apparently increased more than 500,000 tons during 1914, so that the total stocks at the close of 1914 should range between 13,400,000 and 13,500,000 tons, compared with 12,918,633 tons on hand at the close of 1913.

Officials of the iron mining companies are almost unanimous in reporting great depression of trade during 1914. Prices generally were 50 to 75c. per ton lower than in 1913, as low as or lower than those of 1912 and 1905.

THE MARKET PLACE

Weekly Summary of Prices of Shares and Metals

Metal Prices

San Francisco, January 14

Antimony	15 — 15¾
Electrolytic copper	13½ — 13¾
Pig lead	3.95 — 4.00
Quicksilver (flask)	$50.00
Spelter	7 — 7¼
Tin	34½ — 36
Zinc dust, 100-kg. zinc-lined cases	9

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, January 14.—Copper is firm, lead quiet, and spelter strong.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Jan.	7	Dec. 2	12.62
"	8	" 9	12.73
"	9	" 16	12.70
"	10 Sunday	" 23	12.84
"	11	" 30	12.75
"	12	Jan. 6	12.92
"	13	" 13	13.30

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	16 54	14.21	July	14.21	13 26
Feb.	14.93	14.46	Aug.	15.42	12.34
Mch.	14.72	14.11	Sept.	16.23	12.02
Apr.	15.22	14.19	Oct.	16.31	11.10
May	15.42	13.97	Nov.	15.08	11.75
June	14.71	13.60	Dec.	14.25	12.75

The copper market was weak, but a large amount of business resulted in a slight advance. Exports during the week ended January 2 were 12,051,892 lb. The Anaconda company's yield in 1914 was 225,645,000 lb., and Calumet & Arizona, 52,770,000 pounds.

It has been computed that only nine of the principal American copper companies are paying dividends under present conditions. These are Anaconda, Calumet & Arizona, Chino, Old Dominion, Phelps, Dodge & Co., Quincy, Tennessee, Utah Copper, and Wolverine.

According to a 'Daily Consular Report' from Yokohama, Japan, dated November 3, the condition of the copper market is worse than ever, with no prospect of relief. Latest press quotations for electrolytic copper are 29 50 yen per picul (11c. per lb.), and 98% quality at about 28 yen (10.46c. per lb.), but these quotations are nominal, as there are no buyers. The leading mine owners have hitherto exported their output, the home market being supplied by the smaller mines. The suspension of exports, however, has confined the large operators to the home market, which they have congested with enormous stocks. In the consequent slump the price has fallen so low that it does not cover cost of production. A proposal is therefore afoot among mine owners to cease smelting until the congestion is relieved.

COPPER PRODUCERS' ASSOCIATION

This Association, which, up to the commencement of the war, collected and published monthly statistics on the copper situation, voted to go out of existence on January 13.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Jan.	7	Dec. 2	3.80
"	8	" 9	3.80
"	9	" 16	3.80
"	10 Sunday	" 23	3.80
"	11	" 30	3.80
"	12	Jan. 6	3.80
"	13	" 13	3.70

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	4.28	4.11	July	4.35	3.80
Feb.	4.33	4.02	Aug.	4 60	3.86
Mch.	4.32	3.94	Sept.	4.70	3.82
Apr.	4.36	3.86	Oct.	4.37	3.60
May	4.34	3.90	Nov.	4.16	3 68
June	4.33	3.90	Dec.	4 02	3.80

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below.

Week ending			
Dec.	17	Dec. 31	52.50
"	24	Jan. 7	51.50
		" 14	50.00

Monthly averages.

	1913.	1914		1913.	1914
Jan.	39 37	39.25	July	41.00	37.50
Feb.	41.00	39.00	Aug	40.50	80.00
Mar.	40.20	39 00	Sept.	39.70	76.25
Apr.	41.00	38.90	Oct.	39.37	53.00
May	40.25	39.00	Nov.	39.40	55.00
June	41.00	38 60	Dec	40.00	53.10

The price in England is £11, or $52 50 per flask.

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound

Date.		Average week ending	
Jan.	7	Dec. 2	5.20
"	8	" 9	5.50
"	9	" 16	5.50
"	10 Sunday	" 23	5.37
"	11	" 30	5.40
"	12	Jan. 6	5.50
"	13	" 13	5.85

Monthly averages.

	1913.	1914		1913.	1914.
Jan.	6.88	5 14	July	5.11	4.75
Feb.	6 13	5.22	Aug.	5.51	4.45
Mch.	5.94	5.12	Sept.	5 55	5.16
Apr.	5.52	4.98	Oct.	5.22	4.75
May	5.23	4.91	Nov.	5.09	5.01
June	5.00	4.84	Dec.	5.07	5.40

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.		Average week ending	
Jan.	7	Dec. 2	49.33
"	8	" 9	49.91
"	9	" 16	49.83
"	10 Sunday	" 23	48.66
"	11	" 30	48.65
"	12	Jan. 6	48.65
"	13	" 13	48 98

Monthly averages.

	1913	1914.		1913.	1914
Jan.	63.01	57.58	July	58.70	54.90
Feb.	61.25	57.53	Aug.	59 32	54.35
Mch.	57.87	58.01	Sept.	60.53	53.75
Apr.	59.26	58 52	Oct.	60.88	51.12
May	60.21	58.21	Nov.	58.76	49.12
June	59.03	56.43	Dec.	57.73	49.27

Silver production of the United States in 1914 is estimated at 67,929,700 oz. The steamer 'Mongolia' took silver worth $158,142 (320,000 oz.) to China on January 9. In December the Nipissing company of Cobalt exported 1,093,510 oz. to England, this being mine and custom ore products stored. While somewhat sensitive, the market is fairly steady.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	50.45	37.85	July	40.70	31.60
Feb.	49.07	39.76	Aug.	41.75	50.20
Mch.	46.95	38.10	Sept.	42.45	33 10
Apr.	49.00	36.10	Oct.	40.61	30.40
May	49 10	33.29	Nov.	39.77	33.51
June	45.10	30.72	Dec.	37.57	33.60

There is little of importance to note with regard to this metal, prices being steady at about 33.50 cents.

METAL PRICES IN GERMANY

The following prices were fixed by the German government on December 14: best quality copper, 21.45c.; aluminum, 34.93c.; antimony, 16.11c.; tin, 51c.; and nickel, 49c. per pound.

Platinum in England is £9 5s., or $44.40 per ounce., and bismuth, 10s., or $2.40 per pound.

COMPANY REPORTS

MT. ELLIOTT COPPER COMPANY, LTD.

This Company operates in Queensland, Australia, and the report covers the year ended June 30, 1914. Smelter returns were as follows:

Details of operation.	1914.	1913.
Ore treated, tons	37,875	41,633
Copper produced, pounds	8,762,880	10,373,440
Gold, ounces	6,266	8,757
Silver, ounces	8,251	7,285
Net profit	$259,000	$682,000

A dividend of $1.20 per share absorbed $178,000. The surplus was $1,052,000. Ore reserves are estimated at 33,750 tons of 11%, and 500,000 tons of 3% ore. A concentrating plant is needed for the latter grade. A consolidation of certain properties in the district has been accomplished, and a central smelter is proposed.

ST. JOHN DEL REY MINING COMPANY, LTD.

The report of this Brazilian company is for the half-year ended August 31, 1914. The mill treated 95,000 tons of ore yielding gold and silver worth £225,514 in London. All charges totaled £154,064, or $8.44 per ton, leaving £60,074. Dividends amounted to £25,900. Investments of the Company in English and Argentine railways are valued at £96,472.

The superintendent, G. Chalmers, stated that all mine entries and machinery were in good condition. The Sirocco fan gave more air as the result of increased speed and removal of obstructions in the air-ways. There were 180 accidents, four of which were fatal. There were 36 accidents among these due to blistering rock, two being fatal. On horizon 18 the lode has been opened a total of 1150 ft. Horizons 13 to 18 produced 97.34% of the ore. Filling put into the mine totaled 68,622 tons. Sorting rejected 1.75%. Labor is abundant owing to the Brazilian government failing to raise a loan, and also the European war. The Chalmers & Williams tube-mills did well, but the shallow fluted liners in one mill are not as efficient as the Morro Velho design in the other mill. Hadfield steel is the most durable yet tried. The Burt filter is receiving a thorough test. The tramway, electric power plants, transport department, hotel, and medical department all gave satisfactory results. Stores on hand are worth £90,000.

CHAMPION REEF GOLD MINING CO. OF INDIA, LTD.

'Persistence of Ore at Kolar,' India, was the title of an article in the *Press* of December 19, by T. A. Rickard. From the longitudinal section of the mines there, the underground work of the Champion Reef will be understood better. Since 1892 this great property has produced 3,396,119 tons, yielding £11,147,537, and £4,157,633 in dividends. During the year ended September 30 1914, the period covered by his report, the output was 216,934 tons for £527,590, of which £138,667 was paid in dividends, or 53⅓ per cent.

The superintendent, Henry J. Gifford, reported as follows: There were 142 Europeans, 103 Eurasians, and 6384 natives employed. Development totaled 17,334 ft. Garland's shaft was sunk to 4461 ft. On No. 45 level of Glen shaft, the drift opened 2 ft. of $45 ore for 207 ft. The circular shaft should be completed early in 1915. Shaft repair has been generally heavy as usual. Pumping was not so heavy on account of only 21.94 in. of rain, 13.85 in. less than in 1912-13. Mine ventilation was improved. Ore reserves are estimated as 477,384 tons, an increase of 73,259 tons.

Out of 255,943 tons mined, 39,009 tons was sorted as waste, leaving 216,934 tons for the stamp-mill, an average of 141.6 stamps working. Amalgamation recovered 97,989 oz. fine gold. The extraction was 77.22%. The tube-mill plant has started work. The sand and slime plants treated 181,063 and 51,872 tons of new and old material, assaying $2.76 and $1.76 per ton, with 62.6 and 88.3% recovery, respectively. No. 2 cyanide plant treated 101,559 tons of old sand and slime, averaging $2.72 per ton, with 47.9% recovery. The total gold saved in all plants was 124,497 oz., or $11.45 per ton of ore milled.

The report also contains a great deal of information on the mine, mills, and equipment. It may be mentioned that air-blasts were less frequent than formerly.

THE CONSOLIDATED MINING & SMELTING COMPANY OF CANADA, LTD.

This British Columbia company is one of the most important in Canada, and the report covers the year ended September 30, 1914. The general manager, R. H. Stewart, reported as follows:

Conditions at the 12 mines operated, generally speaking, have been satisfactory, with a prospect for increased tonnage had it not been for the closing of a number of properties owing to the unsettled state of metal markets. Heavy accumulations of refined metals have been made, which may have to be held for a time, or until the markets resume more

ELECTROLYTIC LEAD REFINERY, TRAIL SMELTER, B. C.

normal conditions. The net profit for the year was $474,012, after writing off $193,150 for depreciation and charging to profit and loss $492,466 spent during the period in mine development. Four dividends, totaling $464,376, or 8% on the capital, were paid, leaving $9636 for the current year.

Development amounted to 33,146 ft. of general work, and 28,897 ft. of diamond-drilling. The mines at Rossland continue to show an increase in the amount of ore available, the greater part being due to ore developed in the Le Roi. The Sullivan claims at Kimberley show a large quantity of complex zinc-lead ore, some of which can be shipped and smelted for lead, while the zinc portion, worth $20 per ton, is not available. Several new properties were purchased.

The smelter at Trail treated 374,771 tons of mixed ores, yielding 129,083 oz. gold, 2,568,301 oz. silver, 34,617,318 lb. lead, and 3,645,997 lb. copper, worth $6,000,662. Contributing mines were as follows: Copper-gold-silver ore: Centre Star, 172,379; Silver King, 16,031; and Le Roi, 80,499 tons. Lead-silver ore: Sullivan, 30,919; St. Eugene, 1217; Molly Gibson, 7; No. 1, 5790; Highland, 1346; Maestro, 262; Richmond-Eureka, 541; Lucky Thought, 36; and Ottawa, 342 tons. The tonnage smelted showed an increase in the average per month over the last financial year of about 4090 tons. Improvements to the plant were published in this journal of January 9. Like the Granby Consolidated and British Columbia Copper companies, this Company's work is of great importance.

RECENT PUBLICATIONS

THE GEOLOGIC TERRANES OF IOWA. By Charles Keyes. Chart. Des Moines, Iowa. 1914.

THE PHYSICAL GEOGRAPHY OF WISCONSIN. By Lawrence Martin. Reprint from the *Journal of Geography*. P. 7. Illustrated. University of Wisconsin.

ECONOMIC GEOLOGY OF THE BELGIAN CONGO, CENTRAL AFRICA. By Sydney H. Ball and Millard K. Shaler. Reprint from *Economic Geology*. P. 59. Illustrated.

GEOLOGIC PROCESSES AND GEOGRAPHIC PRODUCTS IN ARID REGIONS. Syllabus of a course of lectures at the New Mexico State School of Mines by Charles Keyes. P. 15. Socorro, 1914.

PRODUCTION OF COAL AND COKE IN CANADA IN 1913. Compiled by John McLeish. P. 40. Department of Mines. Ottawa, 1914. The output in 1913 was 15,012,178 tons averaging $2.49 per ton.

ANNUAL REPORT of the Secretary of Commerce, William C. Redfield, for the year ended June 30, 1914, and conditions up to October 13, 1914. P. 210. Ill., index. Washington, D. C., 1914.

The *California Journal of Technology*, Vol. 18, No. 1, November 1914. P. 56. Illustrated. Owing to the business depression, the Associated Technical Students of the University of California have decided to suspend publication of this journal.

THE ELECTRIC FURNACE IN METALLURGICAL WORK. By Dorsey A. Lyon, Robert M. Keeney, and Joseph F. Cullen. *Bulletin* 77. P. 216. Ill., index. U. S. Bureau of Mines, Washington, D. C., 1914. Abstracts from this valuable discussion will be made in the *Press*.

PROLONGING THE LIFE OF CROSS-TIES. By Howard F. Weiss. *Bulletin* 118. P. 51. Illustrated. U. S. Department of Agriculture. Forest Service. Washington, D. C., 1912. The preservation of railroad ties is very important, and is thoroughly discussed in this report.

BIENNIAL REPORT of the State Inspector of Mines of Nevada, Edward Ryan, for the year ended November 30, 1914, with a summary review of the report of 1913. P. 52. Carson City, 1914. A review of this report appears in 'The Mining Summary' of this issue.

ANNUAL REPORT of the Director of the Mint, George E. Roberts, for the fiscal year ended June 30, 1914. Also a report on the production of the precious metals in the calendar year 1913. P. 281. Ill., index. Washington, D. C., 1914. This is a valuable and interesting compilation on the work of the mint, gold and silver output of the world, specie movements, monetary statistics, and many other subjects, from which abstracts will be made from time to time.

University of California publications, Berkeley, 1914:

A PROBOSCIDEAN TOOTH FROM THE TRUCKEE BEDS OF WESTERN NEVADA. By John P. Buwalda. P. 4. Illustrated.

NEW MOLLUSCAN SPECIES FROM THE MARTINEZ EOCENE OF SOUTHERN CALIFORNIA. By Roy E. Dickerson. P. 6. Illustrated.

THE OCCURRENCE OF TERTIARY MAMMALIAN REMAINS IN NORTHEASTERN NEVADA. By John C. Merriam. P. 7. Illustrated.

THE MARTINEZ EOCENE AND ASSOCIATED FORMATIONS AT ROCK CREEK ON THE WESTERN BORDER OF THE MOHAVE DESERT AREA. By Roy E. Dickerson. P. 10. Illustrated.

NOTES ON THE COPPER ORES AT ELY, NEVADA. By Alfred R. Whitman. P. 10. Illustrated. This is an interesting discussion, and abstracts have been made for other issues of the *Press*.

THE MARTINEZ AND TEJON EOCENE AND ASSOCIATED FORMATIONS OF THE SANTA ANA MOUNTAINS (California). By Roy E. Dickerson. P. 18. Two plates and map.

U. S. Geological Survey papers, Washington, D. C., 1914

THE ELLISTON PHOSPHATE FIELD, MONTANA. By R. W. Stone and C. A. Bonine. *Bulletin* 580-N. P. 11. Map.

THE RUTILE DEPOSITS OF THE EASTERN UNITED STATES. By Thomas L. Watson. *Bulletin* 580-O. P. 28. Illustrated.

THE MONTANA GROUP OF NORTHWESTERN MONTANA. By Eugene Stebinger. *Professional Paper* 90-G. P. 8. Illustrated.

THE MOORCROFT OIL FIELD, AND THE BIG MUDDY DOME, WYOMING. Papers by V. H. Barnett. Bulletin 581-C. P. 35. Maps.

A RECONNAISSANCE IN THE CANYON RANGE, WEST-CENTRAL UTAH. By G. F. Loughlin. *Professional Paper* 90-F. P. 10. Illustrated.

PROFILE SURVEYS IN SNAKE RIVER BASIN, IDAHO. Prepared under the direction of R. B. Marshall, chief geographer. P. 12. 37 maps.

THE ROCHESTER MINING DISTRICT, NEVADA. By Frank C. Schrader. *Bulletin* 580-M. P. 58. Map, illustrated. A review of this report appears in 'The Mining Summary' of this issue.

RESULTS OF SPIRIT LEVELING IN VIRGINIA, 1910 TO 1913, INCLUSIVE. Part of work since 1907 done in co-operation with Virginia Geological Survey, T. L. Watson, state geologist. *Bulletin* 562. P. 68. Illustrated.

CONTRIBUTIONS TO ECONOMIC GEOLOGY, 1912. Short papers and preliminary reports. Part II.—Mineral Fuels. Marius R. Campbell, geologist in charge. *Bulletin* 541. P. 532. Maps, charts, index. Twenty geologists contributed to this bulletin.

RESULTS OF SPIRIT LEVELING IN HAWAII, 1910 TO 1913, INCLUSIVE. R. B. Marshall, chief geographer. Work done in co-operation with the territory of Hawaii, Marston Campbell, superintendent of public works. *Bulletin* 561. P. 42. Illustrated.

MINERAL PRODUCTS OF THE UNITED STATES. Review of conditions and output in 1912 and 1913. By Edward W. Parker. Also a summary of mineral production in 1913, compiled by W. T. Thorn. Advance chapter from 'Mineral Resources of the United States, 1913.' P. 169, and one chart.

A DEEP WELL AT CHARLESTON, SOUTH CAROLINA. By Lloyd William Stephenson. With a report on the mineralogy of the water by Chase Palmer. *Professional Paper* 90-H. Shorter contributions to 'General Geology, 1914-H.' P. 26. Illustrated. This well was sunk 2001 ft., and furnished valuable geological data.

THE GLACIER NATIONAL PARK. A popular guide to its geology and scenery. By Marius R. Campbell. *Bulletin* 600. P. 54. Ill., map. This beautiful park is in the Rocky Mountains in Teton and Flathead counties, Montana, just south of the Canadian line. It is now becoming a popular resort. The scenery is extremely fascinating.

Water Supply Papers:

HUDSON BAY AND UPPER MISSISSIPPI RIVER DRAINAGE BASINS. Compiled by B. D. Wood. No. 340-E. P. 26.

COLORADO RIVER BASIN. By Robert Follansbee, E. A. Porter, and H. D. Padgett. No. 329. P. 238. Ill., index.

MISSOURI RIVER BASIN. By W. A. Lamb, Robert Follansbee, and H. D. Padgett. No. 326. P. 375. Ill., index.

STREAM-GAGING STATIONS AND PUBLICATIONS RELATING TO WATER RESOURCES, 1885-1913. St. Lawrence River basin. Compiled by B. D. Wood. No. 340-D. P. 30.

GEOLOGY AND UNDERGROUND WATERS OF THE SOUTHEASTERN PART OF THE TEXAS COASTAL PLAIN. By Alexander Deussen. No. 335. P. 365. Ill., maps, charts, index.

DESCHUTES RIVER, OREGON, AND ITS UTILIZATION. By F. F. Henshaw, John H. Lewis, and E. J. McCaustland. Prepared in co-operation with the state of Oregon, John H. Lewis, state engineer. No. 344. P. 200. Ill., plans, 17 maps, index.

New Machines and Devices

An Automatic Aerial Tramway for Carrying Ore

In the state of Durango, a short distance to the west of the city of Durango, there is a large mining district, which is separated from the city of Durango, and consequently from the railroad, by the high range of the Sierra Madre mountains. It is, therefore, almost impossible to get heavy machinery into this district from this side. To the west the country is also mountainous, but not so difficult of passage. Consequently, most of the heavy freight for this district is taken overland about a hundred miles from Mazatlan, which is a port of call for most of the Pacific coast steamers, as well as a station on the extension of the Southern Pacific railway. Even over this route all machinery must be sectionalized so that it may be handled easily by means of pack-mules.

TRANSPORTING A TRAMWAY THROUGH MOUNTAINS OF DURANGO.

The San Luis Mining Co., operating mines near San Dimas, has installed an aerial tramway to transport ore from the mine to the mill. This tramway was furnished by the A. Leschen & Sons Rope Co. of St. Louis, Missouri. The distance between the tunnel mouth and the mill is 2800 metres, and the fall in this distance 526 metres. The capacity required was 10 tons per hour, and this was secured by using 36 carriers, each having a capacity of 6 cu. ft. of material. A 25-mm. diameter patent flattened strand steel rope is used for the loaded carriers to travel over, and a 22-mm. diameter rope of the same type for the returning empty carriers. A 16-mm. rope of the same construction is used as the traveling rope to which the carriers are attached and which runs at a speed of 91 metres per minute. The tramway operates by gravity and is controlled by means of band brakes. The ore being carried down serves as the lifting force for the return of freight. The country over which the tramway is built is exceedingly rough, there being many sharp pinnacles and deep gulches with steep slopes.

The rope and machinery for this tramway was shipped by water to Mazatlan and from there carried overland to the mine. The machinery was all sectionalized so that no piece weighed over 135 kg., and very few pieces over 70 kg. The rope was shipped in single lengths between the tension points. In this case it was necessary to erect but one intermediate tension station, and the 25-mm. and the 22-mm. rope were each shipped in two lengths about 1200 and 1500 metres in length. These ropes were coiled in such a manner that one mule would carry two coils, there being then a length of about 5 metres to the next mule, and then again two coils, and so on. This method of transporting the rope is clearly shown in the illustration. Since timber is very expensive in this region a large part of the construction work consists of masonry. This includes not only the bins and terminal structures; even some of the towers were built of masonry. Notwithstanding the extremely rough nature of the country over which the tramway was built, construction work went forward with great rapidity, and the tramway was soon in operation. A distinguishing feature of this style of tramway is that but one man is required for operation, he being stationed at the upper or loading terminal. At the discharge end the operation is entirely automatic.

Commercial Paragraphs

THE AIR MOISTENER CO., Chicago, Ill., is distributing a small pamphlet entitled 'The Steamo Air Moistener.' The device is automatic, noiseless, and is claimed to bring about a reduction in the amount of fuel used.

THE BUED HIGH COMPRESSION RING CO., Rockford, Ill., has published a directory of piston ring sizes. The rings are made of a special mixture of the best gray iron, are elastic, will withstand heat, and will glaze to a glass-like smoothness.

CHICAGO PNEUMATIC TOOL CO., Chicago, Ill., in a recent publication, Bulletin No. 24-K, describes the 'Chicago Pneumatic' fuel oil engine driven compressor class N-SO. This machine has many new features and is made in both stationary and portable types.

MESTA MACHINE CO., Pittsburgh, Pa., has distributed a bulletin devoted to the Mesta automatic plate valves. The valves are especially designed to meet the requirements of blowing engines and compressors, and are equally well adapted to the requirements of high and low speed engines.

THE MERRILL METALLURGICAL CO., San Francisco, has recently secured a large contract for Merrill automatic sluicing slime filters from the Aurora Consolidated Mines Co., of Aurora, Nevada. The equipment will include three 124-frame 3 by 4 by 2½-in. filters of the most improved design, and will have a minimum capacity of 500 tons of slime per day.

Danish Tube-Mill Pebbles and Substitutes—By Jay A. Carpenter, page 139

MINING PRESS

Volume 110, No. 4
Issued Every Saturday
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SAN FRANCISCO, JANUARY 23, 1915

Contents—Page 4
Buyers' Directory—Page 26
Advertisers' Index—Last Page

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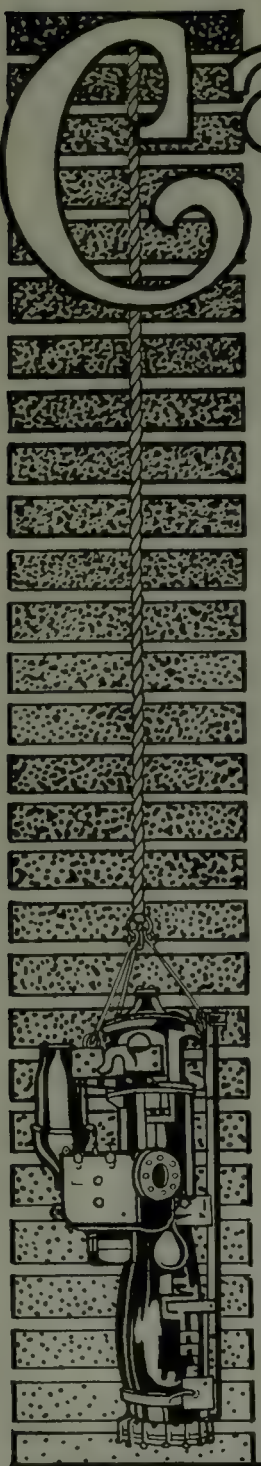

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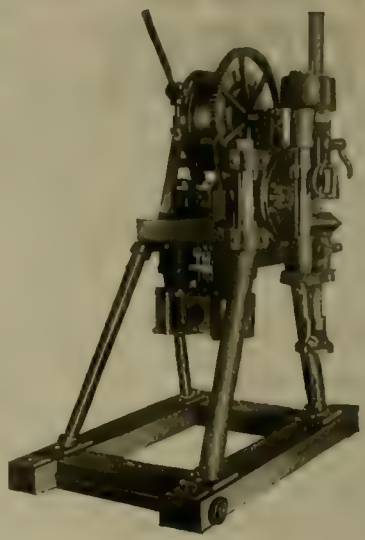

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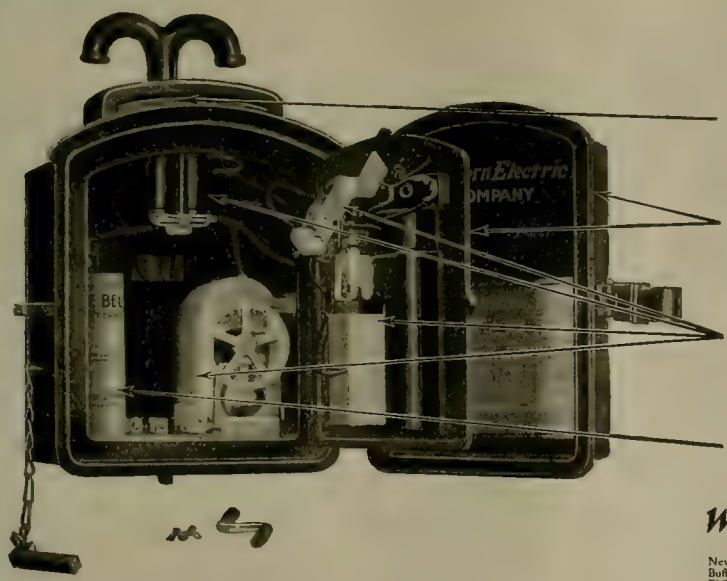

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VOL. 110 SAN FRANCISCO, JANUARY 23, 1915 NO. 4

TABLE OF CONTENTS

EDITORIAL Page.

Notes 129
Reconstruction in Mexico 130
The Copper Producers' Association 131

ARTICLES

CALIFORNIA PETROLEUM IN 1914.
By R. P. McLaughlin 132
The California production in 1914 was greater than that of any previous year, and represented about 40% of the total output of the United States. Mr. McLaughlin analyzes the California production in this article and shows many details regarding the status of the industry in the different oilfields of the state.

ELECTRIC MINE LOCOMOTIVES.
By E. B. Wagner 134
The electric mine locomotive has found a wide application in the field of mining and the allied industries, and details of its construction and operation are presented.

ORE TREATMENT AT CRIPPLE CREEK: A REVIEW.
By P. Henry Argall 135
A review of the metallurgical conditions existing in Cripple Creek district at the close of the past year prove that the metallurgical problems which have been presented by the sulpho-telluride ores have been successfully solved. Ores assaying from $2.50 to $4 are now being profitably treated. The history of the progress which has been made presents many interesting and amusing features as outlined by Mr. Argall.

DANISH TUBE-MILL PEBBLES AND SUBSTITUTES.
By Jay A. Carpenter 139
The subject of the Danish pebble and its substitute is an interesting one to the mill operator; and in the present article the results of a thorough investigation of this subject are presented. It is curious to note that while French pebble, ore, steel balls, artificially rounded flints, and the like have been tried in various parts of the world, the Danish pebble, although an expensive item in many districts, continues to be used largely in tube-milling operations.

MINING IN THE BELGIAN CONGO 142
An abstract from the recent circular issued by the Union Minière, a subsidiary of the Tanganyika Concessions Ltd., showing the operations of the Company during the past year.

MINING IN NEWFOUNDLAND.
By An Occasional Correspondent 143
While the iron ore deposits of Newfoundland have been well known in many markets, but little publicity has been given the work which is being conducted in this, England's oldest colony. The iron and copper deposits have proved to be of considerable importance, and a summary of the work which is being done, is presented.

THE COPPER BEDS OF THE COEUR D'ALENE.
By George Huston 145
The so-called copper beds of the Coeur d'Alene have been the object of study by the author for over a period of seven years. His observations have been made in the most thorough manner, and the commercially mineralized beds, consisting of highly silicious quartzites, have been the subject of particular investigation.

PHILIPPINE DREDGES. Page.
By Frank B. Ingersoll 148
Gold dredging industry in the Philippines has grown in the past six years from nothing to about three-quarters of a million dollars in 1913. At the present time some of the largest operators in the world are invading this field, and the future of the industry is most promising.

ORIGIN OF THE IRON ORES AT KIRUNA, SWEDEN.
By Reginald A. Daly 148
A summary of the field data recently collected regarding the origin of the iron ores at Kiruna.

PERMANENT SURVEY STATIONS.
By John H. Eggers 149
Where survey stations are repeatedly referred to, it is well worth while to establish permanent survey points, some helpful suggestions regarding the construction of such points, together with a convenient card system, are presented in this article.

NEW CORNELIA TONNAGE 150
An estimate of the tonnage available for steam-shovel mining.

SELF-DUMPING BUCKET 151
A useful device whereby economies may be effected by use of an overhead wire rope arranged for hoisting, transporting, and dumping material.

MOISTURE IN BLASTING POWDER 151

THE REGIONAL ALTERATION OF OIL SHALES.
By David White 151
A study of the distribution of petroleums and their salient features.

DEPARTMENTS

DISCUSSION:
Smelting in Georgia. *By Herbert Lang* 152
Comment on Mr. Hafer's article entitled 'Gold Mining in Georgia,' which appeared in the *Press* of December 19, 1914, with special reference to ore treatment problems.
Tin Mining in the Federated Malay States.
By E. J. Valentine 153
The Whim Well Copper Mine. *By H. R. Sleeman* ... 154
A correction of the statement published in our issue of October 31, 1914, regarding the operations at this property.

CONCENTRATES 155
REVIEW OF MINING: Special correspondence from New York; Washington, D. C.; Houghton, Michigan; Joplin, Missouri; Toronto, Ontario; Deadwood, South Dakota 156
THE MINING SUMMARY 160
SCHOOLS AND SOCIETIES 165
PERSONAL 165
OBITUARY 165
THE MARKET PLACE:
Metal Prices 166
MINING DECISIONS 167
MINERAL STATISTICS 167
NEW MACHINES AND DEVICES:
Lighting Plants for Steam-Shovels 168
Commercial Paragraphs 168

EDITORIAL

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ATTEMPTS to close the smelter at Thompson, Nevada, because of alleged damage due to smelter fume trouble have been defeated for the present by decision by the court that a preliminary injunction cannot be granted in such cases upon general allegations, but that specific evidence of damage must be submitted. Smelting is a legal business and a smelter cannot be presumed to be a nuisance.

DREDGING is about to be the target of another investigation, this time by the Anti-Debris Committee of Sutter county. The members of the committee "have a suspicion," according to the report, that the dredges in the Oroville district are accountable for the muddy condition of the Feather river. We have a suspicion that the cause of this muddy condition of the Feather river is the same as that for most other rivers in the country at this season of the year.

AN attractive and useful little magazine, called *The Anode,* has just made its debut at the Anaconda Copper Mining Company. The publication will appear monthly under the auspices of the Bureau of Safety of this Company and will be devoted to the furthering of the 'Safety First' movement at the mines and plant of the Anaconda company. The first issue is devoted largely to the publication of information concerning the work which is being undertaken by the Company for the prevention of accidents; later issues will contain articles of general interest to the employees and items of news regarding the operations of the mines and plants. As the object of all the Company's various activities is the production of anodes for shipment to the electrolytic refinery, so it is planned that *The Anode* will voice the work of this great Company toward furthering the 'Safety First' movement.

REFERENDUM vote of the Miami Miners' Union on the demand for the restoration of the old wage scale, which was $3.75 per day, as against the 10 per cent reduction which went into effect last August, resulted in a decision to quit work until the demands of the union have been met. The properties affected are the Inspiration and Miami mines and concentrators, and the International smelter. The wages at present are regulated by the copper producers of the state according to the condition of the copper market. This method, in view of the general depression in copper since last August and the many difficulties attendant upon keeping the mines in operation, would seem equitable. The Inspiration company, while not in the producing stage, has conformed to this scale, and it will be recalled that twice in 1912 the companies affected voluntarily raised the wages of their employees in accord with the rise in copper at that time. The present strike is lamentable and it would seem that a more opportune time could have been selected for the presentation of the grievances claimed.

CRIPPLE CREEK is justly elated over the discovery in the Cresson Consolidated mine of a body of rich ore, the total value of which is estimated at from $1,000,000 to $6,000,000. It will be some time before definite figures are known, but at least one of the great bodies of high-grade ore, such as originally put Cripple Creek on the map, has again been found. Naturally this raises hopes of others, and probably no former Cripple Creek miner but can call to mind ground he would like to have explored. Despite the enormous amount of work that has been done in the district, there are many blocks of ground uncut large enough to contain more than one such bonanza orebody. The Cresson itself is in territory long passed over as unpromising, but the persistent work of Mr. Charles Roloffs and his associates resulted in an extremely profitable mine there long before the present bonanza orebody was found. No wonder that the hotels are crowded and that the lobby of the National has regained its old-time popularity. A veritable mining boom is on, and visitors are warned to engage rooms in advance. We are glad to say, with some personal knowledge of the district, that the opportunities for really finding ore are, in our judgment, excellent; much better than in many a 'new' district that has attracted even more attention.

TUBE-MILL PEBBLES as used in our modern milling plants have come to be an item of considerable importance in the economic conduct of this work, and it is therefore with pleasure that we print this week a detailed study of this problem at Tonopah by Mr. Jay A. Carpenter, of the West End company. It is peculiar that tube-mill operators throughout the world have depended to a greater or less extent upon Europe as a source of supply, the pebbles found near the plants being almost invariably of such an inferior quality that no economy was possible by their use even with the high freight charges which add materially to the cost of the

European product. There has been considerable discussion as to the use of ore in place of flints in tube-milling, but the consensus of opinion would seem to be against this practice. Rough pieces of ore have comparatively little crushing surface, and a loss in the efficiency of the mill and power consumption is inevitable until these pieces are worn into rounded shapes. Steel balls have also been tried, but because of their excessive weight and the consequent increase in power requirements, amounting to from three to four times that required by a charge of flints, they have generally proved unsatisfactory. This type of grinding has, however, proved the proper medium in ball mills, which take a three-inch feed and where a heavy rolling action takes place. Thus in the Marcy mill, steel balls are used where the purpose of the mill is to reduce two to four-inch ore to 10 mesh. The objections to the use of steel balls in tube-mills are discussed in detail by Mr. Carpenter. The discovery of a deposit of chalcedony near Manhattan, Nevada, from which artificial pebbles of a good quality can be produced at a reasonable cost may help to solve the local pebble problem, and the results of the experimental work at the West End mill on pebbles from this deposit are of interest.

RECONSTRUCTION IN MEXICO

Recent developments in the Mexican situation are far from satisfactory, and prospects for peace of a lasting character appear to be more remote than a few weeks ago when Carranza made a hasty departure from Mexico City and Eulalie Gutierrez was made provisional president, with Francisco Villa as his sponsor. With Huerta out of the way and Carranza in flight, the Constitutionalist, or what has come to be called the Conventionist cause since the Aguascalientes meeting, appeared to be so much in the ascendancy that a feeling of optimism was general. However, things do not happen in Mexico according to rule or prophets, and the *jefes politicos* of today are the *destierros* of tomorrow.

Gutierrez as provisional president is no more, having with the many Diaz successors passed into the limbo of a soon forgotten past, and General Garza, his successor, has commandeered the police force of Mexico City for military purposes and the establishment of some semblance of authority in the Federal District. Just at present there is a question as to whether Gutierrez has abandoned all claims to the provisional presidency or has gone to Pachuca with a part of his cabinet to establish a government in defiance of the Conventionalist authority in Mexico City. With Carranza and his constituents holding Vera Cruz, Gutierrez and a reported force of 5000 men at Pachuca, and General Garza with Villa's support holding Mexico City, the political arena of Mexico takes on the semblance of a three-ring circus with the Conventionists still the centre of attraction. The pending severance of friendly relationship between Villa and Zapata adds another difficulty to the situation, and our hopes for a speedy solution of the many problems which Mexico is facing may be given a further setback because of this anticipated controversy. Just what the solution will be is in no way apparent at the present time, but if we may conjecture the future from what has been the history of this tempestuous country, a return to peace can only be expected through the subjugation of the minority by force of arms, or with help from the outside in the form of American intervention. As this latter course is, at present, out of the question and in all probability will continue to be so, we can but look to the Conventionist element represented by those who fought for the Constitutionalist cause, for the re-establishment of peace.

The difficulties in the way of reconstruction, however, are numerous, and to bring a political plan which is representative of the wishes of the majority out of the present embroglio, and to enforce such a plan, is a task which we hope the Mexican people will work out for themselves. They have brought order out of chaos in the past, and while many see but little reason to believe that they will be able to do so again, the outlook is not without hope, as some would contend. The triumph of the Constitutionalist arms throughout northern and central Mexico while fighting in support of the 'Plan of San Luis Potosi' and the subsequent establishment of peace and order throughout this vast territory, with the exception of a small area in the state of Sonora, would tend to prove that the great majority of the Mexican people throughout this territory are sympathetic with and supporters of the proposed democratic rule and governmental reforms urged by the Constitutionalists. They have succeeded in expelling from this northern country the old federal authority as represented by the followers of Porfirio Diaz and the opponents of Francisco Madero. This Constitutionalist element at present is in command of the political situation in Mexico as far south as the national capital. The northern country so held is free from trouble, and with a restoration of confidence, improved labor conditions, and better transportation facilities, the mining industry should make rapid progress.

The end, however, is not in sight, as personal jealousies and political intrigue among the Constitutionalist or Conventionalist chiefs have resulted in the development of factions in the ranks, and now that the cause has been won, and the last vestige of *cientifico* rule eliminated, the question as to who is best qualified and most able to act as the chief executive is being decided in true Mexican fashion. It is to be regretted that Mexicans can not or will not settle such controversies at the polls, and that he who holds the presidency must establish his place by force of arms. Carranza has failed, Gutierrez has abdicated, and Garza we can but hope will hold office long enough to ascertain the will of the majority and peacefully accede to an executive who, with the Constitutionalist cause at heart and the Constitutionalist army to maintain his position, will rebuild the ruins of Porfirian Mexico and establish a lasting and nation wide peace.

THE COPPER PRODUCERS' ASSOCIATION

On January 13 the American Copper Producers' Association, of which Messrs. John D. Ryan, Rodolphe L. Agassiz, Joseph Clendenin, and James McLean were the executive committee, unanimously voted to discontinue its organization. It was formed five years ago for the purpose of compiling complete statistics as to production, refinery output, and exports of copper in this country, and the data thus prepared were given out to the public in the form of a table on the eighth day of each month. The cost of this work was distributed over the participating companies. Even from the beginning the plan was opposed by some of the producers, and as time went by, the opposition became stronger. It must be admitted that in some ways the arrangement was an anomalous one. The figures were prepared by the producers at their own expense, but the chief benefit of them was to the consumers. If the consumers had prepared a similar set of figures, showing the stocks of copper which they had on hand, the benefit would have been reciprocal, and a mutually satisfactory arrangement might have been arrived at. As it was, although the fact that these figures were prepared under the direction of Mr. L. C. Graton, now professor of economic geology at Harvard University, might have been taken as a sufficient guarantee of their integrity, it was perhaps only human nature that many of the consumers regarded with suspicion figures prepared for their benefit by the producers. Apparent ground for this belief was afforded by the fact that the export figures for each month as reported by the Association did not always correspond with the figures reported by the Bureau of Foreign and Domestic Commerce. As a matter of fact, the figures of the Association were the more reliable, though discrepancies resulted from the difference in the method of reporting the two sets.

Copper for export is, of course, sold some time in advance of when it is actually shipped. When the selling agency places the copper at the refinery on the lighter which delivers it to the ship, it considers its copper as exported, and so reports it. When the shipping company has completed the loading of a ship it takes the ship's manifest to the customs house, certifies to its accuracy, the necessary papers are executed and returned to the captain of the ship, and the ship sails as soon thereafter as practicable. When the manifests are passed upon, or the 'customs cleared' as the technical expression is, the figures as to the contents of the ship are turned over to the Bureau of Foreign and Domestic Commerce, and are duly reported by it as exports. It is obvious that whenever considerable quanties are being exported about the end of the month, total figures arrived at in two different ways would show quite a wide difference. The Bureau cannot guarantee the accuracy of its figures, since it merely reports the data given in the ship's manifest, and the customs service does not investigate these, since there are no duties on exports. There is no reason why the shipping company should report erroneous figures, but if it did there would be no means of checking them. The Producers' Association, on the other hand, knew exactly the quantities exported, since the buyer and seller have to agree on the weights involved.

Cessation of the publication of these figures is regrettable, for, although the producers had little to gain from them, accurate statistics in regard to anything are always helpful. It is true that brokers made use of them in their operations in the share market, but brokers are certain to carry on their operations, anyway, and it can scarcely be more objectionable to have them base their market strategy on accurate information than upon vague surmise. Looked at from another aspect, the disbanding of the Association appears like an opportunity lost. 'Many hands make light work,' the old aphorism says, and a group can always perform services for the general good which individuals are either unable or unwilling to undertake alone. The benefits of concerted action are seen in the extremely capable way in which the critical situation arising as a result of the war has been handled. In 1913 we sold to Germany nearly $75,000,000 of copper. Now that market is entirely cut off and it requires no great exercise of the imagination to perceive how such an abrupt dislocation of commercial relations might have brought ruin to many people engaged in the copper industry; an outcome which has been happily avoided.

As pointed out in these columns some time ago, the increase in our domestic output of aluminum, which is about to become effective, will presumably cause a decrease in the price of that metal. Aluminum is a possible competitor of copper in the electrical field, which absorbs nearly 70 per cent of the domestic consumption of copper, and a long distance transmission line recently constructed of aluminum in California is the equivalent of some ten or twelve million pounds of copper which failed to secure that market. If aluminum rules at a less price during the next decade, this competition will be accentuated, at a time when several large new sources of copper are becoming available. The Chile Copper Company alone expects to begin turning out a half million pounds of copper per day by April or May; the Inspiration and the Ajo mines will produce large quantities of new copper, while the leaching plants of the Anaconda, Utah Copper, and many other mines will put them in a position to largely increase their production. The companies have invested tremendous sums in increasing their output and lowering operating costs; it would seem good business to spend moderate sums at least stimulating consumption and thereby assuring that the selling price will remain at a level which permits satisfactory operating profits on these investments. We venture to assert the belief that it would have been good policy to keep the Copper Producers' Association alive, and divert its funds to maintaining a staff of commercial research investigators, who might develop new uses for copper in the manufacturing industry, and stimulate increases in its use for present purposes.

California Petroleum in 1914

By R. P. McLAUGHLIN

California produced more petroleum in 1914 than in any previous year, more than any single state has ever produced in one year, and about 40% of the total yield of the United States. The amount was about 104,033,000 bbl., valued at about $48,833,000. No entirely new fields were discovered. Production exceeded consumption every month of the year except April, which is reported to have shown a slight deficit. The total excess production, which went into storage, was about 7,000,000 bbl. Activity in drilling went cheerfully on, even in the face of overproduction and prices that are too low to return adequate profit to the producer. Even the European war, which directly affected the market for oil, failed to deter some operators from drilling new wells. Words are not at hand to describe adequately a class of men who conduct business in such a fashion. It is but fair to state that an antiquated system of leases, which require the drilling of wells whether or not they are needed, accounts for some of the wasteful development. At some time an enlightened public will doubtless forbid such a ruthless waste of material, which is limited in total amount. There were about 420 wells completed during the year. As this is the smallest number for six years past, and as the annual production has still steadily increased during that time, it is clear that development must be still further curtailed. About half of the new wells were drilled in the Midway-Sunset field. The Lost Hills and the Whitier-Fullerton fields followed next in order of activity.

Production

The condition of the various fields is indicated by the following table of approximate figures, based on nearly complete returns:

Field.	Production 1914, barrels.	Producing or completed wells.	Proved land, acres.
Coalinga	15,800,000	945	14,100
Kern River	7,073,000	1,690	6,450
McKittrick	3,865,000	278	895
Midway-Sunset	50,550,000	1,420	37,800
Lost Hills	4,855,000	231	2,620
Los Angeles	2,500,000	710	1,460
Whittier-Fullerton	14,100,000	568	3,010
Ventura	935,000	364	1,600
Santa Maria	4,355,000	225	4,470
Total	104,033,000	6,431	72,405

Collectors of oil statistics seem always to be satisfied with statement of gross amount of oil or numbers of wells. Frequently these figures are about as useful to the business man as a list showing exactly the number of nails in his office floor would be. When the price of oil varies from 35c. to $1 per barrel, depending upon its gravity, it seems strange none of the statistics published by marketing companies show anything as to amounts of various grades produced or stored. Cost of production and financial results are seldom dealt with in statistical accounts. With such common omissions of useful matter it may not be necessary to apologize for here presenting some original 1913 figures in a summary of the year 1914. The figures are from *Bulletin* 69, California State Mining Bureau, which is at present in press. Financial and operating conditions have changed but little since the figures were compiled, and they probably show something of what may be expected for 1914.

Accuracy of Statistics

To those not familiar with the difficulty in gathering information on financial and operating conditions it may be well to state that the obtaining of absolutely accurate figures is an impossibility; however, several separate sources of information have here been consulted and the figures are believed to be fairly representative. Only producing companies (totaling 276) were considered. There are some 800 incorporated oil companies in the state, but many have never been active. Capital, as shown by the figures, is not definite, but the figures are intended to include all payments for stock. The cash column is probably fairly accurate, but that showing property is probably a great deal too large. Dividends, as shown, are certainly not overestimated. They roughly indicate the profitableness of the business, but it must be borne in mind that many prosperous concerns reinvest their profits without paying dividends, which probably explains the fact that prices and operating costs appear to vary so slightly between dividend and non-dividend companies. Price of oil, as shown by these figures, clearly demonstrates that only in exceptional cases is oil production profitable when less than 40c. per bbl. is received. Operating cost is here so tabulated as to bring out the operating difference between fields, in the column of cost per well per day. This method of comparing costs is the only way for an operator to determine whether costs are reasonable. A little thought given to the subject will show the absurdity of the customary quotation of costs at only per barrel produced. Two properties might be equally well managed, but if one had very productive wells and the other only small producers, cost figures per barrel would show only the difference in productiveness and not the difficulty of operation nor effectiveness of management. The operating cost does not here include such fixed charges as depreciation, taxes, or insurance, but does include the drilling of new wells and overhead charges, such as officers' salaries. These cost figures are only general, and the subject is more fully treated in *Bulletin* 69, California State Mining Bureau. Marketing companies'

statistics account for most of the figures listed as miscellaneous. Comparison of the dividends and capital with those of the producing companies indicates that there is nearly an equal division of profits between the two branches of the industry, and that larger profits would be wholly justifiable in view of the hazardous nature of the business.

was entirely in keeping with the evidence presented more than a year ago. The companies are directed to file rules and rates for carrying oil. The law is still subject to attack in the State Supreme Court, therefore, it may still be some time before definite action may be expected. What the final result will be upon the oil industry is highly problematical, but undoubtedly

FINANCIAL AND OPERATING CONDITIONS OF CALIFORNIA OILFIELDS, 1913

Field	Under 18° B %	Under 18° B Price.	Over 18° B %	Over 18° B Price.	Average price.	Price to dividend Co	Operating costs — All companies — Bbl well	Per well day.	Per bbl.	Dividend companies — Bbl well	Per well day	Per bbl
Coalinga	55	$0.350	45	$0.508	42.5c.	47.6	54	$10.96	14.1c.	66	$11.70	17.9c.
Kern River	100	....	..	...	32.8	32.7	13	2.64	20.2	26	2.73	9.6
Midway	38	....	62	....	49.0	52.1	69	10.89	15.6	67	11.78	18.7
Sunset	12	0.361	88	0.534	35.2	50.0	50	10.29	20.4	..	....	28.5
McKittrick, Belridge, and Lost Hills	25	....	75	....	47.0	45.7	63	6.87	10.9	65	6.24	9.5
Santa Maria, Lompoc, and Summerland	14	0.379	86	0.560	53.5	44.5	40	4.65	11.6	50	5.15	10.2
Ventura county	8	0.460	92	1.060	101.0	..	19	3.63	36.5	..	....	...
Los Angeles and Orange counties	27	0.555	73	0.758	70.0	..	30	5.76	19.1	..	....	...

Field	Companies considered	Field production, %	Capital. Cash	Capital. Property.	Dividends. 1909.	Co.	1910.	Co.	1911.	Co.	1912.	Co.	1913.	Co.
Coalinga	59	63	$8,087,785	$9,634,512	$1,287,241	17	$1,266,243	16	$1,236,338	14	$1,154,328	15	$956,098	17
Kern River	50	42	5,198,416	3,520,029	1,123,129	22	392,472	24	389,822	22	454,095	26	361,444	19
Midway	59	48	3,891,763	12,110,051	101,000	4	562,763	10	1,076,285	18	1,128,161	19	520,520	14
Sunset	22	35	1,046,297	5,716,563	21,527	3	127,212	5	211,339	7	319,220	7	91,936	3
McKittrick, Belridge, and Lost Hills	14	54	794,859	8,164,292	269,795	2	239,750	2	85,000	1	134,945	2	538,744	6
Santa Maria, Lompoc, and Summerland	12	33	2,451,943	19,613,135	894,125	4	1,548,236	5	1,000,141	5	374,720	6	500,976	8
Ventura county	21	73	1,016,254	4,550,464	11,790	1	22,067	1	46,252	..	26,393	2	54,720	2
Los Angeles and Orange counties	27	39	4,217,826	7,329,343	1,203,556	12	1,427,908	13	1,288,034	12	878,478	12	3,015,159	14
Sub total	264	85	$26,738,143	$70,638,389	$4,912,166	65	$5,686,651	76	$5,333,211	79	$4,470,340	89	$6,039,597	83
Miscellaneous, including marketing companies.	12	..	68,134,840	47,892,543	10,440,331	6	2,981,598	6	2,830,403	5	4,401,218	7	9,509,009	8
Grand total	276	85	$94,872,983	$118,530,932	$15,352,497	71	$8,668,249	82	$8,163,614	84	$8,871,558	96	$15,548,606	91

Among important features of the oil business during the year, the European war has, of course, been most prominent. For some time after hostilities began, San Francisco harbor contained many idle tankers under foreign flags, and even after this phase of trouble was eliminated many markets of fuel oil were destroyed, among them being the copper mines and smelters and the Chilean nitrate mines. Shipments of oil from the fields decreased about 15% after August. Another effect of the war was to suspend several large deals involving California oil properties. The largest transaction thus supended included the Union Oil Co. and the General Petroleum Co., which were under option to English investors. It is currently reported that the Union Oil option has been extended gratuitously. Construction of the Valley Pipe Line from Coalinga to Martinez has not been appreciably delayed by the war, which is particularly surprising as it is backed by the Dutch-Shell interests, whose headquarters are in Europe.

The decision of the Railroad Commission of California that, under the law, all the pipe-lines from the San Joaquin fields are common carriers was not unexpected, and some very interesting facts are about to become the property of the public.

Final decision has not been made by Congress or the U. S. Land Office as to who is to own and control considerable tracts of land in the Midway field claimed by the United States government. The Secretary of the Interior offers contracts to operators, on disputed land, who were drilling prior to October 3, 1910, or were producing prior to August 25, 1914. The contracts specify that patent to the land must be applied for and then the operator may dispose of the oil if one-eighth of the proceeds is deposited in a national bank, to be paid as royalty to the government in case the patent does not issue. The United States District Court did not sustain the presidential withdrawal of some 3,000,000 acres of land on September 27, 1909. There was a later withdrawal authorized by Congress, and upon it future disposal of lands by leasing must rest, and there are close questions of title, where claimants to patent had done some work before the withdrawal. Litigation over oil lands, held under grants from the Government to railroads, indicate that the exception or

reservation of mineral lands in such grants is invalid. Oil has also been decided to be a mineral in the legal sense.

Water damage has been the subject of considerable investigation during the past year. At Coalinga many companies are successfully operating under an agreement to arbitrate differences as to damage from water. In the Midway-Sunset field an association of operators gathers information and advises owners of wells as to the best method of shutting off water. Strenuous attempts will be made this year to have a state law which will enable operators to act to a better advantage.

The Independent Oil Producers' Agency has had a large staff of engineers appraising its property. The Agency is composed of about 165 companies, united, under agreement, to market their product. Most of the companies are situated in the San Joaquin fields, and produce heavy oil. The organization is unique in that each company has an equal number of votes with every other in the direction of business. The appraisal is said to be the first step toward forming a single corporation. Such an effort will be watched with interest, because the Associated Oil Co. had a similar origin with results that have been unsatisfactory to the original stockholders.

Large Wells

Many large wells were brought in during the year, and enumeration of them would be tiresome here. One of the most noted was that of the Lakeview No. 2 Co. in the Midway-Sunset field. It came in during May at the rate of possibly 25,000 bbl. per day, and during the next five months produced about 3,000,000 bbl. of oil. The well was so large and unruly that it caused financial loss to its owners, and will doubtless damage much of the surrounding territory with water. Accounts from reliable sources indicate that the owners were almost criminally ignorant or careless during the drilling operations and entered the oil sand without knowing the true depth of their own well. If such is the true state of affairs, they certainly merit scant sympathy, and undoubtedly such procedure is far from uncommon. In the Whittier-Fullerton field, remarkably productive wells have been brought in, where one sees orange trees uprooted to make room for the drilling rigs, even though the oil is not needed now and some of the operators will lose money by their activity.

An important advance has recently been made in extracting gasoline from natural gas. More than a dozen compressing and refrigerating plants are now in operation, with an estimated daily production of possibly 20,000 gal. Gasoline prices are the lowest in several years. The outlook for 1915 is not particularly encouraging. There will undoubtedly be the same stupendous production, wasteful methods, and inadequate profits to producers. Prophecy as to when all interests will cooperate, either with or without governmental aid, would be extremely hazardous, although the time is surely coming when such will be the case.

Electric Mine Locomotives

By E. B. WAGNER

*The electric mine locomotive consists of several main parts. The electric power is carried down the trolley pole by an insulated copper cable. One end of this is connected to the metal frame that supports the wheel and the other end is connected to the circuit breaker, which acts similar to a safety valve in a steam line. This circuit-breaker is one particular type of automatic switch which opens the circuit when the load on the locomotive becomes too great. From the circuit-breaker the electric power is taken to the controller or 'throttle' of the locomotive. In the same case with the controller is the reverse lever. This is so arranged that besides changing the direction of the locomotive, it gives two speeds in both the forward and reverse directions of running. These are called 'series' or slow-speed position, which should always be used for starting, and 'parallel' or high-speed position, which can be used, if desired, after the locomotive has reached its maximum speed, with the operating handle in the full 'on' position. The operating and reverse levers are interlocked so that the latter cannot be moved except when the former is in the 'off' position. The rheostat, which is connected to the controller, is 'cut in' and 'out' of the circuit by the movement of the operating lever. From the controller the electric power goes to the windings of the motors and from them to the frame of the locomotive and then to the rails.

On starting the locomotive, the reverse lever should be placed in the 'series' position, and the operating lever turned on, a notch at a time, allowing sufficient time between the movements of the lever handle for the locomotive to come up to speed. If the wheels commence to slip, throw the operating handle to the 'off' position, back up, sand the rails a little, and try again.

On stopping the locomotive, the operating lever should be turned to the 'off' position and the brake applied, gradually at first, and then with more force, being careful not to skid the wheels. The greatest braking effect is obtained when the brake is applied sufficiently strong to just not slip the wheels. When the wheels start to slide or skid, the braking effect is practically nothing. In case of accident to the brake rigging or the refusal of the brakes to work, the trip can generally be brought safely to the bottom of the grade by throwing out the circuit-breaker, putting the reverse lever in the reverse-parallel position, and throwing the operating handle to the full 'on' position. By so doing the two motors are connected in such a manner that one acts as a generator and the other as a motor. The retarding effect produced, though not enough to stop the trip, will allow it to descend the grade at a safe speed. This is a point with which every motorman should make himself familiar, as it is often of material importance.

*Abstract from *Employes' Magazine* of the Lehigh Valley Coal Company.

Ore Treatment at Cripple Creek: A Review

By P. HENRY ARGALL

*In reviewing the metallurgical conditions existing in the Cripple Creek district at the close of 1914, and studying the progress of the past 20 years, it becomes apparent to the most casual observer that the metallurgical problems exemplified by sulpho-telluride ores have been most successfully solved. The large mills are handling ores of from $2.50 up to $4 per ton, obtaining from 70 to 80% extraction thereon, and are earning a profit of from 50c. to $1 per ton when handling 8000 tons of dump rock per month, or over. Six years ago, ore of this grade was considered worthless, and few metallurgists ever thought that this material would be worked, much less did they foresee the day when 1000 tons of such ore would be milled every 24 hours within half a mile of the town of Victor.

PORTLAND MILL.

It is interesting to remember the history of the milling of Cripple Creek ores, especially now, when nothing remains of the early-day mills but blackened foundations and greater or lesser piles of tailing, and when the Florence & Cripple Creek railway, the first ore outlet of the early days, is about to be turned into an automobile highway.

Stamp-milling and amalgamation, for many years the recognized mode of treating gold quartz, was first tried and but a brief experience sufficed to demonstrate the inefficiency of this process to deal with the free 'mustard' gold resulting from the oxidation of calaverite, on account of the difficulty of amalgamation due to a tarnish or covering supposed to be telluride of iron. During the years 1892 and 1893 there were, however, some 200 stamps at work in the district; the largest, the Rosebud and the Gold & Globe, having respectively 60 and 40 stamps at work. Percussion tables and blankets were later used, but even then low extraction resulted, and when unoxidized tellurides began to appear this process was entirely abandoned.

Smelting has been immediately recognized as the proper method of treatment for the rich ore, and from the beginning shipments of such ore went to Pueblo and Denver. At the present time the smelters continue to receive the rich ore, treating approximately 8½% of the ore shipped out of the district.

The first cyanide mill was the Brodie, erected about 1892 at Mount City and operated for some time with varying degrees of success. This was long before the day of vacuum-filtration, and the early-day trouble at the Brodie was encountered when trying to leach the slime.

Chlorination was next tried, the first mill to use this process being the Lawrence, erected, I believe, by Edward Holden in 1893. In 1895 the Gillett mill was started, using the barrel chlorination process as adopted

*Abstract from *The Cripple Creek Times'* 23rd annual review.

from that in use in the Black Hills in South Dakota, and operated for a year or so with different results.

In 1894, with the completion of the narrow-gage Florence & Cripple Creek railway to Florence, the Metallic Extraction Works, using cyanide, was constructed, and operation commenced early in 1895. Other mills soon followed, and Florence was for some years the milling centre. Later, with the completion of the Midland Terminal and Short Line standard-gage railways to Colorado Springs, Colorado City, with the Standard and Philadelphia mills, became a milling centre, and the United States Reduction & Refining Co. began to control the industry. This Company took over the Metallic Extraction and Union plants at Florence, closed the Metallic, and thus left chlorination the dominating process. Later still, the erection of the Golden Cycle cyanide mill at Colorado City, and the changing over of the Portland mill to the cyanide process, again put cyaniding in the lead.

The Metallic Extraction Works

Metallurgically considered, the Metallic Extraction Works was the one early-day enterprise designed to leave its mark permanently on the successful treatment of Cripple Creek ores. Here the roast-cyanide process was evolved, and from the experience gained here, Philip Argall designed and erected the Golden Cycle mill, and thus once more brought this process to the front. At the Metallic plant, also, concentration tests were made, and data obtained which later were to be used in the design of the Stratton's Independence mill, and figures were obtained on working cost and extraction which enabled Mr. Argall to tell his company, before even the foundations were started, that the Independence mill could treat, on a basis of 10,000 tons per month, the dump ore at a cost of $1.50 per ton and make an extraction of 70%. In the six years of its active life, the Metallic plant treated 500,000 tons of Cripple Creek ore, earned good dividends for its owners, and was in no small degree a factor in reducing treatment charges fully 50 per cent.

The close of the year 1911 saw the end of the chlorination process as a factor in the treatment of Cripple Creek ore, with the shutting down of the Standard plant and the changing of the Portland plant into one using cyanide.

In 1907 the problem of treating the low-grade sulphotelluride ore, ore of too low grade to pay transportation to the valley mills and treatment after its arrival there, in the district itself, was attacked. In April 1909 the Independence mill first unit of 5000 tons per month was started. In June 1910 the Portland company started its low-grade mill, and in October 1911 the Ajax mill was operating in a small way.

Of the various mills designed to treat Cripple Creek ore, the following table shows their processes, capacities, locations, and history:

Rosebud—100-ton, stamp-amalgamation, Cripple Creek; burned.
Gold & Globe—100-ton, stamp-amalgamation, Cripple Creek; burned.
Brodie—100-ton, roast-cyanide, Mound City; burned.
Lawrence—100-ton, chlorination, Lawrence; burned.
Gillett—100-ton, chlorination, Gillett; burned.
El Paso—150-ton, chlorination, Florence; burned.
National—100-ton, chlorination, Florence; dismantled.
Metallic—350-ton, roast-cyanide, Florence; dismantled.
Union—300-ton, chlorination, Florence; closed.
Dorcas—100-ton, roast-cyanide, Florence; burned.
Economic—300-ton, chlorination, Victor; burned.
Philadelphia—250-ton, chlorination, Colorado City; dismantled.
Standard—400-ton, chlorination, Colorado City; closed.
Portland—350-ton, roast-cyanide, Colorado City; at capacity.
Golden Cycle—1000-ton, roast-cyanide, Colorado City; at capacity.
New Portland—500-ton, cyanide-concentration, Victor; at capacity.
Independence—350-ton, cyanide-concentration, Victor; at capacity.
Ajax—150-ton, cyanide-concentration, Victor; about capacity.
Isabella—100-ton, straight cyanide, Isabella mine; one-half capacity.
Wild Horse—100-ton, straight cyanide, Midway; at capacity.
Jo Dandy—100-ton, straight cyanide, Jo Dandy mine; at capacity.
Anaconda—100-ton, straight cyanide, Anaconda; closed.
Trilby—100-ton, roast-cyanide, Trilby mine; closed.
Wishbone—100-ton, roast-cyanide, Spring gulch; burned.
Little Giant—100-ton, straight cyanide, Pony gulch; dismantled.
Homestake—50-ton, straight cyanide, Cripple Creek; closed.
Free Coinage—50-ton, cyanide-concentration, Altman; about capacity.
Dante—100-ton, straight cyanide, Dante mine; about capacity.
Vindicator—300-ton, screening plant, Independence; recently started.

Cripple Creek milling has had its amusing side, too, which one should not overlook in a review of this kind. One read, for instance, in *The Times* of October 5, 1909: "New machinery and tanks for the Stratton's Independence mill were delivered at the property yesterday, and it is learned that Manager Argall will build an addition to the already big plant for experimental purposes." A special to the *Rocky Mountain News* dated March 28, 1909, reads as follows: "Following the close-down of the Stratton's Independence mill Saturday, the employees of the plant have received their salary checks and been laid off. The only information obtainable from the management is that repairs in the roasting department were necessary. The mill, which was erected at a heavy expense, and which is said to have a capacity of 6500 tons per month, has never been run anywhere

near capacity. According to the assessment rolls, the last assessed valuation of the mill was $317,000, and since the last assessment about $100,000 has been spent in changes and improvements." Those two extracts are very interesting reading in connection with what we know of the Independence mill today.

In this review the next period is that of "secret processes." In *The Times'* write-up of the opening of the Portland mill, July 19, 1910, is the following: "In the agitating tanks the 'Portland process' chemical is added and is known to the millmen as 'goo-goo.' The 'pacifiers' having washed the cyanide solution from the slime, this solution is pumped to the surface again

day. This chemical process will undertake the treatment of low and high grade ores, it making no difference as to the quality or to the quantity of tellurium contained in the ores. By use of the chemical iodide, for which to make solution it is necessary that ¼ lb of this salt be added together with 2 lb. of cyanide and 2 lb. of cyanimide, the metallic tellurium is dissolved and recovered in the zinc dust."

Mr. Clancy claimed that the treatment cost in the Ajax mill would be $1.20. The Moore Filter Co., in an advertisement, claimed the total mill cost, on a 200-ton basis, to be well under 75c. per ton, and the actual loss of cyanide only 0.01 lb. per ton of ore treated.

STRATTON'S INDEPENDENCE, AJAX IN BACKGROUND.

to be used over and over again." I cannot recall that the Portland company ever made an official claim for a secret process, nor has Thomas B. Crowe, the metallurgist in charge of the Portland mill, ever published any explanation of either the 'goo-goo' or the 'pacifiers,' although the *Rocky Mountain News* of July 22, 1910, hazards a guess that the 'goo-goo' is cyanogen-iodide. Yet another expert of local reputation, noticing the conditions at the tops of the agitators, reached the conclusion that the secret 'goo-goo' was a combination of cyanide and yeast cake! In the issue of *The Times* of July 3, 1910, there is further enlightenment along chemical lines as follows: "The difference between bromide and cyanide is that the former is more soluble to gold, being an added salt. It is a very expensive chemical." But the 'Portland process' gradually died a painless death, and we went along in a humdrum mirthless way until the advent of the 'Clancy process' brought new humor to light. In *The Times* for October 25, 1911, was: "Something new of the Clancy process is learned each

Hence it is surprising to read in *The Times* of May 6, 1912: "The Colburn (Clancy) process undertook to do these things (eliminate tellurides without roasting or concentrating) by means of cyanimide and electrolysis, but an official statement from the people who have given the Clancy process a commercial trial is to the effect that the process needs perfecting." Concentrating tables speedily replaced iodide, cyanimide, and electrolysis, and the Ajax mill fell into the procession of successful operators.

But enough of the funny side. The big successful mills of the district today use no patent or secret process. The method worked out in the old Metallic Extraction Works at Florence, improved and introduced to the public at the Independence mill, has become the standard practice of the district. It is, in reality, a combination of previously well known processes adapted to fit the conditions. The sulpho-tellurides must be removed by either roasting or concentration, and since the cost of roasting is prohibitive, concentration was

adopted. The concentrate is sold to the smelters, while the remaining ore, freed from sulpho-telluride, is easily cyanided, and especially so when aided by bromo-cyanide. In brief, then, the successful method in use today on the low-grade sulpho-telluride ore embraces the following well defined steps:

1. Crushing the ore in cyanide solution, instead of water, in order that the cyanide may begin dissolving gold from the moment that reduction begins.

2. Removing the rebellious tellurides as completely as possible by a careful concentration process, conducted alike on slime and sand.

3. Either leaching the sand in ordinary vats to effect a further extraction and to wash out the remaining traces of cyanide, or simply washing the sand in its passage through a dewatering machine and allowing it to pass directly to the dump.

4. Treating the slime by air agitation with the addition of bromo-cyanide or other oxidizers, as and when required.

5. Precipitation of the gold from the cyanide solution either on zinc shaving or by the Merrill zinc-dust process, acid treating the precipitate to remove the zinc, and melting down into bars or shipping the crude precipitate to other refineries.

6. Selling the concentrate to the smelters. The important point here is that the smelter pays 10c. per unit for the iron in excess over the silica, thereby reducing the treatment charge materially on clean concentrate. Chemical processes do exist wherein it is possible to treat this concentrate at the mill and obtain 90% extraction; yet, considering the value of the iron content, which is lost in the chemical method, there is no process known today which can compete with smelting this product.

Future Milling

It is needless to dwell on the success which these low-grade mills have met, for it is ancient history to the residents of the district. With perhaps 150 men actively engaged in operating the mills, work is provided for fully six times that number of men in supplying the ore needed daily, as fully one-half of the tonnage treated is hoisted directly from the mines. There is work in sight for these mills for many years to come, and one may look upon them as giving assured life to the district for one or two decades, perhaps longer. Be it noted, however, that freight is of no import with the existing big mills; the ore is being treated on the ground.

During the past year there have been persistent rumors that one or other of the low-grade mills would be in a position to handle custom ore of $3 or $4 grade. While no official announcements have as yet been made, there is no doubt that something of the sort may be attempted at any time; but in order that the owners of dumps and low-grade ore in general should not become too enthusiastic, it is well to consider what it is possible to do with such ore on a custom basis. Assume a large dump of $3 ore, worthless to the owner without a mill. Having been sorted from the shipping ore, it may be said to have cost the owner nothing; it is, in fact, a by-product. With a mill on the ground it is worth what he can get out of it, less the cost of milling, thus:

Gross value of the ore per ton, $3.	
Extraction, 70%, per ton	$2.10
Milling cost, on a basis of 10,000 tons per month	1.50
Apparent profit per ton	$0.60
With 75% recovery	0.75

From which the cost of the mill must be returned during the life of the dump. Should this ore be shipped to a custom mill, the first charge is 50c. per ton freight, and on the assumption that the mine would expect something for the ore and the mill a small profit for milling it, it is evident that it would not be profitable. For custom milling I assume that the ore is of $4 grade, the probable extraction 75%, and I find as follows:

Milling cost, as above, per ton	$1.50
Railway freight in district	0.50
Loading and unloading cars	0.30
Metal loss, 25%	1.00
Working cost	$3.30
Apparent profit	0.70

Allowing 30c. per ton for profit on milling, the miner would receive 40c. per ton for his ore. Assume further that an aerial tram is built to handle this ore, the freight would then be cut to 20c. per ton, including amortization of a line 1½ miles long. In such a case the freight is cut 30c. per ton, and the profit on loading, transporting, and milling $4 ore becomes $1 per ton, exclusive of mill depreciation.

There is plenty of milling capacity in the district, and the construction of more large mills to handle sulpho-telluride ores would be a useless duplication of capital, and nothing less than a mill of 10,000 tons per month capacity can possibly handle such ores at a working cost of $1.50 per ton. What is needed is a cheap method of transportation to deliver the low-grade ore to the existing mills at, say, 10 to 20c. per ton, depending on the distance between mine and mill.

The year has been a most prosperous one for the district as a whole (980,239 tons of ore yielded $13,551,932, and dividends distributed, $3,128,685), and the part of this prosperity due to the low-grade mills has been neither inconspicuous nor underestimated.

Metals and ores exported from New South Wales during the first nine months of 1914 were as follows: Silver in bars and matte, 2,017,043 oz.; silver-lead bullion and concentrate, 283,315 tons, worth £2,525,357; lead in matte, 18,152 tons, worth £264,701; zinc concentrate, 345,167 tons, worth £977,126; copper in bars, ore and matte, 15,743 tons, worth £912,259; tin, 2151 tons, worth £253,370; and coal, 4,587,586 tons, worth £2,474,451. The total value was £7,628,671. Gold produced in 11 months was 108,892 oz., a decrease of 27,331 oz. compared with that period of 1913.

Danish Tube-Mill Pebbles and Substitutes

By JAY A. CARPENTER

Since the advent of the tube-mill for fine grinding, the Danish pebble has been the main grinding medium. The reason for this is that these pebbles are extremely hard, tough, nearly spherical, and the cost of production is limited to the cost of gathering them from the seashore, and then sizing and grading them for shipment. The cost of such flints, sacked ready for export from Denmark, is about $11 per long ton. The true Danish flint is remarkably homogeneous, and free from all cleavage planes or lines of weakness. On being fractured, the faces are sharp and irregular, and vary in color from a brownish black to a jet black. Occasionally the faces show irregular patches, a brown to gray color, which, while softer are apparently an integral part of the pebble.

The pebbles, from 1 to 7 in. diameter, are divided into about eight sizes, from size 0, 1 to 1½ in., to size 7, 4¾ to 7 in. diameter. The sizes most in demand are No. 3, 2⅜ to 3¼ in.; No. 4, 3⅛ to 3¾ in., and No. 5, 3½ to 4 in. These are sorted into different grades, varying from the best spherical or 'special hand picked' pebbles to the culls. This grade has not been given much attention by the millman, consequently most pebbles are purchased on the specification of size only, without reference to grade.

While the Danish pebble sells around $11 per ton ready for export, the price quoted by dealers *ex* steamer at New York is about $15, and the price delivered to the railroad station of the mines varies greatly with their situation, being in the case of Tonopah about $35 per ton. The same pebbles, upon reaching the mills at Manhattan and Round Mountain, 45 miles and 72 miles, respectively, from Tonopah by wagon road, cost $55 and $62.50 delivered. This nearly places the homely Danish flint in the class of its more fortunately colored brothers, the amethyst and opal.

Quantity of Pebbles

The quantity of pebbles used per ton of ore depends mainly on the hardness of the ore, the coarseness of the sand product fed to the tube-mills, and the fineness to which it is to be ground. At the West End mill, during the year 1913-14, the ore was crushed through battery screens with 0.19 to 0.27-in. openings, and the final discharge from the tube-mill circuit was 80% – 200 mesh. The ore is a hard quartz, not tough, but breaking into sharp fragments. The consumption of pebbles per ton of ore milled was 7.1 lb., varying from 4.82 lb. during one month to 8.73 lb. in another month. The higher limits were with the coarsest screens or with French pebbles. At $34 per short ton, this gives an average cost of 12.1c. per ton for pebbles. This is a high figure due to the coarse crushing in the batteries, and to heavy pebble loads in the tube-mills. The pebble consumption at three other mills in the district, all using finer screens, is 4.2 lb., 4.4 lb., and 4.7 lb., respectively, giving a cost from 7.1 to 8c. per ton of ore. At the Goldfield Consolidated mill the consumption of pebbles is about 4 lb. per ton, and the amount used in 1913 was approximately 660 tons. These figures show that the Danish pebble is an important item of cost in milling, and is a large tonnage item in the freight of a milling district like Tonopah.

It is primarily this cost per ton of ore for Danish pebbles that makes the millman interested in substitutes. It is also the carload substitution of French pebbles at Danish prices, and the receipt of inferior grades of Danish pebbles that sharpens his interest. There is an open question if the Danish supply can meet the demand coming from the increased number of tube-mills installed, and the increasing coarseness of feed to them. At least an extra cost or a decrease in grade can be expected. At the present time it is questionable whether the quantity exported will be seriously affected by the war. Prices soared in the early fall, but are nearly normal again with, however, the supply rather limited.

French Pebbles

A substitute for the Danish pebble in common use is the French pebble. This pebble on the exterior has much the appearance of the Danish article, and is as free from fracture planes; but on fracture its color is light brown to gray, in contrast to the dark brown to jet black of the Danish pebble. While pebble dealers may argue that Nature would not be mean enough to toss up a softer article to the Frenchman, the millman who compares pebble consumption knows it for a fact, even if the pebbles come to him under a Danish bill of lading, or with numbers on the sacks instead of letters.

The cost of French pebbles ready for export is considerably under the Danish, but delivered at Tonopah with the same high transportation charges added to each, the French is but little cheaper, and wearing faster, due, I presume, to being somewhat softer, its cost per ton of ore ground is higher. Where transportation is not such an element in the cost, the French pebble might give an equal or lower cost per ton.

The Newfoundland pebble has a limited use. This pebble is hard enough, but in those received at Tonopah there were distinct parallel fractures or bedding lines across them, along which they would fracture when broken. The reject from the tube-mills showed that this action took place to some extent in the mill, making their use uneconomical in comparison with the Danish pebble.

The substitute most commonly in use is that of pieces of mine ore. Primarily the great advantage of this is the low cost of the material and the saving of the purchase price of the Danish pebbles. Even if the ore only

carries metal equal to the cost of milling, it more than pays its own way in the subsequent steps of milling. On the Rand, according to 'Rand Metallurgical Practice,' the mine ore has entirely supplanted the imported pebble. This in spite of the fact that on a test run of one month, as recorded in the *Journal* of the Chemical, Metallurgical and Mining Society of South Africa, with similar mills, it required 171.5 tons of banket against 10 tons of Danish pebbles. The quantity fed to a mill per day is from 5 to 10 tons, or an average of 8 tons. This is 60% of the normal load of the mill. This figure is quite impressive of tonnage to those American operators who must rely on a small variation of meter reading to check up a failure to add the daily pebbles. This tonnage added to the mills during the year makes an addition of approximately 2½ to 3%, at the same or lower grinding costs.

The adoption of the banket for this purpose by all the mills is conclusive proof of the saving made over Danish pebbles. Although, in the test referred to above, the mill filled with banket gave slightly better grinding than the one filled with Danish pebbles, others cannot have agreed with this, as Alfred James, in his annual review[1] of 1913, states that authentic tests are still to be made to prove that the loss in grinding efficiency does not offset the saving in pebble expenses. Since it is generally conceded that a large portion of the grinding in the tube-mill, especially to my mind, extreme fine grinding is done by the rolling and sliding action of the pebbles, the rectangular edges on the banket must be a detriment to the best work possible. These edges may soon become rounded off, but in so doing a great deal of oversize material is introduced into the mill, being below 1½ to 1 in., which size material is spoken of in 'Rand Metallurgical Practice' as "of no further use for crushing purposes, and during this period it occupies valuable space—and arrangements should be made to remove them." In the extreme case of a square being reduced to a sphere the loss of volume is nearly 50%, and the oversize added to the mill would equal the volume of the pebble formed.

Cost of Power

Of the total cost of tube-milling, the cost of pebbles, though quite an item, is not the main one. Power is the heaviest charge, probably in most cases exceeding that of pebbles two to four times, and the cost of pebbles is probably about one-fourth to one-seventh of the total cost of tube-milling. If the use of ore as pebbles should entirely eliminate the cost of pebbles, it is evident that before adopting its use a careful study should be made to see if it impairs the efficiency of the other three-fourths or six-sevenths of the cost of tube-milling, for it is evident that the impairment would have to be very small to overbalance the saving made.

A. G. Quartana[2] gives data on the use of ore in place of pebbles in Mexican practice. In one instance the daily feed is 1600 kg. of mine ore, as equivalent to 250 kg. of Danish pebbles. He advocates a mixture of the two to avoid handling such large quantities of mine rock, and to furnish Danish pebbles to fill El Oro linings, for which purpose he says the mine rock is not adapted. He also commented on the destructive effect of the mine rock on smooth iron liners. Undoubtedly the use of mine ore or rock as a substitute for Danish pebbles will increase in use as the cost of pebbles increases. In the Tonopah district at the present time, the Tonopah Mining Co.'s mill is using mine rock or low-grade ore exclusively in its two tube-mills with good results.

Another substitute for Danish pebbles are rounded pebbles picked up from stream beds in the vicinity of the mills. These offer a marked advantage of cheapness, and an excellent spherical or rounded form. They have the disadvantage of being softer than Danish pebbles, as they are usually silicified igneous rocks. In a cyanide mill there would be a debit charge against them in the remainder of the plant, but on the contrary in a cement plant, I would presume they would add their quota to the cement. About four years ago flint pebbles from the Colorado river were used at the Tom Reed and Gold Road mills. Several of the cement mills in southern California use the pebbles of silicified igneous rocks found in their vicinity.

Steel Balls

Another substitute for the Danish pebble is a steel ball. Although the steel ball is in use in ball-mills for coarser crushing, it has found no application for fine crushing in tube-milling. The reason for this is probably that where the added weight in striking a blow or in crushing, weight is needed with coarser material, this very fact is against it in tube-milling, where grinding surface is vastly more important than weight. A steel ball would have nearly three times the weight, but no greater surface than a spherical pebble of equal diameter, and all added weight below the centre line of the tube-mill means greater power consumption. This statement is quite at variance with a circular letter recently issued by a reliable conveying machinery firm which has taken up the manufacture of steel balls for tube-milling. A test is quoted in which the capacity of a 5 by 22-ft. mill was increased from 14 bbl. of cement per hour to 23 bbl. by the use of 'manganoid' steel pebbles, and "power requirements not increased." If this be so, their use will become common. Undoubtedly these balls can be made harder than the Danish pebble, closer grained, tougher, and more spherical, which advantages should more than compensate for their greater first cost, especially in distant fields where transportation is the greatest item of final cost.

There might be raised an objection to the steel pebble on account of the metallic iron introduced into the pulp to be cyanided. Several years ago there was a strong prejudice against the cast iron liner as a substitute for silex on this same ground. Not so long ago, with a

[1] *Mining and Scientific Press*, January 3, 1914.
[2] *The Eng. & Min. Jour.*, May 20, 1911.

change of metallurgical engineers at a mill being constructed at a considerable distance from railroad, the new El Oro lining available was discarded on this assumption, and a hurry-up order for silex telegraphed out. Mills in the Tonopah district using smooth cast iron liners over long periods have never noted any harmful effect from this source. In one mill where the pulp was concentrated after tube-milling, the metallic streak of iron was quite noticeable on the final reconcentrating table, giving some idea of the quantity in the pulp. In this case it was shipped with the concentrate, but later, when concentration was discontinued, it went through to the filters with the pulp, as in the other mills. If this iron was acted on by the mill cyanide solutions, it should introduce appreciable quantities of ferrocyanide in the mill solutions. The regular and frequent tests of these solutions at the West End mill for impurities have never disclosed any ferrocyanide, in spite of the large amount of iron in the pulp, the high cyanide and alkali solutions, and the high heat and long agitation.

There is one drawback to experimenting with steel balls in tube-mills designed to carry pebble loads, that of placing too heavy a strain on the tube-mill heads and trunnions. W. A. Caldecott[3] gives the pebble load of a 5 by 22-ft. mill, 56 in. inside of liners, and filled to the centre line, as 9.88 tons. The weight of the pulp within the mill is about 4 tons, giving a total load of 13.88 tons. If steel balls of about three times the density of quartz were substituted, the pebble load would then be 29.64 tons, and the total load 33.64 tons, or 2.42 times as heavy. This load would subject the tube-mill to strains beyond which it was designed, and might exceed its factor of safety.

Artificially Rounded Flints

If, as the circular mentioned stated, the power requirement (interpreting it literally to mean the power requirement per ton of cement) was not increased, then the added weight of the steel pebbles must add wonderfully to the grinding efficiency of the mill. At least, the steel ball is worthy of more experimental work. It must be that large cement plants, having tons of reject steel balls from Lehigh-Fuller mills or ball-mills, have tried them out in tube-mills, but I know of no published data on the subject in the technical press.

Another possible substitute for the Danish pebble is an artificially rounded flint. This substitute is now being tried in the Tonopah district. Such a pebble will have limited application in tube-milling, due to the fact that there must be available a deposit of homogeneous flint, chalcedony, or onyx, and a consumption in the district large enough to justify a 'tumbling' plant.

Omer Maris, of Manhattan, found such a deposit near that place. The rock can be described as a banded and patchwork onyx, yet it has no tendency to break along the banded or patchwork lines, and all the various colored components seem to be of nearly equal hardness. Mr. Maris believed this rock could be used as a substitute for Danish pebbles, and has devoted all his time and energy to bringing this about. As the Danish pebble is worth $50 per short ton in Manhattan, the mill operators gave him hearty co-operation. The first experiments consisted of charging several tons of rough surface rock into the mills. The edges soon rounded on these rocks, and then they gave equal wear with the Danish pebble. After the Manhattan mills adopted the rock for pebble use, Mr. Maris began to mine the rock in order to get fresher material. Soon after this, enough rock was sent to the Belmont mill at Tonopah to charge a tube-mill and supply it with feed during a test. The net result was that the consumption of Manhattan rock was 6.44 lb. per ton of ore against 4.14 lb. of Danish, and its efficiency as a grinder, judged by the amount of minus 200 mesh in the discharge, was only 80% of the Danish. A small lot sent to the West End mill was charged into a mill, and the large amount of broken fragments in the discharge of the mill during the first day did not augur well for the rock, but several weeks later, on opening the mill, the size of the pebbles remaining bore testimony to their hardness.

Results at the West End

It was apparent that the rock must be made into a pebble before shipment, to save freight and to give it a better record for wear and efficiency. A tumbling barrel or mill was built for this purpose, and from the rectangular rock, after an hour or two of dry rolling, a fair pebble is produced. It is far from spherical, but all corners are rounded, and waste in the tube-mills is thus eliminated. This rounded pebble is now being tested in Tonopah mills and the Goldfield Consolidated at Goldfield.

The results at the West End mill have been quite favorable to the pebble. There are two 5 by 18-ft. tube-mills in the plant driven from a common pinion shaft at the same speed, and each taking the classified sands from 10 stamps with screens having 0.12-in. openings. No. 1 mill has smooth liners and No. 2 has Komata; the latter lining being credited with being more economical on pebbles. During August, 12,500 lb. of Danish pebbles was added to No. 1 mill. Beginning September 1, Manhattan pebbles only were added daily to the mill, totaling 11,640 lb. for the month. As the pebble load of the mill when carried at centre is about 8.1 tons, and the daily charge is about 400 lb., the average life of a pebble is 40 days. Calculating from this, the load should have been about one-half Manhattan on October 1. During October there was added 12,190 lb. of Manhattan pebbles, and when the mill was opened the load was at the centre line and all the pebbles except the smallest were Manhattan pebbles. During November there was added 13,490 lb., leaving the mill with a slightly higher load. Comparing the above months, it will be seen that the Manhattan pebble is practically equal, pound for pound, with the Danish pebble, as far as wear is concerned.

During November the load was entirely Manhattan

[3] *Mining and Scientific Press*, June 6, 1913.

pebbles, but different from charging the mill with all one sized pebbles, for by the method of adding them gradually there were all sizes of smooth worn pebbles in the mill down to those small enough to pass through the discharge screen. During November the fineness of the pulp at the discharge of the mill remained practically the same as during the preceding three months, being about 45% – 200 mesh.

In November No. 2 mill took 12,800 lb. of Danish pebbles. This gives a comparison of the Manhattan and Danish pebbles as follows: wear ratio, 1.05:1; cost per pound ratio, 0.95:1.73c.; cost per ton ground ratio, $1:$1.75, or a saving of 40% on pebble cost by Manhattan pebbles. To offset this gain is an occasional delay or stop due to irregularly shaped pebbles sticking in the tube-mill scoop.

While this pebble appears to be as efficient a grinder as the Danish pebble in the smooth-liner mill where a large share of the grinding is done by slippage, and the pebbles tend to wear flat, it is a question whether they would be as efficient in the Komata lined mill, where the pebbles are cascaded; the more nearly spherical the pebble the more efficient the grinding. They are being tried with this type of liner at other mills in the district.

These pebbles are delivered at Tonopah with a wagon haul of 40 miles at $19 per short ton. It is evident that at this price the Manhattan pebble has a marked advantage in price at Tonopah over the Danish, but with freight shipments from Tonopah toward coast points this advantage rapidly diminishes to a vanishing point, leaving this particular substitute for the Danish pebble to the limited field of local use.

The subject of the Danish pebble and its substitutes is an interesting one to the mill operator, and if many operators hold opinions different from those expressed above, they must remember that this article is based to a certain degree on personal opinion, since the literature and discussions on the subject are limited, which fault lies in their power to correct.

TRIBUTERS OR LESSEES at Kalgoorlie, Western Australia, mine a considerable tonnage of oxide and sulphide ores. The former is treated in a number of custom mills using stamps or Huntington mills; but the latter, since the Associated Northern dry-crushing, roasting, and cyaniding plant was dismantled after 10 years' run, has no suitable plant. The government was approached and asked to provide a mill, but in the meantime the metallurgical firm of Allsop & Don leased the Hainault mill of 40 stamps, Cobbe grinding pans, Wilfley concentrators, and sand, slime, and concentrate treatment processes, for the treatment of custom ore. The following charges are to be made for complete treatment of the sulphide ores supplied, 90% recovery being paid for: ore worth $15 per ton and under, $4.80 per ton; for each additional dollar up to $20, 25c. per ton extra; and for each additional dollar over $20 and up to $60, 12c. per ton. This gives a minimum of $4.80 and a maximum of $10.80 per ton. The government is granting the mill lessees a subsidy of $4800 to make necessary alterations to the plant. This should be a satisfactory arrangement, as the Hainault mill is complete. Thus the government at small expense aids a large number of miners, who otherwise would have difficulty in getting their ore properly treated.

Mining in the Belgian Congo

The following circular has been issued by the Union Minière, a subsidiary of Tanganyika Concessions, Ltd.:

"The estimated production of copper by the Union Minière du Haut Katanga for 1914 was 12,000 tons; for 1915, 25,000 tons; and for 1916, 40,000 tons. After the occupation of Brussels by the Germans, part of the Union Minière executive staff, including Mr. Velge, the secretary of that Company, was transferred from Brussels to the offices of the Tanganyika Concessions, Ltd., London, where legally constituted directors' meetings are now regularly held in conformity with article 16 of the articles of association of the Union Minière du Haut Katanga. The Company's smelting operations at Katanga have been kept running without interruption, although copper fell rapidly from £60 to £48 per ton, but has risen since, as will have been seen, to over £56 per ton. During the period that has elapsed since war started, and although considerable difficulties have been caused directly by the war, two furnaces have been kept in blast, producing 3730 tons of copper up to the end of November. The third furnace was blown in at the beginning of December in order to increase the output of copper, and, in view of the rising price of the metal, it is estimated that the total production for this year will therefore not be far short of the 12,000 tons anticipated. The copper produced from the beginning of the year up to the commencement of the war was realized at a price which shows a profit of approximately £20 per ton over the cost delivered in England. In spite of the adverse conditions affecting the metal market since the beginning of the war, the copper produced and landed in England since then has been sold at a price which shows a profit of over £10 per ton over the cost delivered in London. At the present price of copper a considerable increase in this profit will be secured, and as the price of copper is improving, the Company is now considering the immediate erection of two further blast-furnaces which have already arrived at Beira, on the east coast, and it is hoped that the Company will be able to erect these within a short period."

COKE-OVEN ACCIDENTS in 1913 were as follows, according to Albert H. Fay, of the U. S. Bureau of Mines: plants operating, 227; men employed, 24,345; killed, 46; seriously injured, 342; and slightly injured, 2172. The rate of fatalities was 1.89 per 1000 employed, against 1.72 in quarries and 2.06 at metal mines, surface only. There are over 100,000 ovens in 575 plants in the country. About 50% of the deaths were due to transportation systems.

Mining in Newfoundland

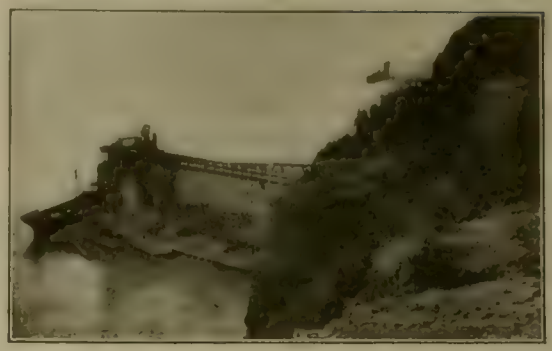
By AN OCCASIONAL CORRESPONDENT

Newfoundland, England's oldest colony, is rich in minerals. It is somewhat larger than Ireland; has a population of only a quarter of a million people, most of whom are fisherfolk living in the many bays far from railroads, and it is insular in fact as well as in reality. Ocean liners steam into the Gulf of St. Lawrence only a few miles from its wild-looking shore which John Cabot first saw in 1497; and it appears much the same now as then. In only a few places have serious efforts been made to develop the mineral wealth; and in still fewer have they been developed under successful management which understood conditions and possessed a sense of proportion. The colony is under a government of its own, separate from Canada, and politics are taken very seriously by the various factions, including the fishermen's union, the big merchants, the English interests, and others. It is a windy, rocky, barren country, with few railroads and almost as few wagon roads. The men available for labor live principally on tea and jam, and show the lack of a hearty meat diet; and the little stunted ponies they drive never haul over half a ton at a load.

On the other hand, the island is well situated for shipping to Canada, the United States, or Europe; it has an extensive coast line with plenty of good harbors, where coal can be brought by steamers or schooners from Sydney, Cape Breton, just across the Gulf of St. Lawrence; the summer climate is excellent for work; and the men can be hired cheaply, and are of 'white man' stock.

Newfoundland iron ore is well known in the markets of England, Germany, the maritime provinces, and the eastern states. It is a hard blocky hematite of about 50% iron, and well liked for furnace mixing; much of it occurs in blocks the size and shape of bricks —a peculiar freak of nature, but not inconvenient for mining. There are several seams of it interbedded with Cambrian sandstones and shales, and varying up to 30 ft. in thickness. The strata outcrop on Bell island in Conception bay, where for many years it was thought to be 'red sandstone,' and they dip at an angle of eight degrees under the ocean, down which incline 'slopes' have been driven for miles, mining being conducted under the sea.

IRON MINE ON BELL ISLAND.



IRON ORE LOADING PIERS, BELL ISLAND.

There are two large companies operating on Bell island (which contains 12 square miles), the Nova Scotia Steel & Coal Co., which purchased the original leases in 1893, and the Dominion Iron & Steel Co., which in 1898 paid the Nova Scotia company a million dollars for extensive surface and submarine tracts that the latter Company is now sorry it sold. Both companies ship ore to their own furnaces and steel works at Sydney, 400 miles away, where they also operate coal mines; and in addition the Nova Scotia company ships extensively to Middlesboro, England, to Rotterdam for German use, and to Philadelphia.

Bell island is described in the advertising pamphlet of the Nova Scotia Steel & Coke Co. as "set like a jewel amid heaving waters;" but for the most part it is a wind-swept, lonesome-looking bit of rock, seen to best advantage in summer. However, the cable-operated tramways across the island from the mines to deep anchorage, the ore-shipping piers, the ingenious stockpiling arrangements, the power house at the coal-unloading pier, and the general equipment are first class and of elaborate design. Between one thousand and two thousand men are employed in good times; in the shipping season of 1909 the Nova Scotia Steel & Coal Co. loaded nearly a hundred steamers varying up to 7500 tons capacity in an average loading time of three or four hours. The ore reserves under Conception bay are estimated to extend nearly to the northern shore, and will last at least a hundred years, beyond which it is scarcely worth while computing. It is stated that the attention of mining men was first directed to the Bell Island hematite through a fisherman sailing to St. Johns with some of the material in his boat as ballast. As an illustra-

tion of a peculiarity of the Newfoundlanders who do the mining, the management of one of the iron-mining companies on Bell island was threatened with a general strike when it attempted to do away with the 'mug-up' habit of the men, which consists in stopping work at 10:30 and at 4 o'clock to boil tea on the underground electric stove and eat a lunch (in addition to the regular dinner interval). This frequent lunching habit of the men is probably due to their subsisting on bread, tea, and jam in a climate so variable that most outdoor work has been uncertain and temporary.

Copper Deposits

'Up north' in Notre Dame bay, along a steep rugged shore, is a district long famous for copper ore. Since 1864, when mining was begun, copper ore to the value of $20,000,000 has been exported, and several of the English companies made very handsome profits, especially the Cape Copper Co., formerly of Tilt Cove, but now developing a new deposit 30 or 40 miles up the coast at Bay Verte. At one time metallurgists were brought over from Swansea, England, to operate a copper smelter at Tilt Cove, and considerable money was spent for several years in the effort to smelt the ore on the ground, but the attempt did not succeed, as the ore is more suitable for smelting when mixed with other varieties. Pyrite of a variety high in sulphur is common in the northern bays, and from Pilley's island in Notre Dame bay over $1,500,000 worth has been exported, although the mine is at present idle and full of water.

Among other minerals known to occur in Newfoundland are coal and petroleum, but lack of interest, roads, and proper management all have tended to discourage development. For instance, petroleum has been known to exist on the west coast, particularly at Parsons pond, for years. The last attempt to utilize it was by a British company which started several years ago with high expectations. Oil drillers from Pennsylvania were engaged, in order to get experienced men, and then the troubles began. So much difficulty was encountered from the machinery getting stuck, and so much difference of opinion resulted as to just where the drilling should be done, that several vague rumors are around as to "interference by American oil interests to keep down competition" and "action by the British government to conserve the oil resources for the navy." At any rate, the company became discouraged, and stopped work, although at least one small well was found. At other places on the west coast favorable looking beds of coal of good quality have been discovered and reported upon; and it seems strange that no one has attempted to do anything in a commercial way with such an important and basic commodity as coal situated in a country which imports coal, and close to the coast, where exporting to half the world would be easy. The Newfoundland government has been accused of discouraging too much interference in its insular affairs by outsiders; and it is true that wealthy St. Johns men, like the Reids (who built and operate the railroad), and various English interests, have tied up immense tracts of land for the sake of holding it; but on the other hand, many of the men in the government and business life of the island have overcome their insular prejudice and are anxious to help any new development of the colony's mining or industrial affairs. The prospecting laws are liberal, the mines regulation act is not unfair, and the workmen's compensation law is not a serious matter to a company of individuals starting mining operations in Newfoundland.

For instance, as to the crown lands act regarding mineral lands, any person can prospect upon public lands without first obtaining a license. A mining claim can be taken up by marking the mineral deposit by a discovery stake, and applying to the Crown Land Office at St. Johns for a license for one year, costing $11; the claim is one mile by one-half mile. During the year for which the license holds, a lease can be applied for, good for 99 years, costing $20 the first year, $30 per year for the next five years, $50 per year for the second five years, and $100 per year for the remainder of the term. Or, a grant in fee simple can be secured after expending, during the first five years, the sum of $6000 in mining operations on the claim. When a lease is applied for, the applicant is entitled to 50 acres of surface rights on his claim, and a right-of-way of a road out to the beach or main roads. The mines regulation act contains only such ordinary restrictions as those commonly incorporated for safety purposes.

Disadvantages of Mining

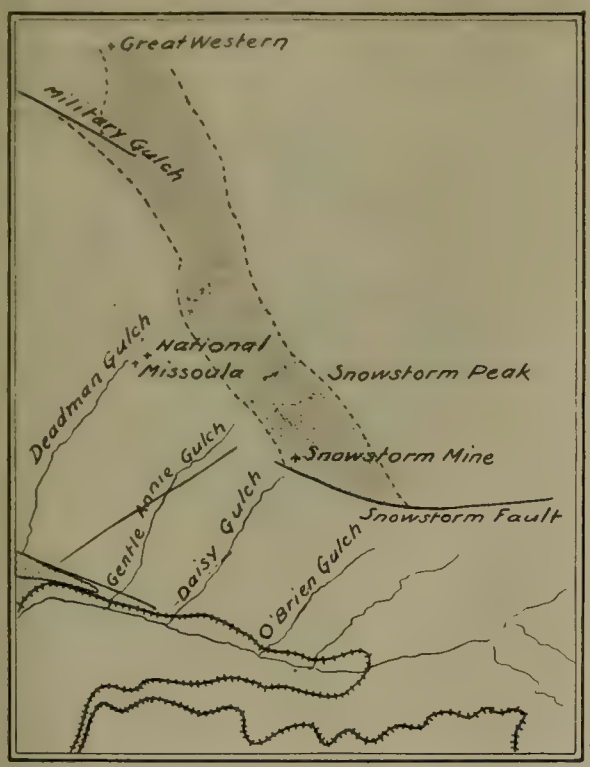
Some of the disadvantages of mining in Newfoundland are due to its isolation and the long time required for mails to come and go (although the railroad across the island has bettered these matters somewhat); the weather is very changeable, as is true of all islands, and the frequent storms during two-thirds of the year make outdoor work irregular, in spite of the fact that the winters are not particularly cold or snowy. 'Newfoundland fogs' are mostly at sea and not numerous on land. Up to a few years ago mining on several hundred miles of the coast (west, south, and northeast) was considerably hindered by French warships, due to France's claim that her rights to fish and dry the catch on those coasts gave her authority to prevent any developments which might injure fishing and drying. More than one hopeful mining man who has started operations on "the French shore" of Newfoundland has been amazed by a huge warship appearing off the coast opposite his prospect hole or development and being warned not to trespass on the rights of the French fishermen. He was told that he was "scaring the fish" by blasting and too much noise. But these matters, which were so long such a bone of contention between Britain and France, have at last been adjusted successfully, so that greater freedom exists for all those who care to brave the bleakness and solitude of the French shore in search of minerals and mineral substances.

The Copper Beds of the Coeur d'Alene

By GEORGE HUSTON

The so-called copper beds of the Coeur d'Alene have been the object of my study over a period of seven years. The areal geology was covered for seven miles in length by one mile wide. Observations were made underground all over the area to the extent of 65,000 ft. of tunnel, shaft, and open-cut work.

Mullan and Larson are the nearest towns to these beds, from which is derived the copper ore of the Snowstorm and National mines. A large amount of development is in progress along their strikes with a fair chance of bringing in more producers. The commercially mineralized beds consist of highly silicious pre-Cambrian quartzites occurring in what is known as the Granite Peak syncline, situated in the east-central portion of the Coeur d'Alene region. The syncline course or trend is nearly north-south for slightly more than half of the distance, after which it swings or swerves to a more east-west course. The upper half of the area north of Canyon creek is of minor importance. From this stream south and east, a distance of about 25,000 ft., the trend may be divided into two divisions according to the strike, the north division for 12,500 ft. and the south division for the same distance. The former stretches from a point just above the upper workings of the National mine to the workings of the Great Western group on Canyon creek. The south runs east-south from this point to the No. 3 adit level of the Snowstorm mine. The Granite Peak syncline is one of the most plainly marked structural features of the region. It is traceable seven miles and probably reaches a greater distance. The trough is filled with sedimentary rocks of the usual Coeur d'Alene series, in age downward, namely, the Wallace, St. Regis, and Revett formations. It contains no visible igneous rocks. Side pressure against the limbs has fractured a plane line down about the centre of the trend, on a scale sufficient to produce mashing and faulting with an overturn effect on the west limb. The pitch is south and the syncline is unsymmetrical.



MAP OF SYNCLINE SHOWING PRINCIPAL FAULT LINES AND AREA OF REVETT FORMATION.

At the junction of the two divisions the syncline swerves more to the east, the pressure effects being found in rocks of both limbs, agreeing with the strike. The wrenching effect has opened fissures across the brittle beds of the east limb, which are quartz filled. These show copper and galena in the immediate neighborhood of the impregnated beds, but the mineralization quickly dies out with distance and the fissures themselves fade away into branching veinlets. They are of no commercial value.

Revett Formation

Each formation, the Wallace, St. Regis, and Revett, contains a group of beds containing copper, but the first two are not profitable for reasons to be named. The Revett contains a group of beds from 20 to 60 ft. in thickness, impregnated with copper sufficient to make pay-ore at intervals. These beds lie in the first or top 350 ft. of the formation, and this holds good over the entire area. The transition from St. Regis to Revett is somewhat indeterminate, but recognition is possible within 50 ft. So plainly defined is the trend that an experienced observer can follow it on the surface, in its sinuosities and faulting, for the length of seven miles, knowing the position within convenient prospecting distance at any point.

The west limb of the syncline is practically barren, the east limb holds the copper beds, and these terminate on the dip into the centre plane of fracturing and faulting. The faulting, as noted, follows about the centre line of the trough, the Sonora fault on the Canyon Creek slope connecting through with the Snowstorm fault on the Mullan side. There is minor faulting which may influence the ore beds, between them and the Sonora fault. The plane line of the fault agrees with the course of the syncline. Looking from the lower end of the south division to the upper end of the north, the faults of horizontal throw are right-hand faults. The swing change in strike governs the throw direction, a fact

useful to the operator in finding lost copper beds.

Lateral pressure over a restricted area on the southeast end of the south division has elevated the syncline bottom, folding St. Regis strata against the Revett ore beds. This is seen on the No. 3 level of the Snowstorm mine. It cuts the ore strata off at about 4700 ft. above sea-level. The pressure effect dies out to the west, giving increased strata length with distance before reaching the fault again. A slight elevation apparently took place around the National mine near the strike change, and the ore beds enrich to the commercial stage again, although the difference allows the ore to go much deeper than at the Snowstorm. The elevation at the Snowstorm mine has given rise to an extensive fault on the east side of its holdings, displacing the beds evidently with a horizontal throw. It is traceable for a long distance. Undoubtedly, they continue east from this point, but I have not studied them.

The dips are flatter in the northern division and the strike more regular, although some movement and faulting is visible near the Great Western group on Canyon creek, but in lesser magnitude than around the Snowstorm and National mines. The dip in the south divisions are far the steepest, which, coupled with the movement, has had an important influence on the depth to which the ore will proceed, the kind of minerals, and the enrichment effect, also the oxidation.

The structural features of the Granite Peak syncline are ably dealt with in Prof. Paper 62, U. S. Geol. Survey, pp. 66-67, and admirably shown on the plate 2 map of the report.

The Copper Beds

As mentioned, there are three distinct occurrences of copper beds, one each in the Wallace, St. Regis, and Revett formations of the east syncline limb. The first two groups are in Wallace and St. Regis rocks, with a large amount of sericitic and other matter, which originally, no doubt, was sandstone or sandy shale, thin bedded, and affording very moderate opportunities for circulation of underground solutions. Infiltrations closed the pore space during the time of metamorphism. Subsequent movement due to pressure has not operated to release mineral, as the rocks smash into gouge, a condition antagonistic to free circulation. The principal copper mineral is chalcopyrite. Galena occurs, and rarely a little sphalerite. The rock carrying the minerals has almost the appearance of a hornstone, and the degree of impregnation is vastly less than with the Revett occurrence.

The copper beds in Revett are thicker strata, brittle, and composed entirely of quartzose matter plus the copper minerals. In crushing or under pressure, they have a tendency to break down like loaf sugar. This structure, favoring free circulation, explains the reason for this enrichment to commercial value. Along the seven miles observed, the Revett group originally contained copper in sulphide form of apparently one-fiftieth to one-tenth of one per cent per ton of rock. It was in intimate dissemination of chalcopyrite seemingly with the rock matrix. Silver to the extent of 2½ oz. or more to each 20 lb. of copper prevailed, with a very small amount of gold. Along a small portion, silicification proceeded to the degree of excluding the copper minerals, but the portion is insignificant and may be a secondary feature on the upper parts of the dip after the rock has been robbed of its copper content. Enrichment has occurred with change of a greater or less degree in the volume and kind of mineral, at intervals where favorable geologic conditions allow.

Copper Impregnation

The deposits are unique in that the nearest igneous rocks are miles away, and there are none whatever in the syncline. There is much to support the theory that the impregnation took place coincident with the metamorphism, the silicious and copper solutions traveling together to fill the pore space in the original sandstone, converting it into the present quartzite, with recurring intervals of pressure, crushing, and cementation.

Weathered quartzite from the Snowstorm mine outcrop shows typical coarse grains of quartz, around which were deposited the silica and copper cements. The rock suggests an early very open circulatory condition, with changes in copper minerals, made through breaking down under pressure. The latter would indicate that the change took place after the faulting and that originally the type of mineralization in the south division was similar to that in the north. The faulting movement steepened the dip, increased through this the concentrative effect, and gave copper minerals of greater content and density. What became of by-products will be noted later. Weathering of exposed strata contributed by sending the released mineral below the plane of the dip, being the easiest path of travel, as the mineralized strata were the weaker and were thus kept open.

The syncline fault I interpret as constituting a dam which held back the solutions, while faults across the strike assisted in checking the flow and thus caused deposition. The evidence is that cross-faults in combination with the dip are responsible for the areas of commercial enrichment. The source of the copper can only be conjectured.

The copper beds are normally very dry; in fact, the presence of water quickly robs them of the soluble minerals, transporting them elsewhere. Water is a bad sign for the prospector.

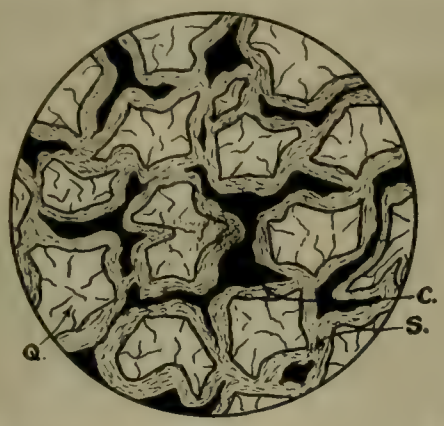
Chalcopyrite is seemingly the primary mineral. Chalcocite is a derived mineral, being found in all stages of formation and transition. Bornite is present. Pyrite is absent over the entire area, only one instance of its occurrence coming under observation, in the Snowstorm mine on an intermediate level, and even then not being in the copper beds proper. A horizontal throw had offset the beds to the north, and pyrite was found through a 30-ft. width containing galena on what would have been the continuation of the orebody. Fault action had smashed the rock to the south, and open spaces were

abundantly coated with pyro-morphite, the chlor-phosphate of lead. The iron oxide effect, so prominent in the upper and lower levels, over and under the occurrence were here notably absent.

Enrichment Evidence

Enrichment in this case may be defined as a change in minerals, resulting in a higher copper content with the casting aside of others. In the destruction of the primary ore and its change to the finished type, the by-products must be accounted for. This is possible in the Snowstorm mine. The discarded iron of the primary chalcopyrite is found as a hydrated oxide in the smashed rocks on the east side of the ore beds. Also these rocks show the effects of acidified water. The micrograph shows the occurrence of copper in quartzite at the Snowstorm property.

Chalcopyrite is almost absent from the Snowstorm



Q, QUARTZITE; C, CHALCOCITE; S, SILICIOUS CEMENT.

mine, but comes into notice gradually toward the west as the zone of lesser movement is approached. In the National mine it occurs in the proportion of about half and half, while in the north division the amount is much greater. A piece of rock, of a given size and degree of dissemination from the Snowstorm mine, will carry double or more the value that rock of the same size and degree of dissemination in the north division would, and at least one and one-half times that in the National mine, although some portions of the latter are almost as good.

The Snowstorm mine I consider an example of the enriching effect of the fault dams. The best ore lies against the side fault, and on the dip the necessary distance up the strata to escape moisture effects from the lower dam westward from the dams, the ore gradually becomes lower in grade. In all probability this will be the rule in the National mine. If the main adit were extended ahead, the beds would be found at no great distance, and the point of strike change determined. However, the smashing effect may be great enough to allow water circulation to the detriment of the ore. Favorable country should be found on the other side of the strike change.

Everything points to the presumption that the rocks along the strike west from the Snowstorm mine are favorable prospecting territory if exploration be conducted low enough to get into the influence of the syncline fault. The beds are well impregnated west of the No. 3 level, and in adjoining ground show marked improvement in the lower levels over the upper. Properties working nearest the syncline fault dam have a distinct advantage over those higher up.

Range of Termination

It has previously been said that the copper beds will end on the dip into the fault occupying the centre of the syncline. For the south division, this will give them a range of from about 4700 ft. above sea-level, at some distance below No. 3 level of the Snowstorm mine, to about 3250 ft. above sea-level at the National mine end. The latter level is about that of the town of Mullan. The distance on the dip will give much greater stoping length. The copper beds in the north division will not go so deep, because of flatter dip and the closer proximity of the syncline fault. The point at which they will intersect will be between the National lower adit-level, or 3963 ft. above sea-level, and the 3250-ft. point mentioned. According to the interpretation here offered, the prospects lying between the Snowstorm and National mines are working too high in the strata to be good mining risks. The No. 4 adit of the Snowstorm company at its 3990-ft. elevation above sea-level would cut into the heart of the copper beds at about the right distance above the syncline fault and serve as the prospect adit of all under one management and plant. The work in the Missoula Copper group should be at least 500 ft. lower vertically. The beds show a marked increase in copper content on the present working level over the upper (they average around 0.6%), and driving along the strike will only serve to emphasize this fact instead of developing shipping ore. Chances are highly favorable for 1½% ore as the syncline is approached. The long adit of the Copper King group cuts across the Wallace and St. Regis copper beds, and the owners dissipated their energy and resources in following scattered bunches in fractured areas adjacent. Extending the work northeast, directly across the beds, would bring it, in from 1600 to 1800 ft., to the copper beds in the Revett, and at a zone 570 ft. below the Missoula group workings. This is very favorable territory for pay-ore. The Copper King adit on the Mullan side of the divide is the logical point to tap and drain the country along the strike on the Canyon creek side, as it is 400 ft. lower and would save the duplication of expenditure in development. All the prospect work could be concentrated on the Revett copper beds at a favorable distance above the syncline fault to work in ore the whole distance. Water enough issues now from this adit from certain strata to mill 1000 tons per day in a plant of the Callow type. The mill should be placed below the mine. The chances are good for a large tonnage from the Canyon Creek side.

Philippine Dredges

By FRANK B. INGERSOLL

Gold dredging in the Philippine Islands has grown in the past six years from nothing to about three-quarters of a million dollars in 1913. For the year 1914 conservative estimates place the production at one-half million dollars and thereafter the increase should be rapid.

Up to the present time dredging for gold in the Islands has been restricted to one locality—the Paracale district on the Pacific coast of Luzon. There for centuries the natives have washed gold from the streams and gophered it from the veins in the hills. Toward the close of the Spanish regime an English syndicate commenced quartz mining in the district and built two small mills. Their operations were discontinued by the Philippine insurrection of 1896 against Spanish sovereignty, following which came successively the Spanish-American war and the insurrection against the United States government.

American prospectors followed the troops but no rights in mineral deposits in the public lands could be acquired until after the passage of the Act of Congress of July 1, 1902, which put into effect a mining law. Unsettled conditions which continued for several years thereafter prevented the development of the mining industry.

Six or seven years ago two American prospectors, who had been holding quartz claims, realized the possibilities in dredging the streams of the Paracale district and opened negotiations with New Zealand dredging men. As the result of an examination an antiquated dredge was procured from New Zealand. After starting at Paracale the dredge had a poor record for continuous running time and handled but very little gravel, but it astonished the mining world by saving an average of more than one dollar per yard. It has since been said that it could not have saved over 60% of the gold contained in the ground. Around this old plant, which was the pioneer, there has gradually accumulated a fleet of dredges at Paracale, now numbering seven in actual operation, with one more promised during the calender year, and others to follow.

MALAGUIT DREDGE, A YUBA BOAT, PHILIPPINE ISLANDS.

One American dredge, of modern type but small capacity, as compared with the monster dredges of California, produced about $200,000 during 1913 and paid a 50% dividend for its company. Another American (Bucyrus) dredge of the most up-to-date equipment has just been set to work. Both of these plants (each costing about $150,000) have been built with Philippine capital furnished by resident Americans and Filipinos.

The Paracale field is estimated to contain about 3000 acres of profitable dredging land which will keep a good sized fleet of dredges at work for several years. Prospecting parties have spread throughout the Islands and already several thousand acres have been proved by testing to warrant the installation of dredging plants thereon. Some of the largest operators in the world are invading the field and the future of gold dredging in the Philippines is promising.—*The Philippine Bulletin.*

Origin of the Iron Ores at Kiruna, Sweden

By REGINALD A. DALY

*Field data collected in the summer of 1914 suggests that the Kiruna ores, forming probably the largest high-grade iron orebodies now being worked in any country, are differentiates *in situ* from a magma, most of which has solidified as the adjacent quartz porphyry. That keratophyric porphyry, like the older syenite porphyry of the district, is believed to be of intrusive origin. The two porphyries together appear to represent a fine example of a composite (double) laccolith, injected into a thick, chiefly volcanic series of bedded rocks. After the injection of the quartz porphyry, the magnetite-apatite ores separated out of its magma in small nodular units. Many of these units settled to the bottom of the quartz porphyry magma, forming the main orebodies at the contact with the somewhat older, underlying syenite porphyry. Many other units, now angular as well as round, were frozen in at higher levels; these are the ore inclusions of the visible quartz porphyry—bodies which some authors have hitherto regarded as xenoliths, thereby obscuring the genetic problem.

THE VAN RYN MINE, Transvaal, yielded $2,870.000 from 439,900 tons of ore during the year ended June 30, 1914. Working costs totaled $3.84 per ton, and the working profit was $1,150,000. Two dividends of $1.08 per share were paid. Ore reserves are estimated as 1,973,312 tons of fully developed, averaging 53 in. wide, worth $6.49 per ton. There is also 1,013,330 tons of $4 ore.

*Abstract of a paper read before the Geological Society of America, Philadelphia, December 29-31.

Permanent Survey Stations

By JOHN H. EGGERS

The system of permanent traverse or survey stations, described below, was adopted on adjoining properties, under one management. The properties covered a peak and ridge and three slopes, each giving a difference in elevation of more than 1000 ft. The veins were numerous and the considerable amount of work done by the several lessees was in consequence scattered.

As developments progressed, it became desirable to have various proposed levels started at similar elevations, so that the lessees, or later the mining company, could drive through and make connections that would be suitable for tramming or other purposes. The question of a millsite also arose, and with it the problem of selecting the one most suitable for the purpose, with regard to the deeper and permanent development of the properties. Progress was measured each month, and together with the outside work the surveying was considerable.

The early surveys on the surface had been run, using small nails driven in wooden stakes, but the latter were of little account at a later date owing to the fact that various persons in going over the ground would trample them down, or sheep in passing through the country would rub against them with a similar result. In consequence, it was often necessary to run over rather long surveys to tie in new work. When such a survey had been run, there were times when an old point which might serve as a check was not available. In other words, the surveys were lacking in permanence, and this was the cause of numerous re-surveys and much added expense which have been avoided in the adoption of the new system.

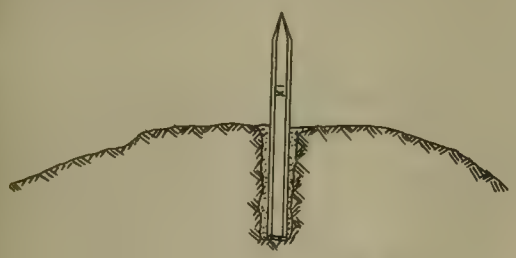


FIG. 1. STEEL POINT CEMENTED INTO CROPPING.

Instead of using the wooden stakes and nail, it was decided to use points made of drill steel, pointed at the upper end, and from 15 to 24 in. long. These points were to be cemented into holes drilled about eight inches deep, in rock in place, and some 40 odd points have been laid out in the manner described (Fig. 1).

The positions for the various points were selected with an idea to their prominence, so that they could be readily distinguished at some distance. They were also placed so that wherever possible triangles were formed, a base triangle having been previously laid out on three peaks, one of which was on the property. Throughout the main portions of the properties the points were placed close enough together so that a survey could be run from one point to another. By triangulation and the survey run from one point to another (with minor closings where convenient), it was possible to check closely the position of the permanent points, and the same applies to checking the elevations. Where the slight variations occurred in the longitude, latitude, and elevations of the points, an average was adopted in fixing its position. The points were numbered in Roman figures cut into one side of the steel.

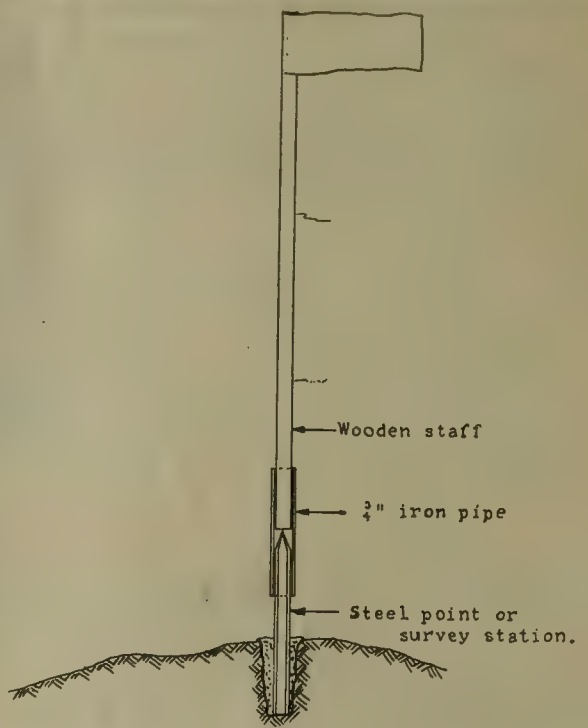


FIG. 2. STAFF AND FLAG USED ON A STEEL SURVEY POINT FOR TRIANGULATION PURPOSES.

For triangulation purposes on distant points a wooden staff is used, upon the upper end of which is nailed a white flag and the lower end of which is set six inches into a 12-in. piece of ¾-in. pipe. This pipe on the end of the staff is then set over any desired steel point (Fig. 2).

The cost of setting these points is slight and, while more expensive than using ordinary wooden stakes, this extra cost is eliminated when a second survey has to be run for want of permanent stations.

In the underground surveying, plugs and spads in the roofs are used in all work not of a very temporary

character, and it is aimed to have the heads of the plugs, and the spads, sunk beneath the line of the roof, so that they will not be shot out (Fig. 3). It has been found to be cheaper to put in the plugs than to re-run a survey underground, and this is in line with similar experience on the surface work.

FIG. 3. WOODEN PLUG AND SPAD IN THE ROOF OF A DRIFT OR STOPE, THAT IT MAY NOT BE SHOT OUT.

In the office, a card system has been adopted (Fig. 4), and all information gathered from a survey is placed therein. Total latitudes, departures, and elevations are at hand for all points, and can be readily obtained when desired. The surveys are platted on the maps from the total latitudes and departures.

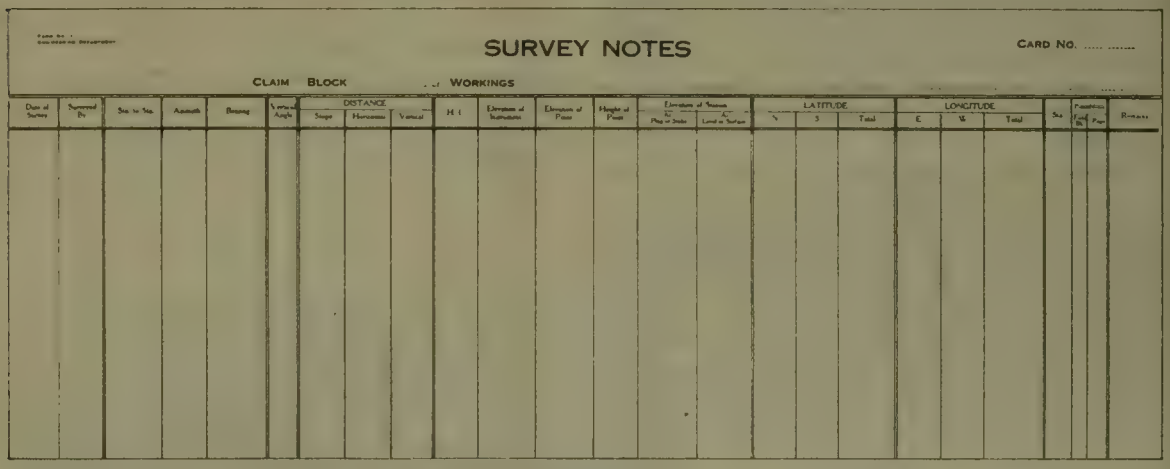


FIG. 4. CARDS FOR NOTES.

The points have proved entirely satisfactory in every way, and permit of closed surveying since they cannot be moved by the chainman or by other persons without the change being noticed. When the position and elevation of the several points have once been fixed, it is a simple matter for the engineer to pick up the known courses of any points to be used (from the map or notes), and to carry on his survey in tying in new work. He has the assurance also that his work is correct, if he has taken ordinary care, and is saved the trouble and expense of running a possible long survey. If such a system were adopted at a time when the first surveys of importance or of a permanent nature were run, a great deal of trouble, delay, time, and expense, would be saved. The system can be extended, whenever desired, by simply placing new points.

As regards the keeping of survey notes and calculations, it is advisable to have at least two sets of the same to be kept in the several offices or elsewhere, so that in case of fire at least one set will be available. The card system of notes is well adapted to this duplication of the records. It requires a certain amount of time, however, to copy the notes, and it would appear to be a good policy to have the form printed on medium or heavy vellum tracing paper, cut to the card size. The 'vellum' cards would not be injured by water, and should take the printer's ink satisfactorily. After a set of cards had been filled with the record of notes and calculations, it would be a simple matter to run off a couple of blueprints of each, and sets of the same could then be filed in the several offices for safe keeping. This should greatly reduce the time and cost of duplicating the records and avoid possible errors in transcribing.

New Cornelia Tonnage

The following estimates of total tonnage and of tonnage available for steam-shovel mining in the properties of the New Cornelia Copper Co. have been made public. The exploratory work here was described in the *Press*, January 31, 1914.*

	Tons.	Copper, per cent.
Ore estimate:		
Carbonate	11,954,400	1.54
Sulphide	28,303,600	1.50
Total carbonate and sulphide	40,258,000	1.51
Available by steam-shovel:		
Carbonate	11,954,400	1.54
Sulphide	20,526,800	1.54
Total carbonate and sulphide	32,481,200	...
Not available by steam-shovel:		
Sulphide	7,776,800	1.40
Rock stripping in carbonate and in sulphide zones:		
Rock in carbonate zone	708,400	0.65
Rock in sulphide zone	2,600,000	0.63
Total rock	3,308,400	...

COINAGE executed by the mints of the United States last year amounted to 4,194,112 gold pieces, worth $53,457,817; silver coins valued at $6,083,823; 80,568,452 copper 1-cent pieces; and coins for the Philippines, San Salvador, Costa Rica, and Ecuador.

*'Diamond-Drilling at Ajo, Pima County, Arizona.'

Self-Dumping Bucket

Where shallow shafts are grouped around a central mill, storage dump, or treatment plant, considerable economy may be effected by use of overhead wire rope arranged for combined hoisting, transporting, and dumping material. The accompanying figures show one such system as applied in the placer mining regions of central Alaska. Here one man hoists the gravel, transports it to stockpile or sluice, and dumps it, without changing his place. The principle is the same as in the familiar hay-carrier and loader on the farms. The

SELF-DUMPING BUCKET AND CARRIER USED AT FAIRBANKS.

bucket travels on a fixed wire to the top of the shaft, and then, the carrier engaging a lug, drops down the shaft. The man at the bottom detaches one bucket, attaches another, signals the engineer, and the rest of the work is automatic. A similar device has been used to some extent at Joplin, Missouri, to bring zinc ore from several shafts to a common terminal.

Moisture in Blasting Powder

As blasting powder is made up mostly of nitrate of soda with 10 to 15% of sulphur and charcoal with no liquid ingredients, it is considered solid. For this reason it is not affected by cold and, hence, will not freeze. On the other hand, hot weather does not affect it, because it requires a much higher temperature than any man could stand to ignite it. Ordinary handling and shaking in transportation does not affect it, according to F. H. Gunsolus, of the Du Pont Powder company. Nitrate of soda attracts the moisture in the air; consequently when exposed to the air in the mines or storage places, it rapidly takes up the moisture and soon loses its explosive force or strength.

The Regional Alteration of Oil Shales

By DAVID WHITE

"The examination of 'oil rocks,' such as cannels and richly bituminous shales which yield petroleums on distillation, lying in or beneath coal-bearing formations, shows that the organic matter of the shales, etc., is, in general, regionally altered and carbonized together with the coals, the alteration of the organic débris by the dynamic agencies being parallel in both. A study of the distribution of petroleums and their salient features seems to show that: (1) No commercial pools of oil are to be found in regions where the coals in or above the oil-bearing formations have reached the stage of carbonization at which the fixed carbon (proximate analysis) exceeds 70% of the pure coal, though gas pools diminishing in importance may lie beyond; (2) in regions of complete anthracitization the carbonaceous matter in the associated shales is correspondingly fixed; (3) the oils of pools in regions of relatively high fixed carbon in the rocks are, in general, highest in saturated hydrocarbons, and so highest in hydrogen and lowest in gravity; (4) in passing into zones of successively lesser alteration of the organic débris, the oils are less refined and the unsaturated and heavier hydrocarbons are, on the whole, more and more in evidence, the lowest grades of oil being found in formations in which the solid fuels are lignitic in rank; (5) while the residues of the organic débris are progressively altered, with the elimination of oxygen, nitrogen, and hydrogen, with some carbon, to composites progressively richer in carbon, the liquid distillates in the rocks as the alteration advances, become richer in hydrogen; that is, while the carbonaceous residues in the rocks become more distinctly carbonized, their liquid hydrocarbon distillates become more fully hydrogenized, the processes being, in a way, complementary.

Occurrences of abnormally high-grade oil in low-grade regions are probably due either to filtration or to migration from more altered rocks below. In cases of igneous rock metamorphism the effects may be erratic, distillates in small quantities being occluded in the magma, which also may contain inclusions of the mother rock. The limitation of commercial oil pools to regions of not too advanced alteration of the buried carbonaceous deposit bears unfavorably on the 'inorganic' theory of the origin of petroleum.

PROFITS of the Aramayo Francke company, producing tin and other metals in Bolivia, was $672,000 in its last financial year, against $720,000 in the previous term. The price of tin affected profits. Four dividends of 12c. each and a bonus of 36c. per share were distributed.

*Abstract of a paper read before the Geological Society of America, Philadelphia, December 29-31.

DISCUSSION

Readers of the MINING AND SCIENTIFIC PRESS *are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.*

Smelting in Georgia

The Editor:

Sir—I have read with interest the article entitled 'Gold Mining in Georgia,' which appeared in the *Press* December 19, and which conveys interesting facts as to ore treatment in that somewhat neglected mining region. Perhaps a few words of comment may not be out of place. I was surprised to hear that ores so complex as those described by Mr. Hafer had been found in the Appalachian country, and I must say that the miners went about their treatment in a manner that evinced correct judgment. The Seminole mine, judging from the too brief description, seems to be a fairly extensive property, from which a good output doubtless will some time be obtained; although it would appear of rather low grade according to our present standards. Orebodies reaching 15 ft. in width, of a variety amenable to ordinary methods of treatment, are certainly not to be despised. In addition to the stated resources in low-grade concentrating material derived from the vein, Mr. Hafer speaks of richer material suitable for shipping to outside (no doubt northern) smelters, and also of wall rock "heavily impregnated with auriferous sulphides." All this is quite flattering, pointing ultimately to extensive mining, concentrating, and smelting operations. The general plan of work seems to have harmonized perfectly with the conditions, embracing wet concentration in steps, followed by blast-furnace smelting of the dressed material, and the shipping of the resulting copper matte, with the incidental recovery of the lead (or part of it, more likely) in the form of base bullion. This seems impeccable practice, and although one may easily criticize some of the details of the process, the whole scheme strikes me as commendable; it is only in details that it is weak. As for these, it is of little use to call attention to defects in planning, without pointing out remedies. Nevertheless it is always interesting to trace the steps by which such installations are built, and to endeavor to elucidate the mental processes of the designers. The problem was not a simple one. The ore is rendered more difficult of treatment by reason of the inclusion of four metals—gold, silver, copper, and lead, the last of which especially complicates the metallurgical process. Evidently this fact was not fully appreciated, since no provision was made in the concentration apparatus for the separation of the galena from the other sulphides, a not difficult matter when the classification is carried to a sufficient extent. The best that can be done in such a case is to use tables which, like the Wilfley, admit of taking off a produce of pure or nearly pure galena, which might in the Seminole works be abundant enough to justify such a course. It may be, however, that the designers thought it wiser to sacrifice the lead, the inevitable result of the style of smelting which was evidently adopted. To carry out the plan suggested would require a much more elaborate ore-dressing plant than that spoken of by Mr. Hafer, for the inability of one jig reinforced by a couple of Bartlett tables to deal efficiently with so complex an ore is self-evident. Again, the free gold which exists in the surface ore—a fact known from earlier times—was seemingly neglected. The proposal now is to add stamps and tables to the already existing plant, in order to save the free gold. But may I suggest that this result could probably be better achieved by fine crushing all the tailing in a tube-mill, and passing the pulp over copper-plates or through a Pierce amalgamator or some equivalent device? The removal of all, or even a tolerable part of the sulphides (which are chiefly iron pyrite) can only be done by adding some regrinding apparatus for the jig and table middlings, and when this is effectually accomplished it should not be difficult to secure the free gold. I take it that the major part of that metal is included within the sulphides. Whatever means may be employed to separate the sulphides from the ore or from each other, the next logical step is smelting, either in blast or reverberatory furnaces, the former preferably on account of the lead content. Although the quantities dealt with were so minute according to our modern notions, there was and is opportunity for the application of much metallurgical knowledge and experience.

I admire the courage, though not the good judgment, of a metallurgist who at this day, or even a decade since, will set about to build and run a furnace such as described by Mr. Hafer. American practice in furnace building obtains now over the whole civilized world, and it prevailed almost universally when the little Augusta stack was set up. Unless it might be some devotee of the old German school, I cannot imagine who would have built such a thing as "a square brick furnace 2 by 3 ft., with three tuyeres all on one side." Can it have been a case of atavism, or possibly a recrudescence which will set us to awaiting expectantly for larger construction of the same kind? I would take more pleasure in building than in running such a furnace; for I have reason to know that to keep such an affair in proper trim is a most nerve destroying proceeding. It would have been far better, it seems to me, to have put up a small round

water-jacket of an approved pattern, arranged to avoid, or at least to minimize, the obstacles to proper running, the more so as a round cupola is more convenient to work, and more easily set right when in difficulties than any square or prismatic stack. By providing a removable hearth, as should always be done in small scale work, and by spacing the tuyeres evenly about the periphery, with provision for their convenient 'pricking,' which is a necessity, the ordinary evils of smelting on a miniature scale are so far done away with that even the almost inevitable freeze-ups are matters of little moment. By letting down and removing the crucible the whole furnace may be emptied, the crucible replaced, and the blast turned on again in two or three hours. Up to a capacity of 100 tons, or even more, a round furnace answers better than a square one, especially as a simple bell and hopper arrangement may be used for feeding, doing away with the laborious operation of shoveling in and spreading the charge by hand. The colossal iron furnaces of today are invariably circular in section, and are fed in this way. The use of the bell and hopper device confers much benefit, especially in the absence of skilled labor.

The final product of the Seminole works was copper-silver-gold matte, containing from 15 to 20% copper, 20 oz. silver, and from 2 to 3 oz. gold per ton. The grievous mistake of shipping this comparatively low-grade material, containing in gross only from $80 to $110 per ton, instead of concentrating it by repeated fusions with quartzose ores to at least 60% copper and proportional gold and silver, is almost reason enough for condemning the whole project. Nothing is easier to conduct in a cupola, and this should be done, in order to diminish so far as possible, the freight and treatment charges of which Mr. Hafer complains. These must have amounted to from $13 to $16 per ton of matte, or in the neighborhood of one-sixth of its total value. Thus, the net return of one ton of concentrate could not have been more than $13 to $18, from which must still be deducted the cost of mining and concentrating the much larger amount of crude ore, as well as of smelting the dressed stuff. Hence the importance of enlarging the scale of operations, and of making a richer product. I cannot attach so much importance to the cost of fuel and other necessities of smelting as Mr. Hafer does, nor can I see that a wagon haul of 12 miles on both incoming coke and outgoing matte would make much difference. The Tennessee Copper Co., situated similarly in a geographical sense, obtains its coke, I believe, for $4.50 per ton, while common labor costs but a little more than $1 per day. Oak wood, I understand, is bought by them for $1.50 per cord. In what part of the world, I would ask, can these conditions be bettered?

The Georgia company, I observe, practised briquetting of its ore, using lime and cement as binders. Lime is commonly used in many works; but the use of cement, although suggested many years since, so far as I am aware, has never come into regular or extensive use for this purpose. It is comparatively an expensive material, and unthinking persons would naturally jump at the conclusion that it would cost too much to briquette smelting materials by its aid. But its holding power is so great that there will still be economy in exceptional cases by employing it instead of lime or even clay, which are the usual binders. I should be glad to hear of some quantitative experiments or practice in this direction. Cement, of course, while basic in composition, is not, like lime, wholly so, and therefore is less useful as flux for silicious materials. Everybody knows the value of lime for that purpose, and the metallurgist would be safe in assuming that an addition of this base would improve the running of furnaces handling such material as the Seminole concentrate. The minute quantity of cement required would scarcely affect the running of the furnace one way or another, and even the lime necessary to bind the fine material would almost be unnoticeable. The slag, no doubt, was somewhat aluminous, and it may have been deemed unwise to mix the concentrate with clay, the usual binder. About 10% of this answers the purpose, or rather less if the pugging be thorough. Clay is, on the whole, a better binder than lime, since the grout holds together better under the influence of heat. I do not know by experience how the cemented briquettes behave in the furnace, but it is natural to suppose that they would lose water and fall to pieces, as when lime is used.

I judge that the Seminole mine is a fairly promising property, which has suffered somewhat from unpractical methods, but which in the hands of professional operators might be made to show a good profit. It evidently came very near success in this attempt, and in the light of the experience thus gained will doubtless do better next time. No doubt the right man will get hold some time and make it a success. Meantime the owners should not feel chagrined that their efforts have not met with entire success, because one can point to many larger and more noted concerns which have suffered quite as much from doing the right thing in the wrong way.

HERBERT LANG.

Oakland, California, December 19, 1914.

Tin Mining in the Federated Malay States

The Editor:

Sir—With regard to my article in your issue of September 26, may I be allowed to explain that it was written in February, when the price of tin was in the neighborhood of £180 per ton and the world's trade was still in full swing? However, the forecast of what would result if the price fell to £140 per ton has been amply justified. A number of mines have been shut down, while many others are now operating at a loss. Many Chinese mines which cannot be paying their way are still kept going, because the mine coolies are only being fed and given small cash advances, but will not get a full settlement until Chinese New Year on February 14,

such being the custom; therefore the owners prefer to continue in the hope that conditions will improve and enable them to pay their labor. Should the price of the metal remain depressed until Chinese New Year, most of these mines are certain to stop work, which will have a serious effect on the F. M. S. output.

I made a mistake in crediting the Chinese mines with 85% of the total output for 1913. No official figures had been published at the time, and the computation was made from the returns of the non-Chinese mines quoted in the local press. The correct proportions are: 74% or 37,000 tons from the Chinese, and 26% or 13,000 tons from the European and Australian mines.

E. J. VALLENTINE.

Intan, Upper Perak, November 16, 1914.

The Whim Well Copper Mine

The Editor:

Sir—I note in your issue of October 31, 1914, a paragraph in regard to the Whim Well Copper Mines, Ltd. There are several misstatements of fact in that paragraph, and I am sure you will be glad of an opportunity of correcting these.

It is stated that owing to Germany being practically the only buyer of copper ore, the Whim Well mine has been forced to close down. The Whim Well mine has never sent any ore to Germany, and I may say that practically the whole of the ore from that mine was sent to and purchased by smelting firms in England. In view of late discussions as to German trade in ores, this fact will probably be of considerable general interest. The statement that the mine employed over 300 men is incorrect. The employment has rarely exceeded 150 men and has for considerable periods employed less. The figure given as the annual exported tonnage of ore (10,000) is substantially correct.

The statement that the Company has been operating a Murex magnetic plant is hardly accurate. Owing to a number of minor defects in the crushing plant and to other causes, the Murex plant was never run continuously or on a commercial basis and never reached the capacity of 200 tons per day. Only a few thousand tons of ore was treated by it. The plant is today practically complete, awaiting mainly an adequate water supply, which can readily be installed. When operating, the ore to be treated by the plant, including waste to be sorted out, is expected to be nearly 200 tons per day, though something less.

The statement that the mine was in bad order is incorrect. It has been worked by open stoping, on account of selective mining being so far adopted. This necessitated the keeping of the stopes unfilled, to enable the surrounding ground to be worked when conditions changed. The reason for selective mining was the policy of shipping ore. This required a grade of ore higher than the average to be mined. It has been desired to abandon this system for some years past, but circumstances have led to its continuation until the late closing on the outbreak of the war. Meantime it is well to state that not one serious accident has ever occurred through the system used, that is, on account of the so-called 'bad order' in which the mine is stated to be. This is an exceptionally good record. It is not correct that the ground worked during the immediate and near past has been more shallow than the average previously. The inspector of mines has required certain filling or timbering to be done before stoping in certain parts is restarted, owing to the height of the stope roof in certain places. Certainly it is highly desirable that selective mining will not be resumed and that suitable system of filling accompanied by the extraction of the ore on an average grade basis, be started. I have no doubt that this policy will be carried out.

I have never, either two years ago or at any other time, estimated the ore reserves at 1,000,000 tons of 5%. It seems a pity that those responsible for supplying such news to the press do not acquaint themselves with the facts before making such statements. Neither did I estimate that, with copper at £70 per ton, a profit of £60,000 per year would be made. This fact obviates any necessity of denying the final statement that later events reduced this estimate considerably.

I consider that there is promise, or reasonable expectation, of fully 1,000,000 tons of 5% *oxidized ore alone* existing in the mine, and that this ore can be worked at a considerable margin of profit. This is a very different matter. I might deal with this more fully, but such does not seem to be called for in this letter, which is written to contradict erroneous statements.

H. R. SLEEMAN.

London, December 10.

[In this instance our correspondent was evidently misinformed. Mr. Sleeman, as manager, evidently has the correct information on the various points. In our issue of May 23, 1914, will be found an abstract of the annual report issued by the Company in which the developed ore was given at about 100,000 tons of 5%, while the 'probable' ore above water-level was stated to be 1,000,000 tons, the figures agreeing with Mr. Sleeman's present estimate. The difference evidently rests upon confusion of the estimate of 'probable' and developed ore. Evidently, too, the Murex plant was stopped after the annual report was written. We accept Mr. Sleeman's statement on this and other points without reserve, and thank him for calling attention to the error.—EDITOR.]

THE RANDFONTEIN CENTRAL COMPANY, Transvaal, shows the following results for the nine months ended September 30, 1914: Development, 78,933 ft.; ore reserves, 8,664,262 tons; ore mined, 1,968,110 tons; sorted, 6.04%; ore milled, 1,849,228 tons; gold yield, $10,100,000; yield per ton, $5.58; cost per ton, $4.02; and profit, $2,880,000.

USE of the phrases 'German silver' and 'German steel' has been stopped in England since the war, and 'nickel silver' and 'nickel steel' are the descriptive terms used.

CONCENTRATES

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, or smelting.

ELECTRIC POWER at the St. John del Rey mine, Brazil, generated by water power, costs 3.24c. per horse-power per 24 hours.

MOLYBDENUM ORES at the Knaben mine, Norway, are now being treated by the Elmore process in place of water concentration. The product contains 80% MoS_2.

TAXES paid by the St. John del Rey Mining Co. to the state and federal governments of Brazil, during the half-year ended August 31, 1914, amounted to $62,400, including some transport charges.

WHERE TREES ARE SCARCE in parts of the West, sage-brush is used for fuel, according to the Forestry Service. In Nevada the large main stems are trimmed by Indians at $3 per cord and delivered to the user at about $6.50. Sage-brush burns rapidly and is rather dirty, but produces good heat.

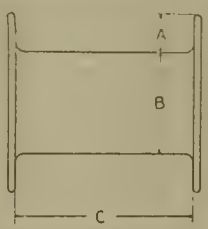
COLD WEATHER at Wardner and Kellogg, Coeur d'Alene district, Idaho, has frozen the water in supply pipes. These were covered by 12 in. of earth, but the frost has penetrated 20 in. Thawing has been done by electricity, by which a heavy current is passed through the mains. This is also done at Spokane, Washington.

'RADIUM ELEMENT' is the correct term to use in discussing treatment by radium, contained in radium bromide, according to William H. Cameron in *Radium* for December. Only the radium element content of any salt is therapeutically active, the bromine in the radium bromide being of no therapeutic value. In this issue mentioned, the writer discusses numbers of cases treated by him and the results.

MINING COSTS at the Iron Blossom mine, Tintic, Utah, last year, were as follows: development, 8755 ft., 21.5c.; stoping 40,480 tons of ore, $3.486; tramming, 10.4c.; hoisting, 39.9c.; surface expenses, 15.2c.; surveying and assaying, 14.1c.; general expense, 17.1c.; pumps, 0.6c.; exploring, 69.1c.; and accident, 0.1c., a total of $5.366 per ton. Driving in waste for filling old stopes increased the cost.

BREAKER plants in the anthracite coal regions of Pennsylvania, which handle coal and produce certain sizes, often burn. Conflagrations are quick and hot, fed by the coal and the numerous drafts throughout the immense open structure. Sprinkler systems that can be turned on by hand from outside the buildings are being installed in 14 of the wooden anthracite breakers of the Lehigh Valley Coal Co., and installations in two more are planned.

DYES FROM SULPHUR have been used only for dyeing cotton, but two chemists at Huddersfield, England, have discovered that sulphur dyes may be used with success on wool, silk, artificial silk, hemp, and other fibres, which can be treated either separately or in combination. These dyes are cheap, and, unlike aniline dyes, add to the properties of milled cloth. Great hopes are held in England for the new methods, as there is a shortage of German dyes.



TO FIND ROPE CAPACITY OF ANY SIZE DRUM.

ROPE CAPACITY in feet of any size drum may be computed by the following rule, according to *Loschen's Hercules*: Add the depth of flange (A) to diameter of drum (B), multiply the sum by the depth of the flange (A), multiply the result by the width of the drum between the flanges (C), and multiply product by figures in column opposite rope size (the dimensions of A, B, and C to be in inches). Example:

$$(A + B) \times A \times C \times \text{multiplier}.$$

Inches.	Multipliers.	Inches.	Multipliers.
¼	4.16	1⅜	0.138
⅜	1.86	1½	0.116
7/16	1.37	1⅝	0.099
½	1.05	1¾	0.085
9/16	0.828	1⅞	0.074
⅝	0.672	2	0.066
¾	0.465	2⅛	0.058
⅞	0.342	2¼	0.052
1	0.262	2⅜	0.046
1⅛	0.207	2½	0.042
1¼	0.167		

ROPE DRIVES have many advantages, the principal of which are the following: (1) Rope drives furnish smooth, continuous action. (2) Rope drives are low in cost of installation and high in efficiency, being from 87 to 97%. (3) The ratio of revolutions can easily be changed by a new small pulley. (4) Changes of pulley alignment which are so destructive to gears or belts, do not affect ropes. (5) Freedom from shut-downs by accidents is assured. The breaking of a tooth is serious; a temporary overstraining of ropes does very little harm. (6) Rope drives are noiseless. (7) The engine or motor may be situated away from the grit and dust of the mill. (8) Freedom from shocks is obtained, as ropes are elastic.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

NEW YORK

NEW KEYSTONE.—INSPIRATION DEAL DELAYED.—ALASKA GOLD FINANCE.—AMERICAN ZINC CO.—ANACONDA.—LEAD AND COPPER EXPORTS.—THE COTTRELL DINNER.

A hitch has developed in the proposed consolidation of the New Keystone and Inspiration Consolidated Copper companies, as J. A. Butler has secured an injunction restraining the Keystone company from carrying out the consolidation, and C. H. Pforzheimer circularized the stockholders in regard to it. Because of this, the meeting of the stockholders was adjourned until January 15, when about a dozen stockholders were present, especially those who were attempting to block the sale. They presented an amendment to the resolution providing for the sale of the Company's assets, calling for the appointment of a committee of five stockholders, two of them to be C. H. Pforzheimer and F. E. Huntress, to appoint two engineers to report on the Keystone property as to tonnage and advisability of independent operation, and if possible also to report on the financial and physical condition of the Inspiration. These majority shareholders believe they should receive a better price for their shareholdings than has already been arranged for, and do not seem to appreciate the fact that the tonnage of ore in the Keystone property is so small that a large part of the operating profit on it would be eaten up in providing for repaying the cost of construction of mine plant and mill, although it will yield a substantial profit when milled in the larger plant of the Inspiration.

The Alaska Gold Mines Co. has called a special meeting of stockholders to be held at Portland, Maine, on January 21, to vote on a proposal to issue $1,500,000 of 10-year 6% bonds, convertible at any time after maturity into shares at $30 per share and redeemable at $110. Also to take action in regard to the proposal to increase the capital of the Company from $7,500,000 to $10,000,000; 50,000 of the new shares to be set aside for the conversion of the debentures and the rest to be held for the conversion of any future debentures which may be authorized. The accompanying circular says that the average grade of the ore developed has proved to be higher than $1.50 per ton first estimated, and the tonnage has also proved much larger than expected. The mill, which is about ready to start, although designed for a capacity of 6000 tons per day, will treat 8000 tons, and the recommendation is that milling operations be increased to 20,000 tons per day as rapidly as practicable.

The president of the American Zinc, Lead & Smelter Co., H. S. Kimball, has stated that in spite of the unsatisfactory conditions prevailing during a large part of the past year, the Company came through the year with a surplus of $70,000 above fixed charges. He estimates that the earnings during 1915 will be at least $700,000, and perhaps may reach $1,000,000. The flotation process at the Mascot property in Tennessee is giving excellent results, and the present rate of earnings of the Mascot is at the rate of over $400,000 per year. The Missouri property of the Company is earning about $100,000, and the acid department is also doing well, as it contributed about $90,000 to the operating profit last year.

The output of the Anaconda Copper Co. for 1914 is given as 225,645,000 lb., as compared with 271,000,000 lb. the preceding year. B. B. Thayer states that some $5,000,000 to $6,000,000 will be spent on the program of construction which the Anaconda company contemplates. Part of this will be spent for doubling the refining capacity at Great Falls, and the rest of it on changes and additions to the Anaconda plants which are in process. Frederick Laist, who developed the leaching process of the Anaconda, has been made chief metallurgical engineer for the Company, and now will have general oversight of metallurgical operations both at Great Falls and Anaconda.

Ordinarily very little lead is exported from the United States, but recently there have been good sales for export, especially to Italy, Russia, and France. One of the producers has estimated that the present exports averaged 12,000 tons per month, compared with 5000 tons in ordinary circumstances. Russia has bought some 10,000 tons during the latter part of 1914. The output continues at about two-thirds of normal, and unless there is a further advance in prices, there is no probability of an increase.

There has been no improvement in the copper export situation, although sales have been rather better than before. The steamer lines to Sweden have followed the example set by the Italian lines earlier in the year, by refusing to accept shipments, since so many vessels have been detained, and the companies are not willing to have their vessels held up at a considerable expense to themselves. Arrangements have been made for the certification by the Swedish minister at Washington that shipments of copper to Sweden were intended for manufacture in Sweden and not for re-shipment to Germany, but the shipping companies do not consider this a sufficient guarantee that their vessels will not be detained. The Italian companies will now accept copper for Italy where same is accompanied by similar documents, but they ask freight rates of about double the ordinary charges. What the producers most complain of is the long delay in acting on shipments. Over 30 shipments are still detained out of a total of 45, and no settlement has been made, although some of these detentions date back as far as August 15. Negotiations between the United States government and that of Great Britain are still in progress, but meanwhile it is difficult for either the copper sellers or the shipping agencies to know just where they stand.

On Friday evening, January 16, over one hundred members of the American Institute of Mining Engineers, American Electrochemical Society, and the Mining and Metallurgical Society of America gathered at the Hotel Plaza, New York, at a complimentary dinner tendered to F. G. Cottrell in appreciation of his services to the metallurgical profession. The dinner was presided over by Sidney Jennings and the first speaker of the evening was Charles D. Walcott, director of the Smithsonian Institution, who told how the Research Corporation came to be organized to administer the valuable patents which Mr. Cottrell had so generously given to the Institution for the benefit of research and the general public. W. L. Saunders next spoke for the Institute, relating some of his experiences with inventors whose patents were valued at a million dollars, saying that this was the first instance he had met where that valuation of patents had been placed upon them by the corporation which owned them rather than the inventor, and paid tribute to Mr. Cottrell's unparalleled generosity in dedicating his patents to public service instead of personal profit. F. A. Lydbury next spoke for the American Electrochemical Society, and told some reminiscences of the time when with Mr. Cottrell he was working as a

student in Ostwald's laboratory at Leipzig. W. R. Ingalls, speaking for the Mining and Metallurgical Society, made an excellent speech, and Mr. Cottrell followed with a response in which, with characteristic modesty, he ascribed the success attained in developing his patent, and in administering the affairs of the Research Corporation, to everyone except himself. It was a source of general regret to all present that Mrs. Cottrell was unable to attend the dinner. The committee sent to her in California a night letter voicing the general regret that she was not present to share in receiving the expression of appreciation.

At the annual meeting of the Research Corporation, held on January 5, 1915, the following minute was adopted: "In 1911, Frederick G. Cottrell, B.S., Ph.D., offered to transfer to the Smithsonian Institution substantially all his rights to his inventions and patents covering the processes known as the electrical precipitation of suspended particles, in order that the profits resulting from the application of the patents, already well assured, might be applied to the advancement of scientific research and investigation." Naturally this proposition was at once regarded as both generous in spirit and highly original in conception. It was Dr. Cottrell's ideal to render the discovery already made the mother of new discovery, and thus contribute to the scientific and technical development of the industrial arts. This far-sighted and patriotic conception found its realization through the Research Corporation, which for administrative reasons was substituted for the Smithsonian Institution as the custodian of Dr. Cottrell's endowment. The objects of the Research Corporation as stated in its charter are as follows in part: "To provide means for the advancement and extension of technical and scientific investigation, research, and experimentation, by contributing the net earnings of the corporation, over and above such sum or sums as may be reserved or retained and held as endowment fund or working capital, to the Smithsonian Institution and such other scientific and educational institutions and societies as the board of directors may from time to time select in order to enable such institutions and societies to conduct such investigations, research, and experimentation."

WASHINGTON, D. C.

MINING EXPERIMENT AND MINE SAFETY STATIONS LEGISLATION.—COPPER SHIPMENTS TO EUROPE.

Mining legislation in Congress is now centring around the bill of Martin D. Foster, Congressman from Illinois, to provide for the establishment and maintenance of mining experiment and mine safety stations, for making investigations and disseminating information in mining, quarrying, metallurgy, and other mineral industries. Meetings have been held to advance the bill in the House, in the hope of procuring its passage on one of the suspension days, but while the legislation in principle is thought generally favored, it involves the large appropriation of about $625,000 if the complete number of stations, eleven (one to be in California), is to be authorized, and as Congressman John J. Fitzgerald, of the appropriations committee, is combatting all new appropriations, and especially those looking large, it is expected that he will raise every obstruction against the bill in a parliamentary way, and it would not be at all surprising if he could block the passage of the bill toward enactment. Then, moreover, the bill would have to pass in the Senate, and the session is now getting short. It is just possible that the House will assent to the passage of the bill with only one or two stations. That would be an opening, and the rest would follow subsequently. Mr. Fitzgerald knows this. A good deal of urgency can be shown for the measure from a sanitation point of view alone in the mines. The great death rate from miner's consumption is most striking. As is shown in Missouri, in certain districts, it amounts to 10%. It is felt that this situation ought to be met and would be met by the bill mentioned. The appeal from this point of view seems unanswerable, and it may have its effect in Congress. At all events, it is the plan to present it. Moreover, the point is going to be made that Congress is more than ever ready to respond to the needs of the agricultural world, appropriating millions of dollars every year for development, and that the mining world should be permitted to share in the benefits of Congress on this score.

The copper situation, with respect to shipments to Europe, continues to be watched here, and especially by T. J. Walsh of Montana, who has given it his special attention. Watchful waiting continues, and there seems nothing else to do.

HOUGHTON, MICHIGAN

REOPENING MINES AND INCREASED TIME WORKED.—C. & H. REFINERY VISITED BY BUTTE OFFICIALS.—COPPER INTERESTED IN GOLD.

Every day or so the copper country learns of the reopening of some mine, an increase in the working force, or a return to full time. Such news is certainly good news, and it gives ground for a spirit of optimism for the year 1915. A report comes from the Iron River district that the Munro Iron Mining Co. will resume operations about February 1, orders having been received from the East to that effect. The Rogers and Chicagoan mines will open on full shifts, and the sinking of the Hiawatha shaft will be continued.

The announcement of the Copper Range Consolidated company that the Baltic, Champion, and Trimountain mines would return to full time schedule was well received here, and especially by the people of the south range towns. Since August 15 of last year the Copper Range mines have been working half a month and shutting down for the other half. The new schedule means full time until next spring at least.

Officials of the Butte & Boston Smelting Co., of Great Falls, recently visited the Calumet & Hecla electrolytic refinery at Hubbell. It is reported that a $2,000,000 plant is to be built by the Butte & Boston company. The visiting party, consisting of the general superintendent, master mechanic, gen-

WATER DRILL IN A MICHIGAN COPPER MINE.

eral foreman of electrolytics, and a draftsman, are on a tour of inspection of electrolytic plants in the East.

For the past five or six years several people at Houghton have been interested in the development of the Oro Belle gold property at Hart, San Bernardino county, California. About a year ago the office of the Company was moved to Houghton, since practically all the stock was held by residents of the Lake Superior region. Great things were expected from the Oro Belle, but as yet no returns have been received by the shareholders. At a meeting of the directors held at Houghton recently, a contract was closed with the Tonopah Belmont company of Philadelphia. After an examination by its own engineers, the Tonopah company accepted the contract to continue the development and equipment of the Oro Belle property.

JOPLIN, MISSOURI

Open-Pit Mining in the Webb City-Carterville District.—Gem, Century, Hurry-Up, and Other Companies' Operations.—A Good Investment.

Open-pit mining is in progress on the Center Creek Mining Co.'s land between Webb City and Carterville, Missouri, the average recovery of zinc-blende and galena being better than 2%. On this land the first mining in Webb City was started over 50 years ago, and operations have been almost continuous since that time. The first mining consisted of lead ore development, 'pay dirt' being opened at places within five feet of the surface. Gradually the operations developed to a more elaborate plan, deeper development being done until the land was opened to a depth of 200 ft. In this ground an extensive formation of hard sheet-ore is encountered, but the upper deposits are all of a soft formation or disseminated in brecciated chert. Remarkably rich soft-ground deposits have been worked at various times, but in recent years much of the property has become so intricately cut and re-cut that good ore formations could not be reached because of the possibility of caving ground. Three separate companies are now engaged in 'pulling' the old ground, by going under the old workings and permitting the ore from above to slide down, the result being that several large caves, that reach upward to the surface, have appeared. The companies at present engaged in this form of development are the Incline Mining Co., the Wisby Mining Co., which is working the old Comet Mining Co.'s lease, and George Moore and associates. The most important sheet-ground development is that of the Ramage mine on the Center Creek land, the blende recovery in recent months having been in excess of 4 per cent.

The Gem Mining Co., situated in an isolated region in the James River country, eight miles southeast of Springfield, Missouri, has resumed operations after an idleness of five months. During the time the mine has been non-productive considerable development has been done, the result being that a good body of choice zinc ore has been opened in a new shaft at a depth of 150 ft., and this will be hauled by aerial tramway to the mill, which is 800 ft. distant. F. R. Cook, sole operator of the property, took over the interests of J. J. Parker, who formerly was interested in the mine. The latter is an Olanthe, Kansas, physician.

The Century Mining Co., at Neck City, Missouri, made its record run recently when in a single day 70,000 lb. of zinc-blende concentrate was put in the bin. This heavy production was made by the day and night shifts. The Company has been operating only a year, having developed an untouched body of rich ore in the midst of a district that had been so thoroughly mined and prospected that almost everyone was inclined to believe that this portion of the district had seen its best days as a mineral producer. However, the Century has opened a really remarkable body of ore at a depth of 200 ft., and in addition to its exceptional richness, which yields over 12% blende, the cleaned concentrate is high in metallic zinc, always yielding above 62%, and, because of this fact, commanding a settlement of several dollars per ton in excess of the basis offerings of the smelters.

To purchase a mine for $3500, and produce enough ore during the first week's operation to pay for it, was the kind fortune that befell Thomas F. Coyne, recently, when he procured a small mine on the Missouri Zinc Fields Co.'s property at Webb City. His first week's work yielded him 100,000 lb. of lead and 90,000 lb. of zinc ore. The property has been named the Red Top Mining Co. and continues to make heavy turn-ins from a depth of 75 ft., while drilling in front of the drifts shows a good body of ore yet to be worked. The ore is hauled some distance to a custom mill for treatment.

The Hurry-Up Mining Co., operated by J. M. Smith, brought $40,000 recently when sold to Kentucky people represented in this district by J. J. McLellan & Co. The mine is on a lease of the Guinn land, and is in the heart of the North Webb City sheet-ground district. It has been a steady producer. The ore occurs at a depth of 200 feet.

John R. Grigg, Elmer Tabor, and Frank Weeks have organized a leasing company and taken over the 746-acre tract of the Saginaw Investment Co. at Saginaw, six miles south of Joplin. The land is known to contain good ore, but the biggest handicap to development has been the heavy water proposition. Even shallow work could not be carried on due to water being encountered within a few feet of the surface. The Company has installed large centrifugal pumps, and the drainage of the land has been started. Leases will be given to prospectors, and a large custom mill is to be constructed to handle the ores mined from the tract.

Carmean & Squires, operators of some of the largest sheet-ground mines in the North Webb City field, have taken over the Mercantile Metal Mining Co.'s properties, also in the North Webb City field. With the stronger ore prices that are now prevailing, a heavy production from all these large mines is looked for.

In drilling into a drift to give better ventilation, good ore was found unexpectedly by Sigler & Co. on the Rex Mining & Smelting Co.'s land, east of Joplin. The Company was working at a depth of 100 ft., the top of the drift being at 90 ft. The drill-hole went into good ore in the roof of the drift, and passing through the drift was permitted to continue downward, with the result that a stope of 18 ft. of good zinc-blende was shown.

DEADWOOD, SOUTH DAKOTA

Oro Hondo, Hidden Treasure, and Echo Mines.—Gypsum Products Manufacture.—County Roads.

Some very hard rock has been encountered in the Oro Hondo shaft, and progress in sinking the three-compartment bore has slackened perceptibly. Where formerly 60 to 70 buckets of rock was hoisted per shift, the output is now 25 to 30 buckets. The city of Deadwood has established a municipal transportation service between Deadwood and the mine, using an automobile to haul passengers and freight. Passengers are charged 10c. per trip, which is considered reasonable for the 4-mile haul. Any deficit in the revenues is met by the city council. The county has recently expended about $3500 in road improvement between Pluma and the mine.

During the season just closing, Lawrence county has spent $75,000 in road improvement, practically all of which has been done in the mining area around Lead, Terry, and Deadwood. All of the work has been under the supervision of a competent engineer, and is of a permanent character. For instance, all bridges are of steel, with concrete abutments, and the maximum grades have been kept below 8% wherever practicable. At the present rate of progress, a couple of more years should give Lawrence county the best roads of any similar mining district in the United States.

With the resumption of shaft work by the Hidden Treasure company, attention is again directed to a most interesting district of the Black Hills and it is hoped that the Company's territory will be thoroughly prospected. The formation is largely porphyritic, consisting of rhyolite and phonolite some veins have been found carrying large percentages of fluorite with encouraging silver and gold content. The shaft was sunk following one of these veins, to a depth of 200 ft., and when lack of funds caused suspension, there was a flattering showing in the bottom. The property is about five miles from Deadwood, on Deadwood gulch. Equipment includes a gasoline driven hoist and compressor. S. R. Thompson has been engaged as superintendent.

Machinery recently purchased by the Echo Gold Mining Co. has been delivered at the property at Maitland, and if weather conditions permit, it will be erected immediately after the holidays. The purchase included a 25-hp. electric-driven Vulcan hoist, an 8 by 8-in. Bury compressor, two Western air-hammer drills, a swing cut-off circular saw for the timber man, and other incidentals to make a complete equipment for prospecting. It is the intention of the Company to sink several hundred feet to explore orebodies which have been exposed on the surface and in adits.

The manufacture of gypsum products, such as stucco, or wall plaster, terra cotta tiling, and the like, has become an important industry in and around Rapid City. According to the report of the state mine inspector, the value of the products manufactured during the year ended October 31 was $59,000. This was the output of two mills. Almost entirely surrounding the Black Hills are large bodies of good-grade gypsum, which will at some future time be immensely valuable. At present the market is limited to practically the local consumption, and with the growth of the tributary sections the demand will naturally increase. It is no unusual matter to find a bed of gypsum 20 ft. thick which can be mined by stripping and open-cutting, and with cheap electric power and fuel the cost is not great; it is the freight rates that govern the scope of the competitive territory.

TORONTO, ONTARIO

NICKEL PRODUCTION OF CANADA, AND THE UNITED STATES, ENGLISH, AND GERMAN INTERESTS.—PATRIOTISM OR BUSINESS CONSIDERATIONS IN THE NICKEL CONTROVERSY.

The agitation for a complete embargo on the exportation of nickel in any form to any country outside the British Empire has not been allayed by the explicit assurance of A. Monel, president of the International Nickel Co., that every precaution is being taken to prevent the refined metal reaching Germany, and that the Canadian government is kept fully informed as to all shipments made by the Company. In view of the continued [illegible] to action by the government to stop the export of nickel matte to the American refineries a memorandum also explaining the situation was issued by the government at Ottawa on December 28. It stated that the whole subject had been carefully investigated since the commencement of the war and there had been frequent communications with the British government as to the precautions which should be taken to prevent export to Germany. The books of the Company in New York are inspected at short intervals by an experienced accountant, who goes thoroughly into all exports and reports for the Canadian government. There is also an arrangement between the Company and the British government by which certain control is exercised in London through the Company's English representatives. The steps taken by the Dominion government, it is stated, have the approval of the British authorities, who are entirely satisfied with these precautions. The widespread belief that Krupp is largely interested in the International Nickel Co. and controls its policy is thus disposed of. "The Company is not under German control, but is controlled altogether in the United States, where the majority of the stock is held. There may be a few German shareholders, but the proportion is insignificant, and there are no German directors." The document concludes by pointing out that as nickel is largely used in many American industries, the prohibition of its export, unless for very urgent reasons, would be undesirable, as it would result in great business disturbance in a friendly country. Furthermore it is stated that German interests control an output of nickel in Norway, which could furnish a sufficient supply for German requirements.

COPPER CLIFF SMELTER OF CANADIAN COPPER CO., CONTROLLED BY INTERNATIONAL NICKEL CO.

This may be taken as conclusive as regards the policy of the government in refusing to yield to the clamor of the scaremongers, and in so doing paralyze an important industry. The total export of fine nickel, contained in ore, matte, or speiss, for the fiscal year ended March 31 last was 50,580,536 lb., valued at $5,374,738, of which 43,989,648 lb., worth $4,398,920, went to the American refineries. In the course of the newspaper controversy over the proposed embargo, which has been in progress for some weeks, much light has been thrown on the real motives of the agitators. The movement is evidently being promoted by the owners of large nickel properties, who wish to shut out the International Nickel Co. and obtain large subsidies or bonuses from the government for the establishment of the nickel-refining industry in Canada. By specious appeals to the patriotism of the people, and their distrust of German influences, they have succeeded in working up a strong feeling on the subject, but the clear and explicit statement of the government has materially allayed the excitement among those who have no selfish interests to promote by it. The Alexo mine produced 878 tons of nickel ore in December.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press.

ALASKA

Chisana

According to G. R. Goshaw, the winter has been mild, and about 250 men are living at Chisana. The trails are being improved, and considerable prospecting is being done on Ptarmigan creek. At the elections, 140 people voted, the population on November 3 being 233.

Cordova

The geology of the Hanagita-Bremner region, in the Copper River district, is described by Fred H. Moffit in *Bulletin* 576 of the U. S. Geological Survey. The examination was carried out under various difficulties natural to the area. Snow remains until the late spring. The only valuable timber is spruce, which is found in varying amounts and quality. The population is small. Trails are not well established. There is plenty of water for sluicing. Gold-bearing gravel was discovered in 1901 by prospectors from Valdez, and placer mining has been done each season since. There are a few gold lodes around Golconda creek, Bremner river, and the Copper river. Copper claims have been staked between Cañon creek and Chitina river.

Fairbanks

Up to December 31, 174,646 oz. gold had been sent out from the Fairbanks district, as the season's output, compared with 197,712 oz. in 1913. The decrease was due mainly to the lateness of the spring. Reports from the new Tolovana district have varied, but recently returned miners are hopeful.

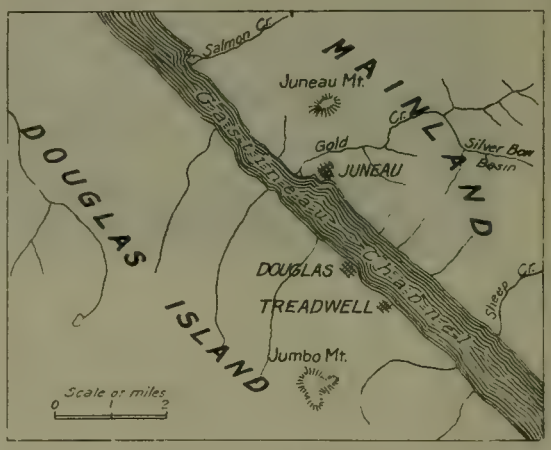
On Fish creek, into which Fairbanks creek empties, there is a little mining being done. McRae & Co. are using a 40-hp. plant to operate a slip scraper in the shallow ground on First Chance creek, a tributary of Fish creek. Carlson & Co. are working on the upper end of No. 1 Above, where the ground is 28 ft. deep. Taylor & McLeod are working on No. 2 Above. Each outfit is employing four men. On Monte Cristo Pup, a tributary on the right limit to Fish between No. 11 and No. 12 Above, J. C. Murphy is working in a small way. Fred Harkins is working, with a couple of partners, on Pearl creek, another Fish tributary. He is ground-sluicing shallow gravel.

Juneau

An interesting general review of the Juneau district mines for 1914 is given in the *Alaska Daily Empire* of December 31. The Alaska Gastineau company's dam at Salmon creek was finished to 165 ft. height and 720 ft. length, using 52,000 cu. yd. of concrete. It will hold 19,000 acre-feet, and now contains 13,000 acre-feet. Both power plants are working. At the mine outside construction is complete. Boarding house, dining room, club house, machine shop, and compressor plant can accommodate 500 men. The compressors have a capacity of 5000 cu. ft. of air per minute. The Sheep Creek tunnel was completed, rails laid, and trains are now running through to the crushing plant. The electric locomotives weigh 18 tons, and the cars will carry 10 tons each. The old Perseverance mine is connected with this tunnel by ore ways 2000 ft. apart, open at each level for ore. Eight levels in the main mine, 200 ft. apart, are all open to the surface in Icy gulch. Every modern underground convenience has been installed. The coarse-crushing plant is finished and has a capacity of 20,000 tons per 24 hours. As the ore cars come from the Sheep Creek tunnel, they are discharged four at a time in electrically operated tipples. The ore passes over grizzlies to 36 by 48-in. jaw-crushers, further screened, and finally crushed to 2 inch in two No. 8 K-type gyratory crushers. The ore falls into an underground storage bin of 10,000-ton capacity. Conveyors then carry it to the mill. This contains motor-driven rolls 54 by 72 in., elevators, screens, and concentrating tables. The plant will treat a minimum of 6000 tons of ore per day.

At the Alaska Juneau property considerable development has been done. A 4000-cu. ft. Ingersoll-Rand compressor is being installed. The site for the large mill was cleared, and necessary buildings erected. Three 9-ton electric locomotives will haul ore to the new mill. The 50-stamp mill is ready. It will crush ore through a ¼-in. screen. One 6-ft. Chilean mill will regrind the pulp from each 10 stamps. An 8-ft. Hardinge mill will regrind concentrate prior to amalgamation. Wilfley tables are to handle coarse material from the stamps.

Owing to the financial condition of the Ebner company, little



MAP OF JUNEAU DISTRICT.

is being done, but a number of men have been extending the main adit, which is now over 8000 ft. long. The mine is one of considerable importance.

The Jualin Alaska Mines Co. contemplates the development of its mine to a capacity of 1000 tons per day. The claims are on the north shore of Berner's bay. As the Company is financed by French and Belgians, work has been curtailed owing to the war. A 5½-mile tramway was constructed from the mine to the wharf on the bay, 4000 ft. of flume and 4500 ft. of pipe was laid for the power plant, a 450-hp. air-compressor installed, and an air-pipe laid to the mine, a distance of 9000 ft. Four sets of Diesel engines will drive generators on the bay when the water supply is low. The mine shaft is to be sunk to 335 ft. Diamond-drilling has been done. The mine is a wet one, and pumps are necessary, but a drainage adit is to be finished, its length being 8000 ft. About $450,000 has been spent to date. Bids were called for mill erection just prior to the outbreak of the war. H. G. Young is general manager.

Fifty miles north of Juneau, in the Berner's Bay district, the Kensington Mining Co. has 70 claims. The ore occurs as a stockwork or a number of veins in diorite, and is similar to that of the Treadwell mine. A cross-cut has been driven over 5000 ft., and three stockworks were cut 2000, 2500, and 5000 ft.

from the portal. Lateral work sampled shows an average of $4 per ton. Plans are under way for ore treatment.

The Eagle River Mining Co. of Georgia is operating 25 miles north of Juneau. Since 1903 the 20-stamp mill has produced over $500,000. The property is fully equipped. The lode formation consists of small rich shoots in black slate. In the Eagle River mine eight of these were mined formerly, although there was considerable faulting. Two years ago these workings were abandoned and a lower adit has been driven 2000 ft. to cut the formations beyond the faulted area. During the past summer the first was cut at 700 ft. depth, showing similar ore and gold content as above. The mill is working again on $20 ore.

Monthly yields of the mines on Douglas island are published frequently in the *Press*, and the regular character of operations is well known to readers of this journal. At the Treadwell mine, work on the 2100-ft. level at the central shaft has been continued. This will facilitate operations in this mine, the 700-Ft. Claim, and the Mexican. The central shaft and crushing plant of 4000-ton daily capacity started during the year. The 300-stamp mill has been equipped with two 500-hp. motors, and the 240-stamp mill will be provided with electric drive in the spring.

At the United company's Ready Bullion mine, a new incline shaft is being sunk to open it 200 ft. below the 2200-ft. level. This shaft is to be kept in the foot-wall slate, the old one being in the greenstone hanging wall. The 700-Ft. Claim is being developed at 2100 ft. The 700-Ft. mill was increased to 150 stamps, and the Ready Bullion 120-stamp mill is also to be increased to 150 in the spring.

At the Mexican mine, the lower ground is being opened by drifts from the 700-Ft. Claim of the United company. No changes were made to the mill.

The new 4740-cu. ft., or 50-drill capacity, Ingersoll-Rand compressor was started at the Alaska Juneau on January 8. It weighs 60 tons, and is rope driven from a 750-hp. General Electric motor. It was erected in 21 days, in charge of Otto Koehler.

ARIZONA

Gila County

It is stated that the International smelter being constructed at Miami may be blown in as early as next April. The output is estimated as 55,000,000 lb. copper from the Miami, and 75,000,000 lb. from the Inspiration. When at capacity the net earnings should be between $1,250,000 and $1,500,000 per year. The Anaconda company of Montana controls the International.

On account of a non-union boilermaker being employed at the Inspiration mine, 25 unionists 'downed tools' on January 12. This action was followed by about 500 tradesmen at the concentrator and smelter. It is also stated that a demand has been made for the restoration of the 10% cut made in wages early in August. Meetings were held and some men wanted the Miami employees to walk out. The secretary of the miners' union declared the strike irregular, and all miners must go to work. C. E. Mills, general manager for the Inspiration company, made the following statement to the employees on the wage dispute: "In view of the present copper situation and the general desire for more pay, I am authorized by the Company to say to you, although it is not yet in the producing stage, that the wages the Company pays its employees are of necessity governed by the copper conditions on which the producing companies of the state base their wage rate. As a consequence, it has been the policy of this Company in the past to raise wages along with the producing companies, although it was at these times producing no copper and benefitting in no way from the increased price of the metal. This policy it expects to and will gladly maintain. All but late comers in the district will remember that the companies, on their own motion, twice raised wages in 1912 on account of the advance in copper prices. The average selling price of copper for the last month was 12 8c., the future price is uncertain, but there are decidedly hopeful signs, and the Company trusts that the past actions of the employing companies of the district will guarantee that the employees will get the benefit of any improvement in the copper conditions at the earliest date possible."

The New Keystone-Inspiration deal is the subject of considerable discussion in New York. A circular has been distributed by Carl Pforzheimer, a large holder of shares in the former Company, giving details of the value of the property. According to the engineer's report of 1912, drill holes and underground work developed 2,516,000 tons of 2.25% ore. Reports in 1911 show about 5,000,000 tons of oxide ore. As a reply to this note, the president, Samuel A. Lewisohn, states that the ore is mixed and difficult to treat. A 1000-ton mill and other plant would be necessary, and this would cost up to $1,250,000. Allowing for all charges, the net annual profit would be only $94,300, or 26c. per share. The Inspiration has 75,000,000 tons of sulphide ore, has raised $12,500,000, is erecting a 10,000-ton plant, and would make a profit of $4.18 per share. At the proposed rate of exchange of shares, Keystone shareholders would receive $9.29 per share in 20 years, instead of $1.82 in seven years if the mine is worked alone.

A vote taken by the Miami miners' union demanding the old rate of $3.75 per shift, against $3.40 at present, resulted in a decision to 'down tools' by a three-to-one vote. The properties affected are the Miami mine and mill, Inspiration mine and mill, and International smelter. Contractors' iron-workers are not affected. All plants are shut down.

Mohave County

The Tom Reed gold output in December was approximately $115,000. Mining below 1000 ft. is decidedly encouraging.—— The Copper Canyon mines have been visited by Henry E. Woods of Denver, R. C. Jacobson, and Anson H. Smith. The former is looking for molybdenite ores and is buying ore from this district. Copper and molybdenite occur together here.

Pinal County

The Kelvin-Sultana Copper Co. held a meeting in Chicago recently. It was decided to increase the capital to $5,000,000 by the addition of 2,000,000 $1 shares. Mine development is to be commenced from the Westfall shaft at 540 ft., to the south end of the property, cutting six veins. This cross-cut will be 2100 ft. long. The new 300-ton mill is to be prepared for resumption of work, and several additions will be made to the power plant.

CALIFORNIA

Amador County

The December output and costs of the Plymouth mine are estimated as follows:

		Per ton.
Tons of ore crushed	10,200	
Value of gold	$42,330	$4.15
Working expenditure	22,618	2.21
Development charges	5,051	0.49
Surplus over above expenses	14,660	1.45
Other capital expenditure	16,283	1.60

The South Jackson Mining Co. states that prospecting has been disappointing on the 500 and 345-ft. levels. Quartz lodes were opened, but they were valueless, save 30 ft. of $3.80 ore 30 in. wide. Prospecting cost $104,000, and at 345 ft. there is 100 ft. of ore 11 ft. wide, not enough to justify a plant. The property is to be closed.

Butte County

The suit of the Forest Service against the Oroville placer mining claim at Forbestown last week was heard at Oroville. A patent is being resisted on the ground that the claim does not contain placer deposits, and further that $500 worth of work has not been done. The answer alleges that the ground

contains placer deposits, some of it prospecting as high as 20c. per pan, that a legitimate discovery of placer gold was made there, and that the indications of a placer deposit are such that a person of ordinary prudence would be justified in expending labor and means with a reasonable prospect for success in developing a paying mine. It also alleges that over $500 was expended in assessment work. W. A. Merrill, of the Forest Service, stated that he found quartz, but no gravel. His examination of the ground occupied four hours. E. P. Gleason made a similar statement, but also said there were quartz deposits. The cross-examination of these witnesses brought out some peculiar methods of inspecting the claim. John M. McIntosh, George White, R. A. Grasse, and E. Kloss also declared that the ground was more valuable for quartz than placer mining. A warm discussion ensued over the meaning of what placer ground and placer mining was. These witnesses ended the case for the Forest Reserve. H. P. Stow, formerly with the Gold Bank company at Forbestown, testified that the ground was a placer area. John Mill, H. Beik, C. K. Colvin, W. Lennon, H. E. Vail, N. Riley, J. C. Labadre, W. H. Ladnes, and C. C. Belding also gave similar views. M. J. Cooney, the principal locator of the ground, was the last witness, and said the right of location of the Oroville placer claim was justified by the fact that some of the area at least is old placer ground. All of the testimony given will be referred to the Commissioner of the Land Office for a decision.

Eldorado County

The Rising Hope gravel mine has been developed during the past three years, and a 150-ton mill has been ordered from the Placerville foundry. Charles M. Henson is superintendent, and G. W. Englehardt represents the New York people supplying money for the property.

San Diego County

The Julian mining district is 60 miles northeast of San Diego, at an elevation of 4250 ft., and placer gold and gold quartz was found there in 1870. Rich ore was mined here in the early days of the field, and the total output to date is said to be several million dollars. The deepest mine at the present time is the Owens, which has been opened to 350 ft. San Diego people are trying to increase the interest taken in the area, and think that numbers of mines are worth reopening.

Shasta County

Zinc ore is to be sent to Oklahoma smelters from the Friday-Lowden mine by the Mammoth Copper Co. A sorting plant is to be erected, and the high-grade zinc ore separated from the copper ore. Other mines in the district have large quantities of similar ore, which is a nuisance in smelting. The Company blew in another blast-furnace at Kennett last week, making three in operation. The Company has sent 28 ingots of copper to the Panama-Pacific Exposition, besides other exhibits.

Sierra County

Very rich gold-bearing quartz, heavily mineralized with arsenical pyrite, has been cut on the bottom level of the North Fork mine near Forest. George F. Stone is manager.

Tulare County

There are signs that the old White River district, near Terra Bella, may have a revival, as shown by the transfer of several properties. The Bald Mountain, Josephine, and other claims are to be reworked. Prospectors are looking for placer ground. Six miles south, the Grizzly mine is keeping a 5-stamp mill at work.

Tuolumne County

The Black Oak shaft at Soulsbyville is to be deepened from 1700 to 1800 ft.——The old Confidence mine is to be reworked by a new company. An adit will be driven to open the lode. T. G. Winwood is in charge.

COLORADO

The Colorado Metal Mining Association held its annual convention at Denver on January 11. Bulkley Wells, of Telluride, is president, and the meeting was attended by representative mining men, Governor Ammons, and Governor-elect Carlson. Three topics of principal interest to mining men were the organization for concerted opposition to the leasehold bills now pending before Congress, the amendment of the mining taxation law which has been a sore point for several years, and the probable consolidation of the various departments of the state government whose activities are concerned with mining, so that their work will be made of greater practical value. The Association, at the suggestion of the state mining commissioner, T. R. Henahan, planned a silver convention to be held at Denver during the current year. The object of the meeting is to fix a standard price for silver and to arrange for an international convention at which free coinage of silver will be urged on all the civilized nations of the world. Officers chosen at the directors' meeting were Bulkley Wells, president; George O. Argall, Leadville, first vice-president; Horace F. Lunt, Colorado Springs, second vice-president; Richard Roelof, Cripple Creek, third vice-president; John M. O'Connell, Denver, secretary; and A. M. Collins, Creede, treasurer. Committees on finance, publicity, legislation, and mining and milling were also appointed.

San Miguel County

The Tomboy mine in December produced 12,625 tons of ore, yielding $50,500 bullion and $34,500 in concentrate shipped. The mill worked 21 days. The profit was $27,860.

Teller County (Cripple Creek)

The Cripple Creek Times estimates the output of the district in 1914 as 980,239 tons, yielding $13,551,932. The output to date is $337,338,672.

The very rich telluride ore opened in the Cresson mine was at 1200 ft. depth. This level showed ordinary grade ore

CRESSON MINE, CRIPPLE CREEK.

for a length of 300 ft., and from 15 to 100 ft. wide. The system of mining was by the pillar method, without square sets. Lateral drifts were driven about 20 ft. apart, the intervening ground being ore. Stoping is extended over these drifts, and in cutting out for an ore-chute a streak was cut and followed, resulting in the discovery of a vug or cave, 15 by 20 by 40 ft., rich in sylvanite. Up to the beginning of the current year 1400 90-lb. sacks of very rich, and 1000 sacks of over $1000 ore had been mined.

IDAHO

Shoshone County (Coeur d'Alene)

The Marsh company, at Burke, is sinking its shaft from

700 to 900 ft. The electric hoist is now ready in the new station at 700 ft. At the bottom of the Hypotheek shaft, 50 ft., a crosscut has passed through 20 ft. of ore, 3 ft. assaying 12% lead, 3 oz. silver, and $1.80 gold, the balance being lower grade, but profitable to work. Development in the Nabob is extremely encouraging.

Discussing the past year's work of the Coeur d'Alene with the *Spokesman-Review*, Spokane, Washington, Stanly A. Easton, of the Bunker Hill & Sullivan company, said: "Estimates of a preliminary character, but of authoritative source, indicate that while the 1914 profits of the Coeur d'Alene will be badly cut into because of the demoralized condition of the metal markets, yet the production exceeds even the former high mark of 1913. The output that year was reported by the government at 148,370 short tons of metallic lead, and for 1914 there is now estimated the remarkable production of 171,730 tons of lead, 13,566,000 oz. of silver, 24,600 tons of zinc, and 21,201 tons of copper. The Coeur d'Alene lead production in 1913 was about 36% of the domestic yield of the United States. The district suffered less industrial depression than any other mining field in the northwest, and if a better market had prevailed the production would probably have been still greater. During the last four months of 1914 many of the larger properties voluntarily curtailed their output by confining operations to the poorer grades of the ore, and the mines at Mullan were practically all closed. This large production would not be so encouraging were it not for the fact that much of it comes from ground hitherto unproductive, in new territory, and the deep development of all of the older properties is of the most satisfactory character. It may, therefore, be predicted with every assurance that the output of the district for several years to come will certainly be up to the present standard of quantity if there is a market, and for many years to come the district will be an important centre for the production of these metals."

MISSOURI

Jasper County

Production of the Joplin and other districts in the second week of 1915 was as follows:

Mineral.	Pounds.	Average per ton.
Blende	8,960,730	$48.28
Calamine	484,660	25.53
Lead	1,437,640	46.71

The Granby Mining & Smelting Co. has made its first purchase of zinc ore for the new Rose Lake, Illinois, smelter, which has a capacity of 400 to 600 tons per week. This plant was described by E. H. Leslie in the *Press* of September 12, 1914.——Considerable work is under way at the old Hoo Hoo mine at Joplin. Sheet-ground has been opened at 180 ft. by three drifts. The mill is of 200-ton capacity.——The McKinley company has started drilling west of Duenweg.——A model showing workings of a Joplin mine has been made for the Panama-Pacific Exposition by Ruhl and Shanklin.——The Oronogo Mutual mill has been driven by steam, gas, and electric power, but it has been decided to have all machinery driven by motors.——The Hornbrook ore, northeast of Joplin, occurs at a depth of 200 ft. and in soft ground, which is the only instance in the vicinity except one other. A 250-ton mill is in full operation.

NEVADA

Esmeralda County

The Western Ore Purchasing Co.'s sampler, at Goldfield, has been overhauled and is ready to receive ore. The plant is entirely automatic.——On March 1 the Jumbo Extension company will pay 5c. per share, or $62,500. The total to date is $222,158. The November return was $124,900, contained in 1599 tons of ore, giving $96,375 net. The December net yield was about $100,000. Development continues to be excellent.

The Florence mine produced 200 tons in December. A winze below 1750 ft. in the Atlanta has opened 3½ ft. of $75.80 ore.

Humboldt County

A rise above No. 4 adit of the Antelope Springs mine has opened 3 ft. of zinc ore.

The new district of Haystack, 8 miles west of Jungo, on the Western Pacific line, is showing fair activity, and small plants are contemplated to treat the free-milling ore. Lessees on the Haystack Mining Co.'s ground are opening good ore.

The Rochester Mines Co. held its annual meeting at Lovelock's last week. L. A. Friedman was elected president and general manager, also W. C. Pitt vice-president, H. J. Nurrish secretary, and R. Nenzel assistant secretary. Directors are L. A. Friedman, J. P. O'Brien of San Francisco, R. Hartley, W. C. Pitt, and Samuel Platt. The mill will be finished early in February, but the power will not be ready for two weeks later.

The Seven Troughs Coalition quarterly report shows that 1114 tons of ore was mined, worth $135,576. Amalgamation recovered 82.78%, and concentration, 10.40%, a total of 93.18%. The net value was $125,000. Rich ore is still showing at 1300 ft. A 600-hp. Fairbanks-Morse gasoline hoist is being erected.

Lincoln County

At the receiver's sale of the Day Bristol mine at Pioche, Eastern shareholders of the Bristol Consolidated Mining Co. purchased it for $99,200, which is the amount of indebtedness. The various claims yield copper, lead, and silver ores.

Nye County

Manhattan is considerably elated on account of the Tonopah Mining Co.'s deal to examine the White Caps property and buy it if satisfactory.——The new Muskett and Wittenberg plant on the Big Pine is doing excellent work. The tube-mill has shown that it can crush 250 tons of ore per day. A conveyor belt has been installed to discharge the overside from the grizzlies to the dump, and has reduced labor charges. A revolving trommel will take the place of the grizzlies.

Five mines at Tonopah last week produced 9148 tons of ore worth $190,624.——The Tonopah company's output in December was $163,525 from 12,540 tons, with $68,260 profit.——A fire service costing about $10,000 is under installation at the Extension.——The Nevada-California Power Co. is erecting three 2500-kw. transformers at its sub-station at Tonopah. These will take the place of 10 old ones.

UTAH

Beaver County

Placer mining is attracting considerable interest in this county. A California syndicate, with E. E. Lindsay in charge, has located 640 acres of ground on South creek, and careful sampling gave an average of 60c. per cu. yd. to a depth of 20 ft. A modified system of dredging is proposed.

Juab County

A report of the Lower Mammoth company shows that 728 tons of silver-lead, 336 tons of zinc, and 531 tons of copper ores were shipped, valued at $9996. Lessees produced 1096 tons of this amount. Including assessment, the net revenue was $23,644. Cash on hand at December 31 was $745.

The annual report of the Iron Blossom will appear in another issue of this journal under 'Company Reports.' The Company will pay 10c. per share, or $100,000, on January 25, making $2,270,000 to date.

The report of the Tintic Central Mining Co. for 1914 shows that development amounted to 542 ft. at a cost of $9.31 per foot. This was done on the 870-ft. level. A rise opened a large shoot of low-grade quartz, which contains pockets of

good ore, and a streak of lead-silver parallel with the fissure. The fissure will be further prospected. Certain claims have been leased.

New rolls are now working in the Knight-Christensen mill at Silver City.——Rich gold is being mined at 600 ft. in the Dragon Consolidated, worked from the Iron Blossom mine. A diamond-drill is working at 1900 ft. depth.——About 60 lessees are at the Eureka Hill and Bullion Beck.——Eight inches of rich silver-lead ore has been cut in the Yankee Consolidated, and is probably an extension of the shoot in the May Day.

PIUTE COUNTY

Ten miles from Marysvale is the Wedge Gold Mining & Milling Co.'s property, under lease to J. V. Sargent. Some very rich gold-silver ore has been cut at a depth of 85 ft. The ore is a quartz with a high percentage of manganese in rhyolite cut by porphyry dikes.

SALT LAKE COUNTY

The Montana-Bingham mine has been leased to S. T. Parr and C. B. Ferlin, well known at Bingham. Not less than 100 ft. of work must be done monthly in the main tunnel.

WASHINGTON

Profits made by companies in the 'Inland Empire' district of this state, Idaho, and British Columbia, were as follows in 1914:

Companies.	1914.	1913.	Total to date.
British Columbia Copper	.....	$ 88,756	$ 704,155
Bunker Hill & Sullivan, Ida.	$ 981,000	817,500	15,710,250
Caledonia, Idaho	166,329	.....	218,329
Con. Smelting of Canada	468,016	464,352	1,948,261
Federal, Idaho	600,000	720,000	14,265,545
Granby, B. C.	448,850	899,911	5,100,893
Hecla, Idaho	220,000	320,000	3,190,000
Hedley, B. C.	300,000	320,000	1,524,000
Hercules, Idaho	3,000,000	1,500,000	8,500,000
Inter. Coal & Coke, B. C.	30,000	120,000	946,000
Kendall, Idaho	30,000	.....	1,505,000
Knob Hill, Washington	.....	25,000	70,000
Le Roi No. 2, B. C.	.....	43,200	1,567,720
Snowstorm, B. C.	.....	45,000	1,124,640
Standard, B. C.	475,000	650,000	1,550,000
Stewart, Idaho	773,976	402,435	1,176,411
Success, Idaho	.....	90,000	930,000
Totals	$7,493,171	$6,506,154	$60,031,204

FERRY COUNTY

At a vertical depth of 250 ft., a cross-cut from the intermediate level of the Knob Hill, at Republic, has cut 4 ft. of $27 gold ore. Shipments of ore are to be increased, according to the manager, J. W. Beckett.

OKANOGAN COUNTY

(Special Correspondence.)—A new compressor and other plant has been added to the Golden Zone equipment. The mill is treating 30 to 40 tons of ore per day, yielding $150 to $200 in gold concentrate.

Conconully, January 16.

CANADA

BRITISH COLUMBIA

The Granby Consolidated produced 21,951,449 lb. of copper in 1914, of which 12,331,332 lb. was from the mines at Phoenix and 9,620,117 lb. from Anyox. The silver production for the same period was 357,752 lb. and gold 27,879 ounces.

ONTARIO

Five inches of 10,000-oz. ore has been cut at 530 ft. in the Temiskaming, an extension of the Beaver vein.——The annual report of the Wettlaufer Lorrain Silver Mines Co. shows that the revenue was $17,531, and profit $5164. No mining was done during the year, and the workings are full to No. 4 level. The outlook for reopening is remote, but the plant is kept in good order, and a caretaker operates the electric mine pump. Examinations have been made of other properties, with generally unsatisfactory results. The credit on hand is $109,913.——On March 15 the Kerr Lake company will distribute $150,000, making $5,670,000 to date.——The Dome mine produced 23,090 tons for $81,660, or $3.53 per ton, in December. During 1914 the total output was $1,065,629 from 219,609 tons.

Including the distribution on January 28, the Hollinger company is now paying 20c. per share per month, or $120,000, against 15c. or $90,000 previously.

MEXICO

SONORA

A special train from El Tigre to Douglas carried 128 bars of bullion, 146 sacks of gold precipitate, and two cars of concentrate from the Lucky Tiger Combination company's mine on January 15. These products contained 700 oz. gold and 225,000 oz. silver. The train, the first shipment in seven weeks, was accompanied by L. R. Budrow and J. W. Malcolmson. There were no important incidents on the trip.

Forty-four cars of concentrate, part of the Moctezuma Copper Co.'s accumulations due to rain and revolution, arrived at Douglas on January 14 from Nacozari. Empties are being sent south for further shipments. First, and especially second-class mail to Nacozari, has been held up for weeks.——The Santa Rosa mine, near Cabullona station, sent a car of copper ore across the border on January 14.

When Nacozari is to be attacked by the Maytorena or Villista forces is doubtful, but they have over 600 men and four cannon marching on the town. The garrison may fight, but surrender is to be expected.

TAMAULIPAS

Notwithstanding the present unsettled conditions prevailing in this district, the November shipments of crude oil from Tampico to the United States shows a steady increase over the same month of the preceding years. During November 1,106,248 bbl. was shipped, compared with 1,028,068 bbl. during November 1912.

NICARAGUA

The Tonopah Mining Co. of Nevada has issued a statement to the effect that it has an option on the property of the Panama Mining Co. in Nicaragua, and has until the first of February to decide whether it will take the property or not. In case the option is exercised, a new company, controlled by the Tonopah Mining Co., will be formed to take title to the property and operate it, and the stock of this new company issued to pay for it. Forty per cent of the stock of the new company will be turned over to the Panama Mining Co. to be disposed of as its officers and stockholders may determine. It will be noted that under this arrangement, if the option is exercised, the Tonopah company buys the property and does not buy the stock of the Panama company. A circular has been issued stating that the property will be taken over on January 28.

The former president of the Panama Mining Co., Rolando Kuehn, and a large shareholder, filed a suit in the United States district court at Philadelphia against the Panama Mining Co. and its officers, and the Tonopah Mining Co. of Nevada and its officers, asking for an injunction restraining a conveyance of the property of the Panama company to the Tonopah company with the forming of a new company to be known as the Eden Mining Co. Kuehn charges the directors of the Panama company with having been guilty of fraud and neglect. He also alleges that no accurate return of the Company's accounts was made. Other objections to the deal were made by the plaintiff.

PERSONAL

HENRY E. WOOD was in San Francisco

ARTHUR THACHER is visiting New York.

L. C. GRATIN was in New York last week

JOSEPH CLENDENIN has been in California.

WALDEMAR LINDGREN was in New York last week

H. FOSTER BAIN and CHARLES JANIN have gone to New York.

J. V. N. DORR has gone to Denver and will remain there about a month.

C. WILLARD HAYES is in Washington, D. C., and expects to go to London soon.

ARCHER WILMOT HENDRICK has been elected president of the University of Nevada.

T. A. RICKARD was expected to arrive in New York on the *Lusitania* on January 22.

SUMNER S. SMITH, government mine inspector of Alaska, has returned to the territory.

M. N. COLMAN is now mill superintendent of the Atolia Tungsten Mines, Atolia, California.

R. C. STICHT, of the Mt. Lyell mine, left for Tasmania on the *Ventura* on January 19. He has been on a long visit to the United States.

J. K. TURNER, consulting engineer for the Jumbo Extension Mining Co., has left Goldfield for Johannesburg, California, for a business trip of several days.

W. MOTHERWELL, who has been experimenting with flotation processes at the Moctezuma Copper Co.'s mill, Sonora, has finished his work and is at Douglas, Arizona.

GEORGE W. GOETHALS was the guest at a luncheon given by the Western Society of Engineers and the Chicago Engineers' Club on January 22, at the La Salle hotel, Chicago.

BARTLETT L. THANE, general manager for the Alaska Gastineau Mining Co., has been called to Seattle to testify in the suit brought against the Company by Stanly Byers for $90,000.

C. A. FILTEAU, who was formerly with the Colorado Mining Co., Manila, sailed from New York on January 13 for Peru, where he will assume the management of the Inca Mining & Development Co. at Santo Domingo, in the province of Carabaya.

Obituary

EDWIN HAMMOND MOWER, 44 years old, died at Joplin on January 12. He was largely interested in Missouri mining concerns.

HANS VUNDER, superintendent for the Alta Consolidated Mining Co. at Alta, Utah, for the past four years, died recently, at the age of 42 years, from ulcers of the stomach. He had been a resident of Alta since 1887, and leaves a widow and five children.

EDWARD WARNE, 53 years of age, superintendent and master mechanic of the Franklin company's mill, Michigan, and in the company's employ for 34 years, died two weeks ago. He was an authority on milling methods, and highly esteemed in the copper country.

Mrs. M. A. PARR, principal owner of the Mineral Zone mine at Elk City, Idaho, died on Nov. 25 from heart failure. Mrs. Parr was well known among mining men. She kept a small hotel, and grub-staked many a miner who was in difficulties. It is pleasant to record that this brought its own reward, since she died possessed of extensive mining holdings.

THEODORE ARMSTRONG died, on January 5, at his home in Chestnut Hill, Philadelphia. He was born in New York in 1841 and was one of a family of seven children. His ancestors had been prominent soldiers in the Revolutionary War and following their traditions Mr. Armstrong and his brothers served in the Union Army through the Civil War. At the close of the war he was appointed to a position in the accounting department of the Internal Revenue Service and a short while afterward was appointed chief accountant of the Pennsylvania Salt Manufacturing Co. at its plant at Natrona, Pennsylvania. Seven years later he became chief auditor of the Philadelphia offices and he was promoted to secretary. By faithful application to duty he rose to treasurer, vice-president, and finally president of the Company in 1888. He was also president of the Wedge Mechanical Furnace Co. and was prominent in business affairs in Philadelphia. In various industrial organizations he was an able and progressive executive and the success made by the companies with which he was connected is in large measure due to him alone. He was a miner of wide interest and a prominent member of such diverse organizations as the Union League Club, the Society of Chemical Industry, the National Association of Manufacturers, the Historical Society of Pennsylvania, the Academy of Fine Arts, and the Ancient Order of United Workmen. He will be keenly missed in the public life of Philadelphia.

BARTON SEWELL died at his home in New York, on January 7, after an illness of a few months. Mr. Sewell was born in 1847 and at the age of fifteen was a drummer boy in the Union Army in the Civil War. After the war he engaged in the dental supply business in Chicago and by the early seventies he had attained so strong a position in the metal industry as to organize the Chicago Smelting Works. Later this was consolidated with the Chicago & Aurora Smelting Co., and about 1888 Mr. Sewell sold out his interest in this Company and organized the National Smelting & Refining Co., at Chicago, of which he was president. About 1891 this Company was purchased by the United Smelting & Refining Co., which needed a refinery in connection with its smelters at East Helena and Great Falls, Mr. Sewell becoming general manager of the United and retaining the presidency of the National. About 1899 he joined with H. H. Rogers, Leonard Lewisohn, F. L. Underwood, and E. W. Nash in forming the American Smelting Co., which two years later joined in a consolidation with Daniel Guggenheim's Sons to form the American Smelting & Refining Co., since popularly known as 'the Guggenheims.' When the American Smelting & Refining Co. was formed he became vice-president and a director of this organization and remained so until the time of his death, holding a similar position in the American Smelters Securities Co. when that corporation was formed. He was active in the formation of the United Lead Co., and was its first president, though not connected with it at the time of his death. During recent years he had chiefly devoted his energies to the Braden Mines Co., of which he was president. He was also a director of the U. S. Zinc Co. Besides his wife, two sons, William B. and Fred W. Sewell, survive him. He was an active factor in the manifold activities of the great organizations with which he was connected and his loss will be keenly felt.

Schools and Societies

The Columbia section of the A. I. M. E. will meet at Spokane in February. Mining laws, taxation, mining and milling methods are suggested by the committee as desirable subjects for papers and discussions.

A 'Caterpillar school' is to be held at Stockton, California, January 18 to February 13, by the Holt Manufacturing Co. F. L. Peterson, formerly assistant professor of farm mechanics at the University of California, is in charge of the course, by which full instruction will be given in the use of the Caterpillar gas tractor. This machine is useful in hauling mining or farming supplies. The tuition fee is $25 for the term.

THE MARKET PLACE

Weekly Summary of Prices of Shares and Metals

Metal Prices

San Francisco, January 21.

Antimony	15 —15¾
Electrolytic copper	14 —14¼
Pig lead	3.95— 4.00
Quicksilver (flask)	$52 50
Spelter	7 — 7¼
Tin	34½—36
Zinc dust, 100-kg. zinc-lined cases	9

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, January 21.—Copper is strong and advancing at 13.53c., lead quiet and weak at 3.70c., and spelter strong and advancing at 6.13c. per pound.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.		Average week ending	
Jan. 14	49.12	Dec. 9	49.91
" 15	49.00	" 16	49.83
" 16	48.75	" 23	48.66
" 17 Sunday		" 30	48.65
" 18	49.00	Jan. 6	48.65
" 19	49.00	" 13	48 98
" 20	49.00	" 20	48.98

Monthly averages.

	1913	1914.		1913.	1914.
Jan.	63 01	57.58	July	58.70	54.90
Feb	61.25	57.53	Aug.	59 32	54.35
Mch.	57.87	58.01	Sept.	60.53	53.75
Apr	59.26	58 52	Oct.	60.88	51.12
May	60.21	58.21	Nov.	58.76	49.12
June	59.03	56.43	Dec.	57.73	49.27

The silver market has been very steady. On January 16 the 'Shinyu Maru' took $123,190, or 250,000 oz. to the Orient. The Cobalt district of Ontario shipped 470,231 oz. last week to England, the Nipissing contributing 406,663 oz. The Indian Bazaars have given a little support to the market, but China is the mainstay at present. Stocks of metal in London at the end of 1914 were worth £1,400,000, or 14,500,000 oz. Pixley & Abell's 'Annual Circular' has been published, and should be secured by silver producers. The average price of bar silver in London in 1914 was 50.62c. per ounce, the range of prices being 11.25c., and in New York, 54.8c. Stocks held by the Bazaar in Bombay and Shanghai amount to about 70,000,000 oz. Imports into the United States were $25,331,000, and exports $50,500,000. Mexico supplied $14,186,000, and Canada, $5,657,000 of this.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Jan. 14	3.70	Dec. 9	3.80
" 15	3.70	" 16	3 80
" 16	3.70	" 23	3 80
" 17 Sunday		" 30	3.80
" 18	3.70	Jan. 6	3.80
" 19	3.70	" 13	3.70
" 20	3.70	" 20	3.70

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	4.28	4.11	July	4.35	3.80
Feb.	4.33	4.02	Aug.	4 60	3.86
Mch.	4.32	3.94	Sept.	4.70	3.82
Apr.	4.36	3.86	Oct.	4.37	3.60
May	4.34	3.90	Nov.	4.16	3 68
June	4.33	3.90	Dec.	4 02	3.80

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	50.45	37.85	July	40.70	31.60
Feb.	49.07	39.76	Aug.	41.75	50.20
Mch.	46.95	38.10	Sept.	42.45	33.10
Apr.	49.00	36.10	Oct.	40.61	30.40
May	49.10	33.29	Nov.	39.77	33.51
June	45.10	30.72	Dec.	37.57	33.60

Tin is fairly strong at 34.35 to 34.75c. per pound.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Jan. 14	13.53	Dec. 9	12.73
" 15	13.53	" 16	12.70
" 16	13.53	" 23	12.84
" 17 Sunday		" 30	12.75
" 18	13.53	Jan. 6	12.92
" 19	13.53	" 13	13.30
" 20	13.53	" 20	13.53

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	16 54	14.21	July	14.21	13 26
Feb.	14.93	14.46	Aug.	15.42	12.34
Mch.	14.72	14.11	Sept.	16.23	12.02
Apr.	15.22	14 19	Oct.	16.31	11.10
May	15.42	13.97	Nov.	15.08	11.75
June	14.71	13.60	Dec.	14.25	12.75

Copper exports to the end of November were 757,261,120 lb., and with December estimates, a total of 790,000,000 for the year, against 857,000,000 lb. in 1913. Consumers say that at the present price there will be a tendency to increase production, and are doubtless holding off with their orders. Now that the Copper Producers' Association no longer furnishes figures there is no telling what stocks on hand amount to; but it is not probable that they are small enough to justify any increase in production, and Thomas F. Cole has stated that he sees no probability of an increase.

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound

Date.		Average week ending	
Jan. 14	6.13	Dec. 9	5.50
" 15	6.13	" 16	5.50
" 16	6.13	" 23	5.37
" 17 Sunday		" 30	5.40
" 18	6.13	Jan. 6	5.50
" 19	6.13	" 13	5.85
" 20	6.13	" 20	6.13

Monthly averages.

	1913.	1914.		1913.	1914.
Jan	6.88	5.14	July	5.11	4.75
Feb.	6 13	5.22	Aug.	5.51	4.45
Mch.	5.94	5.12	Sept.	5 55	5.16
Apr	5.52	4.98	Oct.	5.22	4.75
May	5.23	4.91	Nov.	5.09	5.01
June	5.00	4.84	Dec.	5.07	5.40

Exports of spelter in November were 12,747 tons domestic and 957 tons foreign metal. In 11 months the total was 46,486 tons, against 3564 tons in 10 years to the end of 1912, when the total was 45,119 tons.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Dec. 24	53.00	Jan. 7	51.50
" 31	52.50	" 14	50.00
		" 21	52.50

Monthly averages.

	1913.	1914		1913.	1914
Jan.	39.37	39.25	July	41.00	37.50
Feb.	41.00	39.00	Aug.	40.50	80.00
Mar.	40.20	39.00	Sept.	39.70	76.25
Apr.	41.00	38 90	Oct.	39.37	53.00
May	40.25	39.00	Nov.	39.40	65.00
June	41.00	38.60	Dec.	40.00	53.10

The quicksilver market is stronger, enquiries coming from foreign sources for supplies.

METAL PRICES IN FRANCE

According to a consular report of December 15, these were as follows: copper, 14.93c.; lead, 5.10 to 5.13c.; tin, 35.89 to 35.28c.; and zinc, 8.32c. per pound.

Transactions on the San Francisco Stock Exchange in 1914 were as follows: 62,167,554 shares valued at $16,103,664, against 41,300,952 shares and $14,411,153 in 1913. There were two periods of increased dealing, Tonopah and Goldfield stocks being the attraction.

MINING DECISIONS

Petroleum Lands—Executive Withdrawals

The President of the United States has no authority to withdraw petroleum lands from location and entry, pending the enactment by Congress of legislation in respect to such lands thought by him to be needful. The power to dispose of and make all needful rules and regulations respecting the territory and other property of the United States, including the lands thereof, is vested by the Constitution exclusively in Congress.

United States v. Midway Northern Oil Co. *et al.*, 216 Federal, 802 (California). May 29, 1914.

Sale of Mining Stock—Default Excused

A corporation agreed to sell B shares in a certain mining corporation, on specified payments, knowing that B did not have the money to buy the same himself, but would interest outside parties. Some good ore was developed, and B sought to make an examination accompanied by an engineer, which as a shareholder he was entitled to do; but the directors of A conspired to prevent the examination, so that B was unable to get his financial backers to raise the first installment of the contract price and defaulted in payment thereof. Held, that an action for specific performance would not lie, as B was in default on the first payment. Failure to enforce his legal right to examine the mine did not excuse the default.

Hobbs *v.* Davis (California), 143 Pacific, 733. October 5, 1914.

Severance of Surface and Underlying Minerals

A conveyance of underlying coal with the privilege of removing it, effects a severance of the right of the surface from the right to the underlying coal, and makes them distinct corporeal hereditaments; the presumption that the party having possession of the surface has also possession of the subsoil not being applicable after such severance. In such case the owner of the surface cannot by mere possession thereof gain prescriptive title to the coal beneath it, but it would be incumbent upon him to prove adverse possession of the minerals as such, independent of the surface. The claimant of mineral rights under a void deed with mere color of title, who fails to retain possession of the mine for the prescriptive period, but abandons it and moves to another state, he is barred from recovering same under a subsequent claim of prescriptive title.

McBeth *v.* Wetnight (Indiana), 106 Northeastern, 407. October 9, 1914.

Synopsis of New Mining Laws

Act of August 25, 1914.—Provides that the Secretary of Interior may make agreements with applicants for patents for oil or gas lands included within an order of withdrawal as to the disposition of said oil or gas, or proceeds from sale thereof, pending final determination of the title to said lands.

Act of July 17, 1914.—Provides that lands withdrawn or classified as containing phosphate, oil gas, nitrate, potash, or asphaltic minerals shall be open to location, selection, entry, or purchase under the non-mineral land laws—all patents to contain a reservation to the United States of deposits withdrawn and the right to mine and remove the same. Any person qualified to acquire reserved deposits may prospect and mine on such lands for same upon furnishing a bond to be approved by court and Secretary of Interior protecting and compensating owners of the land for damages.

Act of October 20, 1914.—Relating to disposal of Alaska coal lands.

MINERAL STATISTICS

The following data covering the year 1914, are from the U. S. Geological Survey.

Coal in Michigan

The production was about the same as in 1913, when it was 1,231,786 tons.

Coal in the Rocky Mountain States

Excepting New Mexico, all of these states showed decreases. Colorado suffered on account of labor troubles, and New Mexico supplied the deficiency. Hydro-electric power is a competitor of coal in Montana. The outputs are as follows: Colorado, 1,000,000 tons less than in 1913; Montana, decrease from 3,365,712 to 2,938,671 tons; New Mexico, increase of 15 to 20%, to 4,450,000 tons; Utah, decrease of 10%; and Wyoming, a decrease of 7%. Reduced copper production affected Montana and Utah.

Metal Yield of Washington

According to C. N. Gerry, this was as follows: gold, $558,000, decrease of 20%; silver, 253,000 oz., or —23%; copper, 737,500, or —23%; and lead, 202,487 to 65,000 pounds.

California Metal Production

The output of this state was as follows, according to Charles G. Yale: Gold, $21,138,500, an increase of $731,500; silver, 1,987,700 oz., an increase of 609,300 oz.; copper, 34,000,000 lb., a decrease of 560,000 lb.; lead, 6,484,000 lb., an increase of 3,514,342 lb.; and zinc, 2,107,000 lb., an increase of 1,050,000 pounds.

Arsenic Production

According to F. L. Hess, white arsenic from smelters was 1227 tons, worth $251,268, against 2513 tons and $159,236 in 1913.

Idaho Metal Production

The depression of the metal market that followed the declaration of war did not prevent Idaho mines from again making a record production of silver, lead, and zinc, and the value of the gold, silver, copper, lead, and zinc produced at these mines in 1914 was $24,141,000, against $24,149,049 in 1913. Details are as follows: gold, $1,344,559, a decrease of 17%; silver, 13,000,000 oz., an increase of 30%; copper, 5,500,000 lb., or a decrease of 4,000,000 lb.; lead, 345,000,000 lb., an increase of 9%; and zinc, 38,614,000 lb., against 23,173,953 pounds.

Oil Output a Record

The phenomenal increase which has characterized the growth of the industry during the past eight years was more than maintained in 1914, according to John D. Northrop. Preliminary estimates show the yield to be 292,000,000 bbl., compared with 248,446,230 bbl. in 1913, Oklahoma, California, and Texas showing the greatest increases.

Coal in the Mississippi Valley States

According to E. W. Parker, the following are the yields last year: Illinois, a decrease of 10% from 61,000,000 tons in 1913, hydro-electric power from the Keokuk dam affecting coal used for steaming; Indiana, a decrease of 10% after October 1; and Iowa, a decrease of between 500,000 and 1,000,000 tons.

Oregon Metal Production

According to Charles G. Yale, this was as follows: gold, $1,600,000, about the same as in 1913; silver, 126,000 oz., a decrease of 53,000 oz.; copper, 5000 lb., against 43,000 lb.; and lead, 41,000 lb., a decrease of 46,000 lb. Of the 175 producing mines in Oregon, 125 are placers of small size.

New Machines and Devices

Lighting Plants for Steam-Shovels

For night work in steam-shovel operations, adequate illumination is imperative, not only for the bank from which the shovel digs, but also around the shovels themselves, to permit the necessary inspections and adjustments and to afford safety for the workmen. Acetylene had been tried for this work at the Utah Copper Co.'s property, but proved troublesome, costly, and somewhat dangerous, so illumination by means of electricity was adopted.

The general illumination of the bank is furnished by a battery of powerful projector searchlights on the opposite side of the cañon from the property. To supply local illumination, about twenty incandescent lights were placed on each shovel. The current supply for these lamps proved quite a problem. One of the difficulties was due to the shovels being constantly moved about. To meet this difficulty, a reel

STEAM-SHOVEL WITH LIGHTING SET. THE ARROW SHOWS POSITION OF TURBO-GENERATOR.

which carried a semi-flexible cable was carried on each shovel. This arrangement gave considerable trouble, as the rocks rolling from one terrace to another would carry away wires or poles, and blasts would frequently throw rock that would damage the semi-flexible cables along the ground. Not only were such accidents costly on account of the replacements required, but shovels were frequently put out of commission due to all lights going out when a rock from a higher level crashed down through its feeder line. The problem was one of constant annoyance until in December 1913 the Westinghouse Electric & Mfg. Co. furnished the copper company with a 1-kw. general utility turbo-generator outfit. This set was mounted directly on the shovel, being fastened to the under side of the main shovel frame, as shown in the accompanying illustration, and was supplied with steam from the boiler furnishing steam to the shovel. The shovel with its little self-contained power plant was immediately freed from all interruptions caused by accidents to its supply of illumination. The turbo-generator outfits are now in use on seven shovels, making, it is claimed, a great saving in wire and time. One of these sets will operate an arc lamp and a few incandescents at the same time, or about forty 25-watt incandescents. Practically no attention is required for the set, and there are no delicate adjustments to make. Full rating is developed on steam pressures between 90 and 250 lb. A governor controls the speed and keeps it uniform. A fixed resistance furnishes voltage regulation, and a rheostat is provided to adjust the voltage when the number of lamps in use is varied. Hence, in spite of the abrupt changes in steam pressure and load that characterize shovel service, steady light is obtained.

Commercial Paragraphs

The *Caterpillar Times*, house organ for the HOLT MANUFACTURING Co., Stockton, California, contains numerous instances of the adoption of the caterpillar type tractor to agricultural purposes.

S. FLORY MANUFACTURING Co., Bangor, Pennsylvania, has published an elaborately illustrated bulletin devoted to the products of this Company which were used in the construction of the Kensico dam. This equipment included two 12-ton capacity cableways, two Flory tower moving hoists, nineteen Flory 75-hp. two-speed patented hoists operating traveling derricks on the dam and at the quarries and twenty-two Flory 11-hp. boom swingers for traveling derricks.

MESTA MACHINE Co., Pittsburgh, Pa., in Bulletin 0 and 1 are presented detailed descriptions of the rope drives and gas-engines manufactured by this Company. Rope drives are claimed to have many advantages over other types of drives and are especially adapted to heavy work. The catalogue is illustrated and contains considerable information on the subject. The gas-engines of the Company are built for all classes of service and for any fuel. Bulletin 1 contains a brief description of Mesta gas-engines together with information regarding their operation.

The PELTON WATER WHEEL Co., San Francisco, California, has recently issued a very attractive catalogue, Bulletin No. 8. This bulletin illustrates and describes the Pelton wheels which are particularly adapted to driving mining, sawmill, industrial, and other machinery, and to acquaint the prospective purchaser with a few of the types of Pelton wheels technically designated as standard. The bulletin is replete with illustrations and contains a large amount of information regarding the installation and operation of Pelton wheels for a wide variety of power purposes.

ALLIS-CHALMERS MANUFACTURING Co., Wilwaukee, Wisconsin, in Bulletin No. 1088, describes the distributing transformers manufactured by this Company. Among the features claimed for this transformer are three cooling surfaces in place of one as usually employed, a continuous natural circulation of oil, and a low operating temperature. The bulletin is fully illustrated and shows in detail the construction and operation of this type of transformer. Bulletin No. 1089 is devoted to the reversing motor planer drive. The motor as used for this work is automatically reversed at the end of the cutting and return strokes. In the design of this motor no effort has been spared to provide apparatus which will be the best for the particular character of the work to be performed. Bulletin No. 1090 is devoted to motor-generator sets. The motor-generator set is a convenient means of transforming or converting electrical energy from one form to another. For this purpose the Company manufactures a large variety of sets to meet the requirements of the many conditions obtaining in practice. The bulletin is fully illustrated and contains considerable general information on the subject.

The Manganese Industry in California—By Samuel H. Dolbear, page 172

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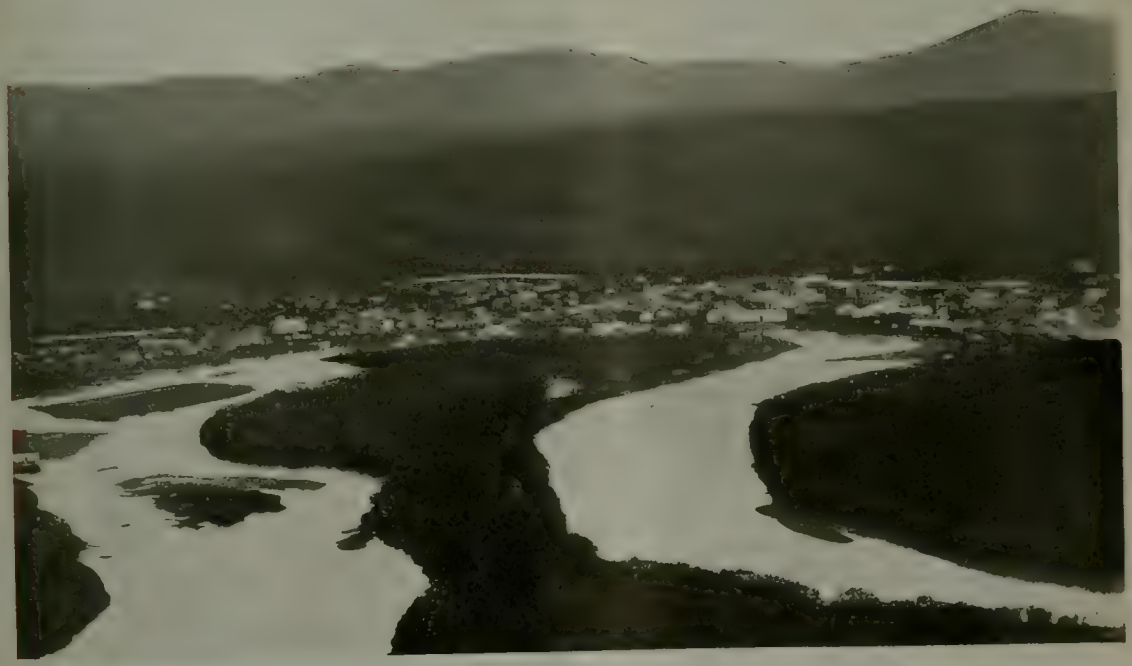
SAN FRANCISCO, JANUARY 30, 1915

Contents—Page 4
Buyers Directory—Page 28
Advertisers Index—Last Page

ITDITAROD was the scene of a gold discovery in 1909, and during the succeeding years the town of this name was established and foundations laid for a gold mining industry. Reports of the fabulous wealth of the district attracted prospectors and engineers from everywhere and the 'long tom' and sluice boxes were very much in evidence until the winter of 1911-12, when control of a large part of the ground was obtained by the Yukon Gold Company. The advent of the dredge marked a new era in Iditarod mining and the old time placer miner has been superseded in large part by buckets and ladder. The Yukon company obtained $734,000 during the past season from dredge operations at Iditarod. The situation in the district at the present is discussed in the current issue by Mr. Hurja.



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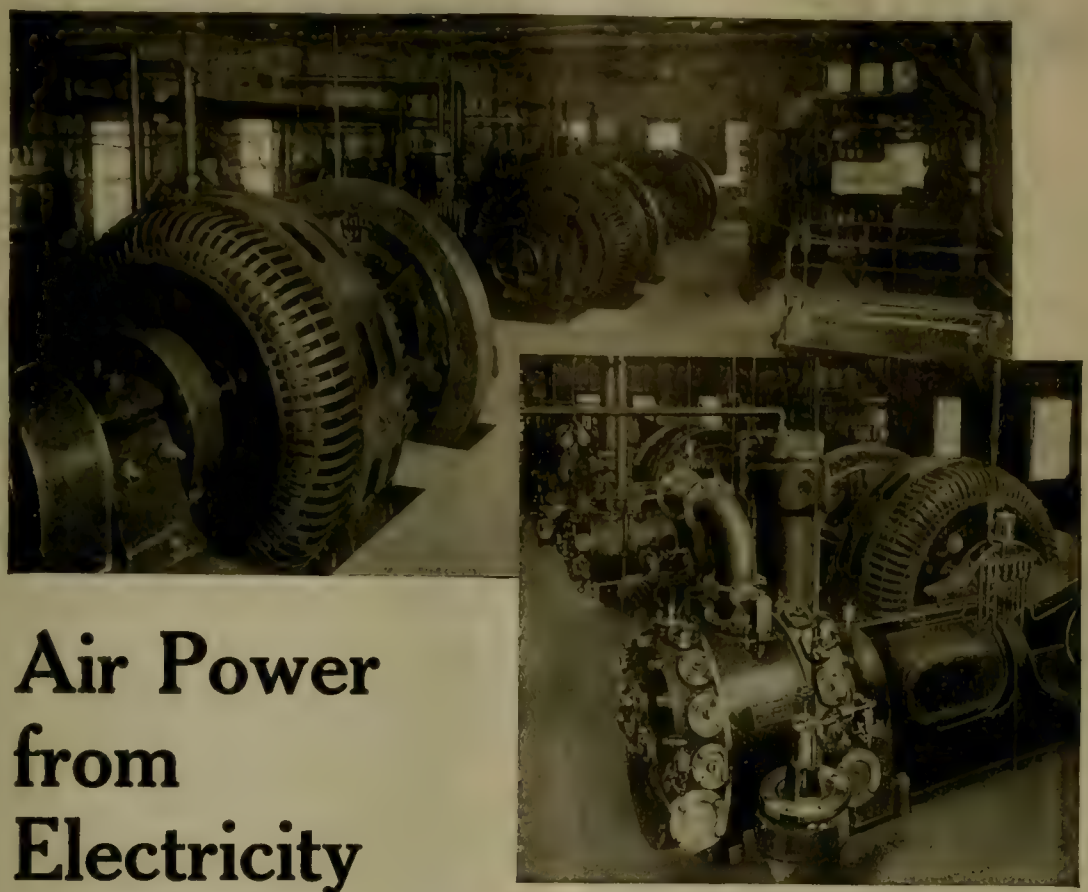

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TABLE OF CONTENTS

EDITORIAL Page.

Notes 169
Protection of Oilfields 170
Problems of Labor 170

ARTICLES

THE MANGANESE INDUSTRY IN CALIFORNIA.
By Samuel H. Dolbear 172

California has been a purchaser of manganese ore for nearly fifty years. Of the early output a large part was consumed by chlorination plants. However, since the cyanide and other processes have practically eliminated this market, the ore at present being mined is used largely by local steel mills and dry cell manufacturers. Manganese ore is known to occur in 33 counties in California. The present status of the industry and the uses to which the ore is being applied are discussed.

COAL-DUST FIRED REVERBERATORY FURNACES 175

The use of coal dust as a fuel for reverberatory furnaces is being tried out at the Washoe smelter with satisfactory results. Details as to the operation of one of the furnaces is described.

THE INFLUENCE OF SLAG AND FUMES ON THE ZINC MUFFLE.
By O. Proske 176

A large amount of experimental work has been conducted under the direction of O. Proske on the influence of slag and fume on zinc muffles. The results of this experimental work are interesting and instructive. It was necessary to establish the absorption of zinc oxide by the clay and the combination of zinc oxide with the individual constituents of the clay. The investigation followed three lines of attack, namely, the diffusion of gases as influenced by pressure, temperature, and time.

IRON MINING IN MICHIGAN. *Staff Correspondence* 180

The total production of iron ore from the mines of the Marquette range during 1914 amounted to 2,463,973 tons. During the year 30 mines shipped ore. Production statistics of the mines are presented.

KAURI GUM DEPOSITS OF NEW ZEALAND.
By W. D. Hornaday 181

While little is known to the outside world of the kauri gum mining industry of New Zealand, it is nevertheless an important industry, and has a production since its beginning in 1853 valued at approximately $85,000,000. The present annual production is about $2,500,000. The manner of mining the gum is illustrative of the well known fact that many things are done differently in New Zealand from any other country on earth. Interesting details regarding the industry are presented in an instructive manner.

BLAST-FURNACE PRACTICE AT MOUNT LYELL, TASMANIA.
By Robert Sticht 183

The Mount Lyell company began operations in 1896 with three blast-furnaces, and later installed converters. This plant was enlarged to six blast-furnaces, and a second plant of five additional furnaces was later erected. The development of the present practice has been largely the outcome of years of experience in the treatment of the Mount Lyell ore. This development has been an interesting one, and is described by Robert Sticht, who has been connected with the Company for a number of years, and who brought to Mount Lyell a wide experience acquired in the treatment of ores in the United States.

CHILEAN NITRATE STATISTICS 185

The Iquique branch of the Nitrate Propaganda Association reports that the production of nitrate in November 1914 was 2,659,875 quintals, which is but little more than half of the production for the same period of the preceding year. Details as to production and value of output are presented.

FIRING BOILERS. *By Alexander M. Allen* 185

It is well known that boilers working in batteries, though of the same size and style, will not evaporate the same amount of water per hour. This is due in no small extent to the method of firing. The correct method for firing is the subject of this discussion.

DEPARTMENTS

DISCUSSION:

Bucket Elevators. *By William Seward Mann* 186
A method for overcoming difficulties in the use of bucket elevators.

Johnson Electric Furnace. *By Joseph Struthers* 186
An erratum in an article on the subject of electric smelting which appeared in our issue of January 2 is corrected by Joseph Struthers.

Solution Control in Cyanidation. *By A. W. Allen* 186
An answer to Haral Layng's contribution to the discussion of cyanide solution control, which appeared in our issue of October 17, 1914.

Precision of Thought. *By T. A. Rickard* 187
Attention is called by Mr. Rickard to the inconsistencies in the use of verbs as employed by the American Ambassador in a recent note to the British government.

CONCENTRATES 188

MINING IN THE FAR NORTH.

The Iditarod District—Dredging and Placer Operations. *By Emil Edward Hurja* 189
Mining in the Iditarod district during the past few years has undergone a change and small-scale operations, as conducted by the individual prospector and miner, have given place to the wholesale operations of the dredge. Mr. Hurja, in the present article, presents the status of the industry today with details as to operations which are at present being conducted.

REVIEW OF MINING: Special correspondence from Kalgoorlie, Western Australia; New York; Toronto, Ontario; Lordsburg, New Mexico; Petrograd, Russia 191

THE MINING SUMMARY 195

PERSONAL 199

SCHOOLS AND SOCIETIES 199

THE MARKET PLACE:
Metal Prices 200

MINING DECISIONS 201

BOOK REVIEWS 201

COMPANY REPORTS 202
De Beers Consolidated Mines, Ltd.; Iron Blossom Consolidated Mining Co.; Sulphide Corporation, Ltd.

RECENT PUBLICATIONS 202

NEW MACHINES AND DEVICES:
Large Jaw Crushers 203
The Largest Induction Hoist 204
Commercial Paragraphs 204

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ARRANGEMENTS have recently been completed whereby Mr. T. A. Rickard, editor of *The Mining Magazine*, will return to San Francisco, within the next few months, as editor of the *Press*, and Mr. H. Foster Bain will go to London as editor of *The Mining Magazine*.

NEW tax regulations covering mining properties in the Philippine Islands have been proposed by the Collector of Internal Revenue, but open meetings are to be held in which mining men and others interested can express their views before enacting the law.

CHINA'S method of creating a merchant marine is to guarantee dividends on the stock of a shipping corporation, in return for advantageous freight rates on certain articles. The shipping corporation, recently organized, proposes to operate ships between China and New York through the Panama canal.

GOLD OUTPUT of the Rand for 1914 was 8,378,139 ounces, as compared with 8,798,336 ounces in 1913, which output is generally considered satisfactory. It is gratifying to note that the war has not affected gold mining operations in the Transvaal, and it is anticipated that the new producers will keep up a steady output. Dividends for 1914 totaled £8,371,228, as compared with £8,596,532 for the preceding year.

CHEMICAL and drug imports which were seriously interrupted during the first three months following the outbreak of the European conflict, have again resumed normal proportions. The November imports were valued at $7,904,944, as against $6,746,147 for the same period of the preceding year. The importation of sodium cyanide, which in August dropped to 84,000 pounds, increased to 2,182,000 pounds in November, greatly ameliorating the American supply.

NITRATE operators in Chile are in a parlous condition. The Chilean government has advanced about $1,500,000 to operators so that they may not have to close down their plants, but this has been of no avail to the smaller organizations, and it is said that many of the small towns are almost depopulated, over half of the plants having already been closed. The exodus has one compensation in that the supplies of food available, which would otherwise have soon been exhausted, will probably suffice for several months.

MERCHANTS all over the world are turning their attention toward the United States, as the war in Europe has served to cut off their former source of supply. The Department of Commerce at Washington is in daily receipt of numerous inquiries for products of every imaginable variety, and the daily *Commerce Reports* has had to largely increase the space devoted to the publication of these inquiries. Copper wire and cable for Europe, tin plate and aluminum sheets for Denmark, mining supplies for the Far East, electric equipment for South America, white lead for Russia, sheet brass for Great Britain, chemicals for Greece, lamp chimneys for miners' lamps in England, mining machinery for South Africa, bichromate of potash for France, locomotive tubes for northern Europe, calamine for the East Indies, tin plates for South America, nitrate of soda and fireclay for Greece, glass for China, and brass wire for Portugal; these are only a few out of thousands. It seems reasonably certain that if our own producers will make concessions when necessary to form desirable permanent connections, instead of taking advantage of present conditions to reap a temporary advantage, a large increase in our foreign trade may be expected.

ANTIMONY has been rising steadily in price, as the good demand from Europe has enabled speculators in the East to clear out their stocks, which were large. Reports from Japan state that large orders from Europe are being received there, but can not be filled, as the Japanese stocks are small and production not large. Orders are also going direct to China, where the Wha Chang Company, the principal producer, has been selling its regulus to the Chinese Antimony Company, a subsidiary of Cookson's, under a contract providing for payment on the basis of the average metal market report in London. As the London market has been low and the New York market high, the Wha Chang Company objected to this basis of settlement, and refuses to make any more deliveries until its contract with Cookson's expires June 30 next. Sales are being made direct to export houses in China, and recent sales to Russia have been reported. As China exports about 15,000 tons of antimony each year, and can produce much larger amounts, it would seem that the present affords the Chinese producers an excellent opportunity to get control of the world's trade in antimony, and the Wha Chang Company has shown commendable foresight in opening a sales office in New York City.

STANDARD OIL operations in China have been made in the public eye, without much in the way of definite result to record as yet. The *Sinwan Pao*, of Peking, has recently stated that the first well in the Yenchang district of Shensi has struck oil at 400 ft. and is yielding 1700 to 1800 *Ko* of oil per day. The translator supposes *Ko* to here mean the Japanese *Koku*, equivalent to $1\frac{1}{8}$ barrels, but it is much more likely to signify a Chinese measure equivalent to 0.01 gallon, corresponding to a flow of some 18 gallons per day. So small a flow from so slight a depth is interesting, but not important. Of more importance is the report that the government at Peking has recognized the Morgan concession, covering mineral rights in Ssuchuan, as valid and binding. This was a blanket concession given to an English group five years or so ago, covering almost every form of activity which might be likely to be undertaken in the province. Nothing of importance was done under it until the Standard Oil Company obtained its concession, when strenuous efforts were made to establish the validity of the earlier one. The occurrence will awaken a chord of sympathy in the breast of all those who have attempted to develop mining property in an old district. The Chinese government, in its contract with the Standard Oil, took upon itself the burden of settling all such disputes, so the event only bears on the Standard Oil Company in that it removes the possibility of development in an area which seemed of some promise.

PROTECTION OF OILFIELDS

The protection of oilfields against the flooding of the oil-bearing strata by carelessness of a few operators is the subject of a bill which has recently been drawn by the State Mining Bureau and submitted to the public for criticism or suggestion before introduction to the legislature. Mr. R. P. McLaughlin, who has been particularly interested in this movement on behalf of the Bureau, has made an investigation of the existing evils attending the flooding of oil-bearing strata and has proposed a bill which is submitted for the purpose of arousing a discussion of the subject.

The proposed bill provides that the owners of property representing one-half or more of the oil-bearing ground in any community who desire to prevent injury to the oil-bearing strata by the infiltration or intrusion of water, may present to the board of supervisors of that county a petition setting forth their purpose to form an association for the protection of such ground within certain boundaries. These mutual protective organizations will be administered by a board of trustees who shall have power to provide all necessary ways and means for the proper protection of the oil-bearing strata in these districts and shall act as judiciary bodies for deciding all questions relating to the protection of these strata. An engineer is provided to act in an advisory capacity to each board of trustees, whose duty it will be to investigate and make recommendations to the trustees as to the experimental and repair work necessary. The trustees are empowered to order such repair work as is necessary upon wells which are adjudged a nuisance, and if such work is not completed within a certified time, it will be ordered by the trustees and the costs for such work will constitute a lien against the property. This bill is a modification of the old Sutherland bill, which provides for the formation of districts entirely under local management.

The discussion of the McLaughlin bill has resulted in the framing of a second bill which provides for state supervision of the work contemplated in the various districts. This second act for establishing and creating a department of the State Mining Bureau for the protection of the natural resources of petroleum and gas from waste and destruction through improper operations in production is drafted for the same purpose as the first bill, but differs in the method of execution. Under this second bill, a separate department of the State Mining Bureau is established which shall be under the general jurisdiction of the state mineralogist, who shall appoint an oil and gas supervisor whose term of office shall be four years. Both bills are about to be introduced in the Legislature and will be published and distributed by the State Mining Bureau. As the bills can not be voted upon before March, there is time for a further discussion, and it is hoped that a more general expression of opinion may be obtained. The subject has come to be one of primary import in certain of our oilfields, and as such the present action is timely, and a serious consideration is well worth while.

PROBLEMS OF LABOR

The daily papers in New York last week recorded that the Industrial Workers of the World had begun to organize a rent strike among the unemployed, on the theory that a man who is receiving no wages should not be required to pay rent. It is proposed to extend this to a 'workers' moratorium,' the unemployed to pay for nothing until work is forthcoming. With this is coupled a refusal to work for less than standard wages, and a demand that either work or bread be furnished. The tendency among employers is to dismiss such demands as preposterous, and they are preposterous to one who believes that the present system of organization of industry must remain essentially unchanged. The same daily papers which recorded the views stated above also set forth the testimony of Mr. S. R. Guggenheim before the Federal Commission on Industrial Relations. The numerous companies under Mr. Guggenheim's control employ thousands of men, and his views on labor problems are therefore of unusual interest. Mr. Guggenheim was interrogated by Mr. Frank P. Walsh, chairman of the Commission, a prominent lawyer of Kansas. Mr. Walsh had inquired what Mr. Guggenheim's companies had done to help their employees. We give below the more interesting parts of the dialogue as reported in the New York *Tribune*:

"Up to a year and a half ago, when anything unusual arose," Mr. Guggenheim replied, "we immediately did what we could to remedy conditions and make improvements. I told the members of the executive committee and board of directors that we should do more than we had done—we should see to housing the men better, relieve the conditions under which they worked, establish a pension fund—try to throw a helpful, encouraging light into their lives. It meant better business—a higher efficiency.

"We wanted a man who could take full charge of just this—a man who understood what was needed and how to go about to see that what was needed was provided. So we engaged Mr. C. P. Neill, former Labor Commissioner, and told him just what we wanted him to do. We wanted suggestions from him for the encouragement of the men. He went into it, and he has given us lots of suggestions. Some of them are now before our executive committee, and the committee usually follows his suggestions. We have adopted every compensation law that has gone on the statute books."

"Have you or your companies ever opposed legislation benefiting the workingman?"

"Never," Mr. Guggenheim replied. "We adopted every compensation act as soon as it was passed. We are now trying, in our Perth Amboy plant, the experiment of insuring our workers, single or married, so that from $500 to $1000 is paid in the event of death.

"I am a member of the labor committee of the American Smelting and Refining Company. When we hear that conditions are bad in this or that plant, the matter is brought to the attention of the executive committee and an investigation ordered, and then, if conditions are found to be bad, the situation is at once changed. I would have nothing to do with a company that refused to do that."

"Do you oppose the policy of organized labor?"

"Employees are fully justified in organizing. Very often the capitalist is very arbitrary—just as the laborer is, at times. I have no objection to what our employees do outside the plant. They are human."

"Do you think industrial discontent is increasing?"

"I think it is on the increase and will continue to increase unless something is done to prevent it. The high cost of living is partly responsible for that, but the greatest canker known to the world is envy. A man these days sees so many things to invite his envy. But envy is a pretty well distributed trait.

"I think we are getting to a higher standard in dealing with labor, just as I think the world today believes it no longer necessary to kill off your competitor to get along or grind down your fellow man.

"There is not enough legislation. I am not one of those who complain that our statute books are cluttered up with useless laws for changing this and that. We are many years behind England and Germany in legislation which helps the workingman—the poor man.

"There is today too great a difference between the rich man and the poor man. To remedy this is too big a job for the state or the employer to tackle single handed. There should be a combination in this work. The men want more comforts—more of the luxuries of life. They are entitled to them. I say this not because I have enough and always have had, but because humanity owes it to them."

"Do you think the workingman should have a voice in the arrangement of the conditions under which he labors?"

"The workingman should have not only a voice—he should have a compelling voice. And he is getting it. The workmen's compensation act was won by the workingman. He will win more legislative victories. And legislation that will benefit the many is desirable, no matter what that legislation is."

"Have you a remedy for relieving this unemployed situation?"

"I think the state should furnish work for the men who lack employment. You may call me socialistic, if you like, but it is a job of the United States to look after its people. Were it not for philanthropic work there would be a revolution here.

"But enough is not given in this cause. People won't give up money they make. They hold it too dear to them. They won't give it up, even though they have more than they need. They reason that they haven't too much. So the government must raise the money—raise it by taxing the estates of the rich, if you will—but the United States must raise it some way.

"An evil of philanthropy lies in the fact that its proposed beneficiaries feel themselves placed in the light of paupers. Thousands of persons are too proud to accept help unless they can give something in return. Many of them prefer to starve. They want help—money—but they want to work for it.

"In the scheme of uplift in which we are all interested, I think, I believe the workers are entitled to share in the profits in all industries. This should be so arranged that the money could be taken in bulk at the end of the year and deposited to their account in a banking institution. If that were done it would change conditions in thousands and thousands of homes.

"Workers, in the mass, do not understand how to save. My method would teach them. It would be the same as teaching a child to read and write. The people in this country, who have built up fortunes in the last ten or fifteen years, have done it because they have been thrifty. Many are poor because they did not save. Sometimes, of course, fortune comes without thrift, as in the case of the son of a worthy or unworthy sire. The sons of the rich, in many cases, are entitled to great sympathy, though I would not say as much sympathy as the poor."

Mr. Guggenheim closed his testimony by stating that pension systems increase the efficiency of the men, and that his companies are run on the open-shop policy. We have often expressed our own views on labor problems, and, considerations of space forbidding, will not pursue the subject further here.

PIT RIVER AND WORKS OF NOBLE ELECTRIC STEEL COMPANY.

The Manganese Industry in California

By SAMUEL H. DOLBEAR

California has been a producer of manganese ore for nearly fifty years. During this time, there have been lean years in which no production was recorded; of the early output a considerable percentage was consumed by chlorination plants. Since the cyanide and other processes have practically destroyed this outlet, most of the ore mined in recent years has been used by local steel mills and dry cell manufacturers. Considering the fact that this industry has had a long period in which to develop, and that its entire production to date is only about 13,000 tons, it has not enjoyed the prosperity to which it is entitled.

Manganese ore is known to occur in thirty-three counties in California, and there is no doubt that some of these deposits are large enough to justify further exploration. Distance from transportation and high freight rates to consuming centres will, of course, exclude some of these deposits from consideration, but there are several close to rail, and two or three within fairly low freight rates to tidewater.

While India produces large quantities of this ore, the Caucasian deposits of Russia are undoubtedly the most important. Much of the crude ore shipped ranges from 75 to 80% MnO_2, and that ore which has been prepared by washing, amounting to about 15% of the total production, carries from 80 to 90% MnO_2. The deposits of India, however, supply over one-half of the ore consumed in the United States, the imports from that source being several times greater than those from Russia.

The principal use for manganese ore is in the manufacture of the iron-manganese alloys—ferro-manganese and spiegeleisen, with lesser amounts in the silico-manganese alloys and some others. As Germany is the largest producer of these alloys, every nation playing any important part in the manganese industry became involved in hostilities last August, with the exception of Brazil, with an annual output of crude ore of but 60,000 tons, and the United States. The United States is a factor of importance only so far as the manufacture of manganese alloys is concerned. Manganiferous ores of Colorado and Arkansas have been used in the past for the manufacture of ferro-manganese and spiegeleisen, but their principal use is in the fluxing of ores. Similar ores from the Lake Superior section, as well as those of Arkansas, are said to be used in the production of high-manganese pig iron. The only important source of manganese for the manufacture of its alloys in this country is in its occurrence as an impurity in the zinc ores of New Jersey. The greatest output from this source was in 1910, which, according to figures of the United States Geological Survey, amounted to 141,264 long tons. The average yearly output will probably not exceed 110,000 tons. The production of manganese ores is small, averaging about 4000 tons per year, and during several years recently it fell far below this mark. Virginia has shipped the largest amounts—the mines of this state having yielded about 250,000 tons.

Manganese Alloys

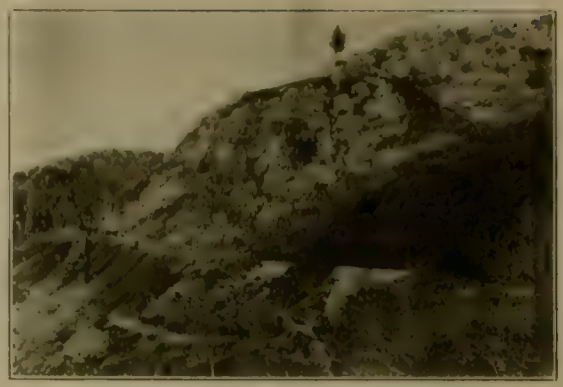
The United States depends upon European countries for about 35% of its manganese alloys. As it has appeared likely that the steel manufacturers would have to operate at a low percentage of capacity on account of the general industrial depression, the situation would not appear at first glance to be especially alarming. But a large part of our average yearly production of about 230,000 tons is manufactured by the larger steel mills for their own use, and this fact accounts for the unprecedented rise in price in this commodity. Prices as high as $140 per ton are said to have been asked at one time. The present quotations are from $60 to $70 per ton at Baltimore, with little demand.

An authority on the subject, formerly engaged in the manufacture of alloys at Niagara Falls, has recently predicted that if the war in Europe should continue for one year, ferro-manganese will command an active market at $100 per ton. That California may become a producer of these alloys is not at all impossible. Attempts in this direction have already been made by two concerns, and the field is being carefully investigated at the present time by two others. A good deal of doubt has been entertained by some as to the possibility of producing a product cheap enough to compete with eastern and European manufacturers. That cheap power may be developed on the Pacific coast is generally conceded. The high cost of labor and the problem of bringing cheap power and the crude constituents together is the factor yet to be determined. What I have already said in my discussion of magnesite and the labor problem in a previous issue of this journal, will aptly apply to this case. An influx of European labor to the Pacific coast through the Panama canal will doubtless follow in time, and as the law of demand and supply pertains to labor as well as to other things, it must result in a revision of our wage schedules. How long this change will be deferred by the European war is theme for prophets. It is possible that the high prices which are likely to prevail in the interim will permit our manufacturing at our present labor rates.

Other Uses

Aside from its use in the preparation of manganese alloys, as above stated, less important amounts are demanded in the various arts. In two industries, which formerly consumed variable amounts, its use is now practically obsolete. The chlorination process has been supplanted by other methods, and there is little call for it now in the manufacture of varnish. The trade now demands transparent or light colored varnishes, and cobalt compounds, in spite of their cost, are used. A large amount of high-grade ore is used in the manufacture of Leclanche and dry cells. For this purpose, as in its application in the glass industry, the demands are very exacting, and the ore must be crushed to the proper fineness and must contain only negligible amounts of impurities, particularly iron. Its principal function in glass is to prevent the green color so common in the cheaper grades. It also imparts the purple and dark brown or black colors, depending upon the quantity used and its method of application. In the ceramic arts, it produces dark colored products and is often crushed to such size as will pass a No. 15 screen and be retained on a No. 60 screen, and in this form used sparingly to produce a mottled effect. Ground to nearly 200 mesh, it forms the color basis of some paints. In the manufacture of chlorine, bromine, oxygen, potassium permanganate, and other salts, there is some demand. Manganese salts finding various applications in the arts and in medicine.

ELECTRIC SMELTER, HEROULT, CALIFORNIA.



MANGANESE MINE AND QUARRY.

Prices

Crude ore from the Tesla mines has brought prices ranging from $8 to $18 per ton during recent years, according to the amount purchased, and purpose for which it was to be used. Where it was sold for dry battery manufacture, and consequently required careful selection, the ore was sold for $14 to $16 per ton at the point of shipment. Some of this ore was ground roughly in burstones before shipment. For use in the steel mills, the crude ore is shipped without any preparation, and sells for about $10 per ton at the point of shipment. This price applies, of course, for occasional carloads. Recent contracts for large amounts are understood to have been made at about $8 per ton on cars. A figure such as this should allow a substantial margin of profit from the Tesla mines. The actual cost of mining and transportation to railroad will depend largely upon the amount of ore handled. At the Winship-Doak mine, there is an opportunity for low cost of operation, if the mine be equipped and handled properly.

Western Manganese Company

This Company, of which Sumner Merrick is manager, has recently entered the California manganese field. The Company purposes to refine manganese ores and has nearly completed a plant at Alameda for this purpose. As a result of extended experiments with California ores, a plant has been designed which seemed best adapted to these ores. The plant comprises in a collective sense,

two parts—a mechanical unit and a process for chemical treatment. The mechanical treatment consists of crushing, sizing by screens, washing, and jigging. At this point, the product receives chemical treatment, the nature of which the Company, for reasons of its own, declines to divulge. The principal impurities to be removed are classed as 'insolubles,' of which silica is the greatest, with lesser amounts of alumina and magnesia. According to Mr. Merrick, ore containing 55% MnO_2 when refined by this process, resulted in a finished product, carrying 91.75% MnO_2, less than 1% Fe_2O_3, and a phosphorus content below 0.001%. All soluble impurities are treated in the chemical unit. The finished product is intended for use in the dry cell, glass, ceramic, and other trades. A contract for minimum ore shipments of two hundred tons per month has been made with the Winship-Doak mine, the plant having an estimated capacity of twenty tons per day of refined manganese.

Noble Electric Steel Company

At the plant of the Noble Electric Steel Co., exhaustive experiments have been made in the production of pig iron in the electric furnace. Its equipment, therefore, required but little change to permit the manufacture of ferro-manganese. When the price of this alloy soared to $100 per ton and above, such figures represented a very satisfactory margin of profit. Many authorities believed that these high prices would continue to prevail so long as war continued in Europe. It was the assurance of these authorities that such was the case, that led the Company to purchase six carloads of manganese ore from the Corral Hollow deposits. According to John Crawford, Jr., the superintendent, this ore was both too impure and too expensive, and would not pay to use at the present prices of manganese alloys. After investigation of a number of local manganese deposits, a lease was taken on the Thomas mine near Ukiah in Mendocino county. The ore here is said to be high grade, and is but four and one-half miles from Redwood station on the Northwestern Pacific railroad. As the roads here can be used only during the dry season, no shipments of ore will be made and consequently the plant will not be operated before March 1915. The furnaces have a capacity of twenty-five tons of ferro-manganese per day, and will be worked to capacity, provided the price prevailing at that time is high enough to insure profitable operation.

The most important occurrence of manganese noted in California is in the Tesla district about 12 miles southeast of Livermore in Alameda county. Most of this ore produced in the state has been mined in this section. The largest individual producer was probably the Ladd mine, controlled by the Caire estate. Most of the ore was sold to chlorination plants, and when this market ceased, about 1902, the mine was sold and has since been only an occasional producer. Three shipments are said to have been made to England from this mine, but this statement, so far as I know, remains unconfirmed.

Winship-Doak Mine

This property adjoins the Ladd mine, and the deposits, which were largely worked out to a depth of possibly 400 ft. in the latter, extend into the ground covered by the Winship-Doak lease, and may be traced for over half a mile by surface croppings and small adits and trenches.[1] The occurrence of this ore has been described by Harder as in a fault fissure; owing to considerable irregularity in the size of the vein, which averages perhaps five or six feet, it has often been referred to as a series of lenticular masses of ore. The strike may be followed for considerable distance and the ore shows continuity throughout the present exposures. The ore is largely psilomelane associated with manganite and pyrolusite.

The promise of the existence of a deposit equal to the Ladd mine seems good, although but little work has been done on the Doak property. The main workings of the old mine extend to the boundary of the Doak lease and should indicate pretty clearly the ore possibilities in the undeveloped area covered by the lease. The old workings extended to the surface from the tunnel at the bottom of the hill and were said to have furnished a back of about 400 ft. This seems rather deeper than the contour of the hill would indicate, and at the time of my visit in the summer of 1912, the old chambers were badly caved and for the most part, inaccessible.

The Winship-Doak lease has been operated intermittently by W. C. Doak for several years, some of the ore being used in the manufacture of dry cells, but more recently has been shipped principally to a local steel plant. Six or eight carloads have been shipped from this mine during the latter part of 1914, a portion of which was used in an attempt to produce ferro-manganese. Owing to the lack of care in the selection of this ore, it is said to have carried too great a percentage of silica and was not suitable for the purpose. The remaining amount was purchased for steel use. The mine is very fortunately situated from a point of transportation. It is but two and one-half miles to Carnegie, a station on the Western Pacific railroad, and enjoys a low freight rate to San Francisco.

Thomas Mine

Attention has recently been drawn to this property through its having been leased to the Noble Electric Steel Co. The mine is in Mendocino county, about nine and one-half miles from Ukiah. The nearest railway is Redwood station on the Northwestern Pacific railroad, a distance of about four and one-half miles. The mine consists of nine claims and ore is said to occur in all of these. These claims are arranged end to end along the strike. The five most northerly claims are looked upon as the most valuable.

According to John Crawford, Jr., no work has been done to determine the extent of the deposit, and it is not apparent from present exposures whether the ore is continuous or is a series of lenses. The croppings, however,

[1] *Bull.* 427, U. S. Geol. Survey.

WESTERN MANGANESE CO., ALAMEDA, CALIFORNIA.

are bold, and in one place extend twenty-five feet above the surrounding surface. Large boulders of good ore are also found on these claims, which, taken with the prominent outcrops, are a sufficient indication of the extent of the orebody to justify the construction of necessary roads and further exploration of the claims.

Analyses made at the direction of Mr. Crawford show percentages of manganese dioxide, ranging from 61 to 84 in much of the ore. The samples analyzed were intended to represent the average ore for the full width of the exposures, and the lessees anticipate no trouble in securing shipments of ore averaging about 80% MnO_2 or about 50% metallic manganese.

Except for its remoteness from the railroad, the mines of the California Manganese Co. are said to be quite promising. The claims are situated near the Stanislaus and Santa Clara county boundary lines and about forty miles from Patterson on the Southern Pacific railroad, and about an equal distance southeast of Livermore. The manganese-bearing belt may be traced for over a mile, the ore occurring in irregular lenses and veins. On the southern portion of the property is the most important occurrence of ore, which can be traced for several hundred feet in length and has been exposed for a width of from five to ten feet in the tunnels. Much ore is said to contain as high as 75% or more Mn_2O_3.

Miscellaneous Deposits

Space will not permit the mention of the many deposits found in nearly all parts of California. There are numerous abandoned workings in the Livermore-Tesla district, and other deposits which have been but slightly prospected. One of these latter is the Mammoth mine, belonging to W. C. Doak, about ten miles south of Livermore.

Very pure ore, specimens of which are said to run as high as 90% MnO_2, is reported on the Newport ranch near Winchester, Riverside county. Manganese ore has been mined within the past year or two at Kleinfelter, a station on the Santa Fe railroad about fifteen miles west of Needles, in San Bernardino county. The ore, here, carried a baryte gangue, with which it was intimately mixed. Two or three hundred tons had been piled up for shipment at the time of my visit. According to the owner, the ore was to be finely ground for use as a pigment, and the presence of baryte was considered desirable, as it gave weight and body to the paint.

Manganese ore is found on the United States military reservation at the Presidio of San Francisco, and on Red Rock island in the San Francisco bay. It is found near Sausalito in Marin county. In Calaveras, Tuolumne, Plumas, Fresno, and San Luis Obispo counties, manganese ore is found in quantities which may warrant further exploration.

Coal-Dust Fired Reverberatory Furnaces

Reverberatory furnace No. 8, of the Washoe smelter, Montana, which is using pulverized coal as fuel, marks quite an advance in reverberatory smelting, according to L. V. Bender in *The Anode* for January. This method of firing furnaces does away with grating, the ash of the coal being either absorbed by the molten mass or drawn by the gases into the flue which connects the furnace with the Stirling boilers. This is a decided advantage to the skimmers and helpers on that furnace. The cleaning of the grates is hot disagreeable work, and no doubt the workmen are glad to be rid of it.

To prepare coal for this method of firing, it is first crushed to one-inch maximum size. It is then dried in a long, rotating, cylindrical-shaped dryer until it contains 1% or less of moisture. This drying makes it easier to pulverize as well as increases its efficiency when it finally reaches the furnace. After drying, it is pulverized in a mill which does its work something similar to a Huntington mill. This mill reduces the coal to a fine powder. The separation of the fine particles from the coarse is not done by a screen, but by means of a current of air, the fineness depending upon the pressure of the air. Whenever a particle is too large to be carried away by the current of air, it falls back upon the grinding surfaces for further pulverization. From the cone-shaped dust collector the dust is conveyed to a bin above the furnace. It is then fed by a screw, dropped upon a nozzle through which air is forced by a fan, carried into the furnace, and instantaneously ignited. All machinery and conveying apparatus are carefully covered to prevent the powdered coal from escaping. This furnace smelts double the tonnage of either of the grate-fired furnaces.

Transactions on the New York Stock Exchange during the week ended December 19, 1914, totaled 960,910 shares and bonds worth $9,476,000, compared with 1,588,056 and $11,887,000 in that week of 1913. The Exchange was only reopened during the previous week after being closed for 4½ months.

Copper concentrate produced by the Elmore process at the Sulitjelma mine, Norway, in December, amounted to 1162 tons.

The Influence of Slag and Fumes on the Zinc Muffle

By O. PROSKE

*Various experiments have been made to determine the effect of slag and fumes as they occur in the zinc muffle. It was first necessary to establish the absorption of ZnO by clay and the combination of ZnO with the individual constituents of the clay. The investigations followed three lines of attack, on the theory that the three following factors were the most important.

The diffusion of gases is increased (1) with the pressure, (2) with temperature, and (3) with time. It is impossible to embody all three factors in any one test.

The idea of using a small retort had to be discarded, as a furnace was not available that would stand the high temperature. A daily heating of the muffle would be injurious to such a sensitive material and might cause erroneous results through cracking. The three factors were therefore investigated separately.

Apparatus

It is almost impossible to construct a suitable apparatus to determine the degree of diffusion of zinc fumes because of pressure and also the absorption of zinc by the clay. The idea of using the gaseous pressure of the zinc fumes at high temperatures was employed in the following way. A clay sphere containing about 5 gm. of ZnO mixed with other ingredients was made as follows: A sphere of 6 cm. diameter was made with a pocket in the centre and an opening leading thereto. This centre was filled with the mixture and a clay stopper inserted into the hole and molded coherent with the rest of the clay. This thickness of clay was deemed necessary to prevent bursting and cracking. The drying took about two months, and the burning was accomplished by gradually increasing the heat. The result was a hard solid sphere, the surface of which showed cracks in only rare instances.

The Hallescher clay used was dry crushed to a slime and had the following composition: SiO_2, 61.44%; Al_2O_3, 26.76%; Fe_2O_3, 1.04%; CaO, 0.49%; MgO, 0.10%; moisture, 9.63%; alkalies, 0.51%. This clay was selected because it is well suited and burns hard and solid. Twelve balls were made in this manner, eight of which had no reducing agents, and four had the addition of a nucleus of burned clay in order to reduce the density and thus increase the diffusion. The compositions were as follows:

1 and	2—5 gm. c.p. ZnO	
3 "	4—5 gm. commercial ZnO	
5 "	6—1 gm. sugar coal, 4 gm. ZnO	
7 "	8—3 gm. ZnO, 4 gm. PbO	
9 "	10—5 gm. commercial ZnO	Mixed with burnt clay
11 "	12—4 gm. ZnO, 1 gm. sugar coal	Mixed with burnt clay

There are here two sets of experiments to avoid accidents. The balls were heated gradually in a gas muffle to 1400°C. At 1000°C. one of the balls exploded with a loud report. This was ball No. 6, which through the reduction of ZnO and the resulting formation and expansion of CO, caused the explosion. Ball No. 5 soon followed with a pronounced crack. At 1200°C., No. 11 and 12 showed fissuring with a Zn colored flame. At 1100°C., No. 8 showed fissuring and the formation of a hole in the vicinity of the burned-clay nucleus. Apparently the Pb silicate must have been quite fluid to have eaten its way through the shell. Ball No. 7 developed a crack on cooling which penetrated the spot where the PbO had made the greatest inroads into the shell.

In comparing tests 1 to 4 with 11 and 12 it is noted that No. 3 developed a slight crack in burning which at 1400°C. became pronounced, and therefore must be eliminated. In breaking open 1 to 4, there was more ZnO left than in 11 and 12. It was impossible to weigh the residue because the ZnO, partly yellow in color, was irretrievably sintered into the clay. In 11 and 12 it was plainly seen that the material was less dense than in No. 1 to 4. Volatilization would naturally increase with decrease of pressure, and the greater the fumes the greater the pressure.

On breaking the clay balls, which required heavy blows of the hammer, it appeared that at the parting wall or contact the color was a clean white which in approaching the centre became pale blue, and in the vicinity of the ZnO became darker blue. No difference could be noted in the effects of chemically pure and commercial zinc. In balls No. 11 and 12 the blue color could be seen at different points. One of these patches was pulverized and treated with concentrated HCl. The Zn silicate goes into solution, while the Zn aluminate remains insoluble. The solution gave ZnO, 0.12%; the total ZnO of the pulp was 4.40%, indicating that almost all of the Zn was combined with Al_2O_3 of the clay material.

Microscopic Examination

A microscopic examination was not made. ZnO has a strong affinity for Al_2O_3 and SiO_2 at these high temperatures even without a reducing atmosphere. If the theory is approved that the thick walls retain the Zn, it is known that if the ZnO of the mass remains constant the clay has absorbed it. The entire ball was pulverized and on analysis showed a content of 4.80 gm. of ZnO for the entire ball, so that it is safe to assume that none escaped.

This method of putting substances in a clay ball to determine effects will be tried on the slag-forming metals such as Fe and Mn with different percentages of S. In this way the reducing action of the fuel gases is avoided.

*Translated from *Metall und Erz*, XI, N. F. II, by F. Sommer Schmidt.

It is necessary to use great care in making the balls, and it requires a long time to dry and burn the clay.

Manifestly the clay has great capacity for absorbing ZnO, and it is the Al_2O_3 constituent that does it. In general, it can be said that the more acid the retort the less loss of Zn by absorption, and the more basic the greater the loss. It must be remembered that there are other factors, such as the tendency to form cracks, which give the ZnO greater surface for attack.

Relation of Time to the Absorption of ZnO by Clay

The greatest absorption takes place in the first day. This is conditional on the muffle being burned solid and that the fusion does not protect the clay. In order to determine what part the element of time plays, the following experiments were performed. A graphite crucible, 9½ cm. high and 5½ cm. upper diameter and 2½ cm. lower diameter, was prepared. Zinc oxide mixed with other compounds was introduced and heated in a muffle to 1300°C. A circular clay disc or plate was embedded in the mixture at about 8 cm. under the upper rim of the crucible. The plates had a diameter of 3 cm. and a thickness of 1½ cm., and were made of the clay described in the preceding experiments. These plates were dried for six weeks and heated to 1000°C. for 10 hours. The idea in these experiments was to determine by increase in weight the amount of absorption of ZnO. This could not be done satisfactorily, as in some cases the attached ZnO carried some of the clay with it when separated from the plate.

The temperature was held at 1330°C. for 8 hours per day for a period of 12 days. In this way only a small portion of the contents could have an effect on the plate, as this remained free in the mass and the greater part of the fumes naturally followed the line of least resistance alongside the clay plate.

The increased time of trial gives some data on the absorption. On the first day a blue coloration was noticeable on the surface of the plate. On breaking the plate it appeared that in certain places the color had already penetrated somewhat deeper, but only on cracks which were often too minute for the naked eye.

On the second and third days one could detect a deeper color, but the rate of absorption decreased daily. The color was always unevenly distributed and mostly along cracks in the plate. Here again it is seen that in the case of a dense material devoid of cracks the ZnO would make much less progress.

The absorption varied greatly in individual cases. After six days one plate contained 2.34% ZnO, and a second 6.78%. These results do not apply to the whole plate, but only the 3 mm. next the surface.

There were 10 crucibles with different mixtures, each one having a burned-clay plate. Crucible No. 3 alone had an air-dried plate.

Crucible No.	Mixture.
1	ZnO, commercial
2	ZnO, chemically pure
3	Air-dried plate, ZnO
4	ZnO and C, 3 to 1
5	ZnO and PbO, 10 to 1
6	ZnO, PbO, C, 8 to 1 to 4
7	ZnO, ZnS, 10 to 1
8	ZnO, ZnS, C, 8 to 1 to 4
9	ZnO, Fe_2O_3, C, 8 to 1 to 4
10	ZnO, CdO, 50 to 1

In crucibles 5 to 9 it was apparent after the first day that a layer of slag had attached itself. A blue color was visible under this, but not so pronounced as in the other tests. In 7 and 8 the reason for this slag formation is that the ZnS was richer in Fe and SiO_2. The slag rim was more pronounced on the second day. Then the plate could not be extracted. It was stuck fast. On this account it was necessary to break crucibles right along in order to allow fumes to escape that would otherwise have been retained. For this reason, tests following No. 4 were not treated after the fourth day. The slag did not show a marked effect on the clay. It was further advanced in some places than others, due to cracks, and caused a somewhat stronger blue coloration.

At a temperature of 1100°C. almost all crucibles showed bubbles on the outer wall which disappeared on further heating. The bubbles were white, thin walled, and delicate, and were of different sizes up to 1 cm. diameter. It can be imagined that at this temperature the ZnO was partly reduced by the graphite crucible, the metallic Zn fumes being drawn into the muffle, where the oxidizing atmosphere of the muffle caused the formation of ZnO on the outside of the crucible. On mixing this ZnO with the carbon of the crucible, the ZnO was reduced, which could be oxidized again by the atmosphere of the muffle. The diffusion of Zn fumes through the walls of the crucible could have been foreseen, but it would naturally be expected that they would avail themselves of the better escape to the surface.

Twelve-Day Test

The plates 1, 2, 3, 4, and 10 showed no change after 12 daily heatings. In course of time, more ZnO was absorbed, but not in proportion to the time. The first day showed the maximum absorption. The individual plates showed after 12 days the following absorption:

No.	ZnO absorbed.
1	4.43 per cent
2	2.18 " "
3	10.34 " "
4	1.08 " "
5	4.38 " "

It must be remembered that this ZnO content is figured on the whole plate, but that the outside of the plate showed the strongest absorption while the interior often showed only traces. That these results do not compare well is due to other considerations, chiefly structure.

The ZnO in No. 3 is strikingly high. The plate was of unburned clay, causing numerous cracks, giving the

ZnO better access. In plate 4 the greater part of the ZnO was reduced so that only a small portion was available. It will be noted that the temperature of reduction of ZnO is lower than that of volatilization. These tests show that the element of time plays a big part, but that, after all, the structure of the clay, porosity, and cracks, is the more important factor. It can be said that where a gas is penetrating a solid it is largely a question of the amount of surface exposed.

Effect of Temperature on Absorption

In the third series of experiments the absorption was noted under varying temperatures. According to Doeltz and Graumann, ZnO begins to volatilize at 1200°C., but I find ZnO in the clay of the muffle at considerably lower temperatures. This is due to the easy oxidation of the Zn fumes by carbonic acid and other gases of the atmosphere. As the fusing point of Zn is lower than the volatilization point of ZnO, there is an absorption of ZnO at a lower temperature than 1000°C. The furnace, even at this temperature, shows the presence of ZnO.

In some plates which were in ZnO and C for 10 hours at a temperature of 1000°C. the characteristic blue color appeared at the edges. The ZnO was all combined with Al_2O_3 because on treating the powdered clay with HCl only 0.10% ZnO was in solution, while the total ZnO was 1.02%. For the following experiments, the same kind of clay discs and crucibles were used as in the previous experiments.

In order to determine the effects of higher temperature, an electric furnace was used, such as has been described in *Metall und Erz*, 1913, page 511. Because of the large diameter of the crucible, it was necessary to widen the chimney to accommodate the increased air pressure. It was found advantageous to coat the pipe with a mixture of clay and carbon, as this protected the pipe from the oxidizing atmosphere.

In order to insure a good contact, a sheet of copper was put between the iron and the carbon plate. Because of the air pressure of the heating tube, it was necessary to have about 1300 amperes with seven volts, in order to attain 1800°C. Two cables designed to carry 1250 amperes were used because they could be depended upon to carry 1500 to 1600 amperes at a temperature of 1800°C. The temperature could not be measured over 1300°C. with a Le Chatelier pyrometer. The guard pipe was porous to gases at this temperature. The Zn fumes caused a disturbance in the wires at a temperature over 1300°C., but they had very little effect on the pyrometer wires. The temperatures were measured up to 2000°C. with a Wanner pyrometer.

No exact gradations of temperature could be determined because the burned CO mixed with metallic Zn fumes gave a colored flame at the mouth of the pipe. They could be determined, however, in a manner satisfactory for the purpose. The carbon-flue oven proved unpractical for this purpose owing to its inability to retain high temperatures. The time used in these experiments never exceeded 1½ hours. There were, therefore, many imperfect contacts which led to a speedy destruction of the furnace. Several attempts were made to use a gas blast-furnace called a Fletcher furnace. As lower temperatures were used in this case, the time of trial was longer, that is, 6 hours.

The clay plates in the electric carbon-pipe furnace were treated for 1½ hours. The individual temperatures were attained in 1 hour, and the maximum was maintained for ½ hour. The experiments are tabulated in Table 3. Clay plates were then studied at different temperatures in a graphite crucible without any mixture.

At 1650°C. the disc was still unfused; at 1800°C. it was converted into a black-gray mass; at 2000°C. and over, the greater part of the disc was volatilized. On the upper part of the carbon pipe, a sort of velvet layer, consisting of minute needles, was noticed.

To see how muffle furnaces consisting of a higher carbon content behave at these high temperatures, experiments No. 10 and 11 (see table) were performed. One of these muffles is very acid and the other very basic, and the experiments were made in a Tamman furnace simultaneously. The fusing took place much slower. A large part of the carbon burned out first, then the mass became viscous. Big bubbles, occasioned by the burning coke, had formed, and finally at the end of the experiment it was seen that the crucible was filled with a bubbling molten mass. In the centre of this mass, there appeared, after breaking a crucible, a piece of the muffle not yet molten, which still had its original appearance. As this was entirely covered with the molten matter, the carbon could not burn. This had hardened the fragment to such an extent that it could not be fused at 1900° Centigrade.

Influence of Zinc Oxide

After having observed the behavior of the discs under different temperatures to 2000°C. and over, I think the influence of the ZnO on the discs can be determined from experiments No. 11 to 16. In experiment No. 11, at 1420°C., in 1½ hours, there was noticeable a great absorption, and a particularly dark blue spot gave 8.9% ZnO. In experiment 12, at 1580°C., there was a pronounced and rapid absorption of ZnO.

It is interesting to note the ZnO contents of the plates at temperatures higher than the fusing point of the clay plates. Here is a much quicker volatilization of the ZnO, but less influence of the fumes. One can assume that the ZnO was volatilized before the high temperatures were reached. The carbon flues were closed at both ends, so that there was a strong atmosphere of ZnO. Every plate that was fused had the characteristic blue to black coloration in several places. In breaking the crucibles the cake could be removed and the approximate amount of absorbed ZnO could be determined by weight.

Plate No. 13 weighed 19 gm.; the cake originally weighed 27 gm., and therefore the absorption of 8 gm.

equals .80%. The fused mass had a volume from three to four times that of the original. This is explained by its viscous condition, and that a portion of the ZnO being volatilized, was given to the formation of bubbles. That there was volatilization of ZnO could be recognized by the fact that the upper layer of the cake had a different color from the underlying one. One layer of a ½-cm. was yellow-brown. While there was a marked volatilization of ZnO at 1300° to 1400° C., one sees that in spite of the high temperatures the ZnO is so strongly held that it diminishes very gradually in the upper layers. There is not only a reduction of Zn spinel at high temperatures, but also in the volatilization of ZnO, from the Al_2O_3-ZnO combination. It must be remembered that in the carbon pipe there is a strong CO atmosphere.

The cake on the walls of the crucible had the blue color, and through the uncombined C a reduction of the spinel would take place with difficulty. One sees that the absorption of ZnO by clay and the combination with Al_2O_3 occurs at higher temperatures than the fusing point of clay, up to 2000° Centigrade.

To determine the behavior of a clay plate in a mixture of ZnO and C at higher temperatures, experiment No. 8, containing these ingredients in the proportion of 3 to 1, was performed at a temperature of 1560°C. Experiment No. 9 had the proportion of 2 to 1 at 1600°C. As the coal has an ash which would surround the plate, the coal of sugar was used in excess of the requirements for reducing the ZnO. There was in both cases unconsumed carbon. As expected, all the ZnO in the crucible was reduced before the highest temperature was reached. The plates showed a blue-gray color. The formation of spinel could not be observed. An analysis of the plate showed only traces of Zn. As only metallic Zn fume was formed, no absorption could take place.

In experiment No. 10, there was ZnO and C together with PbO, an average temperature of 1410°C., and a period of 6 hours. The plate showed no fused layer. The PbO was reduced and therefore could exert no influence on the clay. No PbO could be found in the muffle. The PbO is reduced at a lower temperature than that at which volatilization begins, so that the PbO was reduced before it could attack the clay.

The results are different when only ZnO and PbO are used as shown in experiments No. 17 to 22. Only the thinnest layer of slag could be found on the plate which was more developed with a greater percentage of PbO. The greater amount of slag the less the absorption. In these cases only a faint blue color was seen.

In experiments 17 and 18 a slight slag formed and a stronger ZnO absorption took place at the edges, namely, 2.3%. In cooling, the slag cracks in the clay and thus gives a better access to the Zn fumes, and thus by oxidation a greater amount of Zn spinel is formed.

TABLE SHOWING RESULTS OF EXPERIMENTS TO DETERMINE THE ABSORPTION OF ZnO BY CLAY WITH VARYING TEMPERATURES

No.	Substance in which plate was immersed.	Duration in hours.	Max. temp., deg. C.	Furnace.	Condition of plate.	Remarks on the products.
1	Graphite crux only	1½	1600	Tamman[1]	Not fused	Dark gray outside; white inside; very hard; no cracks.
2	Graphite crux only	1½	1650	Tamman	Not fused	Black coating on under surface of plate.
3	Graphite crux only	1½	1800	Tamman	Fused	Hard, dense; no bubbles; some unfused pieces.
4	Graphite crux only, 4 plates	1½	2000[2]	Tamman	Fused	Nothing left in crux; all 4 plates volatilized; crux much corroded.
5	Graphite crux only, 4 plates	1½	2000[3]	Tamman	Fused	Plates mostly volatilized; crux covered with glaze half way, black color.
6	Graphite crux with acid muffle	1½	1900	Tamman	Fused	Black mass, strong bubbles; in bottom a piece unaltered muffle.
7	Graphite crux with basic muffle	1½	1900	Tamman	Fused	Same as No. 6, except less bubbling.
8	ZnO plus C, 3 to 1	1½	1560	Tamman	Not fused	No Zn spinel; outer edge plate black-gray for 2 mm.; inside white. Plate 0.3% ZnO.
9	ZnO plus C, 2 to 1	1½	1600	Tamman	Not fused	Like 8; much unconsumed carbon.
10	ZnO, PbO, C, 5 to 1 to 2	6	1410	Fletcher	Not fused	No slag; some Zn spinel on edge.
11	ZnO	1½	1420	Tamman	Not fused	Strong spinel; interior blue; one sample 8.9% ZnO.
12	ZnO	1½	1580	Tamman	Not fused	Like 11; no stronger blue coloration.
13	ZnO	1½	1830	Tamman	Fused	Mass blue violet; weight of plate 19 gm., with absorbed products 27 gm.; many bubbles.
14	ZnO	1½	1910	Tamman	Fused	Like 13. One spot sampled 30.84% ZnO. Original weight, 20 gm.; weight with absorbed products, 28.4 gm.
15	ZnO	1½	1930	Tamman	Fused	Like the three previous. Original weight, 20 gm.; with products absorbed, 33.4 gm.
16	ZnO	1½	2000[4]	Tamman	Fused	Like 15. Original weight, 19.5 gm.; with absorbed products, 35 gm.
17	ZnO-PbO, 98 to 2	6	1410	Fletcher	Not fused	Blue on edge giving 1.04% ZnO; thin slag.
18	ZnO-PbO, 96 to 4	6	1430	Fletcher	Not fused	Like 17. Thin yellow slag coating. Spinel like 17.
19	ZnO-PbO, 94 to 6	6	1420	Fletcher	Not fused	Like 18. ZnO 0.08%. More slag.
20	ZnO-PbO, 92 to 8	6	1410	Fletcher	Not fused	More slag attacking plate.
21	ZnO-PbO, 90 to 10	6	1440	Fletcher	Not fused	Heavy slag coating. No blue color in plate.
22	ZnO-PbO, 90 to 10	1½	1650	Fletcher	Fused	Transparent green glass, octahedrons of zinc spinel.

[1]Electric. [2]Considerably above. [3]Above. [4]Slightly over.

Iron Mining in Michigan

STAFF CORRESPONDENCE

The total production of iron ore from the mines of the Marquette range for 1914 amounted to 2,463,973 tons. By the first of December all shipments had ceased with the exception of about 2000 tons per week from the Republic mine, which is sending ore by rail to the Algomah furnaces, Ontario; and 900 tons from the Cambria, Negaunee. The tonnage was 1,502,707 less than was forwarded in 1913.

Thirty mines shipped ore during the year. The Cleveland Lake and Cliffs Shaft mines of the Cleveland-Cliffs Iron Co. were the largest producers. The Steel Corporation mines were not very active. At the present time there is a large tonnage of unsold ore at many of the mines. Many are idle, and some are working only part time and with greatly reduced forces. The Cleveland-Cliffs Iron Co. was the largest shipper of ore on the Marquette range, as follows:

Ishpeming group of mines.—Cliffs shaft, 285,310; Chase, 19,708; Lake, 318,204; North Lake, 120,639; Morris, 29,063; and Salisbury, 69,089; a total of 842,013 tons.

Negaunee group.—Maas, 55,903; Negaunee, 247,484; and South Jackson, 20,241; a total of 323,628 tons.

Swanzy group.—Austin, 30,492; Gwinn, 20,151; Princeton, 13,607; and Stephenson, 93,795; a total of 158,045 tons; and the Republic, with 45,316 tons; making a grand total of 1,365,010 tons.

Decreases are shown by all the properties operating during the year. The selling prices* of the ore from the Swanzy group was 75c. per ton under the basis of the valuation as set by the state tax commission.

Shipments from the mines of the Oliver Iron Mining Co. for the year totaled 241,423 tons less than in 1913. No work was done at the Champion mine, Beacon; none at Section 21, south of Ishpeming; and the Ishpeming and Negaunee properties were worked in a quiet way. The Oliver company's shipments were as follows:

Lake Superior group, 86,957; Queen, 178,547; and Stegmiller, 40,972; a total of 306,476 tons.

Breitung interests.—Mary Charlotte, 96,105; Breitung Hematite, 49,055; and Washington Iron Co., 1146; a total of 146,306 tons.

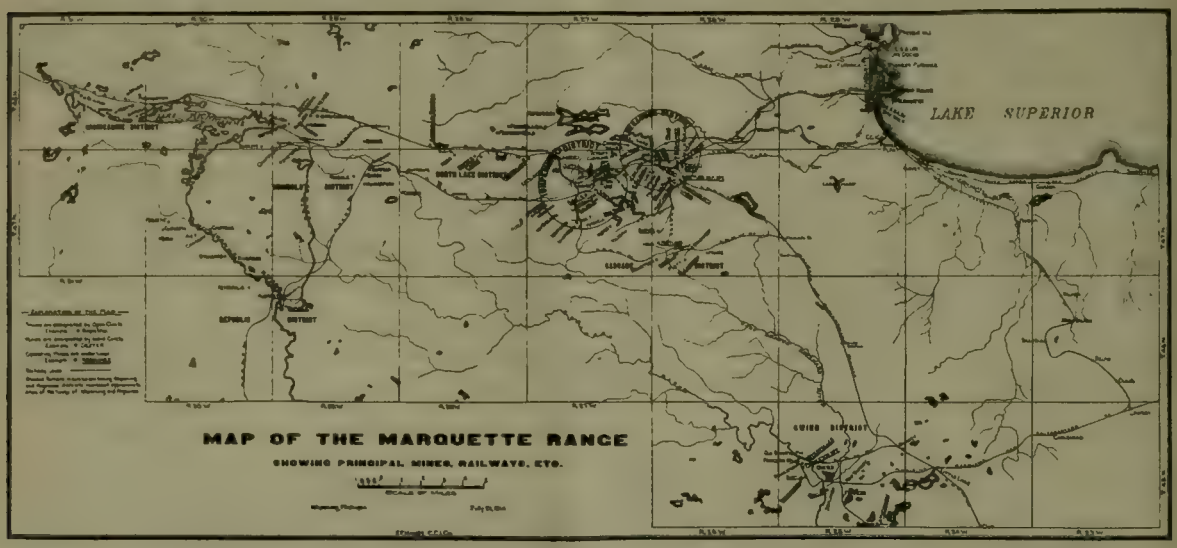
Jones & Laughlin interests.—Pittsburgh & Lake Angeline, 128,073; and Rolling Mill, 98,011; a total of 226,084 tons.

American, 78,887; Portland, 43,323; Republic Iron & Steel, 127,967; Richmond, 129,548; and Volunteer Iron Co., 38,345 tons.

Total shipments from the Gogebic range during the year amounted to 3,363,419 tons. Of the active mines at the beginning of the year, the Asteroid, Castile, Colby, Ironton, Mikado, Windsor, and Yale are now idle.

Total shipments from the Crystal Falls district, with the Hemlock estimated, amount to less than 500,000 tons. It was the poorest year in over a decade. Corrigan, McKinney & Co. shipped 175,000 tons, and the Bristol mine 172,000 tons. The Carpenter and Ravenna mines of the M. A. Hanna company shipped about 100,000 tons, and the Judson 5000 tons.

About one-fifth of the iron ore from the Lake Superior region is now delivered at Lake Michigan ports. For the season just closed these ports received 6,109,019 tons of ore. According to the annual report of the collector of customs of Chicago, receipts of iron ore from the Lake Superior region totaled 5,767,337 tons at Gary, South Chicago, and Indiana harbor. In 1913 the tonnage was 12,530,023.



*Iron Ore.

A GEOLOGICAL SURVEY of the oil deposits of Papua (New Guinea), northeast Australia, shows them to be worthy of commercial development.

Kauri Gum Deposits of New Zealand

By W. D. HORNADAY

Mining kauri gum is an important industry in New Zealand. Enormous quantities of this product are shipped annually to the United States and European countries, where it is used in the manufacture of varnishes and for several other purposes, one of which is to give gloss to linoleum. Since 1853 there has been exported from New Zealand kauri gum to the total value of approximately $85,000,000. The value of the annual production is now about $2,500,000. It is one of the large industries of New Zealand. The total exportation in 1912 was 8014 tons, of which 3964 tons went to the United States and the remainder to Europe. The price paid in Auckland for the gum ranges from $25 per ton for the lowest grade of dark dust to $1800 per ton for the highest grade of bright scraped gum. The average value of the product here is about $375 per ton.

The gum fields, as they are called, cover an area of approximately 914,000 acres of the Auckland province in the North Island. It is considered probable that the producing territory may be greatly extended in the years to come. The valuable product is found wherever the kauri pine forests once existed. Even in wide areas where there is at this time no semblance of a forest having ever covered the barren and often swampy lands, there are found enormous deposits of the fossilized gum beneath the surface.

One of the interesting features of the industry, aside from the large revenue that it produces, is that, of the total area that is now being exploited, the government owns 500,000 acres. Instead of trying to make a direct profit from the gum upon these Dominion lands, the government merely charges each 'digger' a nominal fee of $5 for a perpetual permit which gives the man the right to produce and sell for his own benefit as much of the product as his labor will produce. It is a place where the unemployed may always find profitable work. Many instances are cited where men who are now prominent in the business and industrial affairs of the colony obtained their start in the gum fields. The labor is hard and disagreeable, but the returns are usually good. It is not unusual for an expert in the work to make as much as $40 to $50 per week, and the average weekly return per digger is about $15. At present there are more than 6000 men employed in the different fields. Most of them are Austrians, who seem to find the occupation particularly agreeable. They are said to be law-abiding and industrious, and, inasmuch as the average British laborer finds gum digging distasteful, the Austrians do not come into competition with the organized worker, and are therefore not regarded in an unwelcome light by the masses of unionist employees.

The Gum Industry

The manner in which the kauri gum industry is carried on is only another illustration of the well known fact that many things are done differently in New Zealand from any country in the world. Imagine what a rush of aggregations of capital there would be to exploit a field of this character if it existed in the United States. There is not a corporation or firm operating in the gum district. This is true of not only the Crown lands, but of the privately owned properties as well. The wishes of the government that the fields shall be perpetually held as a sort of workshop for idle or surplus labor is re-

DIGGING KAURI GUM.

spected by private owners of gum-bearing land. The latter lease their properties on a royalty basis. If large dredges were employed instead of the present method of hand digging, the output of gum would be increased enormously. The supply, however, would soon be greater than the demand, and a fall in prices would result. The fields would also be exhausted much more quickly than under the system that is now followed.

The kauri pine, which produces the gum that has brought much wealth to New Zealand, is indigenous to the Auckland province. It is a giant in size, its height often being 120 to 160 ft. The tree varies from 5 to 12 ft. in diameter. The standing forests cover a large area and are the chief sources of lumber supply for the Dominion. Its percentage of resinous properties is high. When scarred by the falling of another tree, the gum oozes from the wound in large quantities. It is so prolific in this respect that a considerable quantity of the product is now obtained by tapping the trees in much the same way that rubber trees are treated. Most of the product, however, is obtained from the ground and is in a fossilized state. It is estimated that the gum which is thus obtained is fully 3000 years old. The trees are of slow growth, a fully matured giant of the forest being from 400 to 500 years old, according to the calculations of scientists.

Digging Operations

The digging process is not without human interest. It has its speculative element, as there is always a doubt as to where the gum will be found and what the day's output will be. Sometimes a digger will find a large pocket of the amber-colored product, and he may realize a return of $50 to $100 from a few hours' work. At other times his labors may go almost unrewarded for a day or two at a time. Scattered all about through the producing region are small stores where the diggers sell their weekly outputs. These storekeepers in turn sell the gum to merchants and commission men in Auckland. The country stores offer every opportunity for a prospective digger to start work. They advance him a week's supplies and provide the necessary tools. The outfit consists of a spade, an ax, and a long sharp-pointed rod, which is used to test the earth near the surface. When a hard substance is prodded, an investigation is made and a lump of gum is usually turned up. The Austrians carry on operations systematically, working in gangs and digging deep and long trenches, prospecting every inch of the ground. The gum is found in two layers or strata, the second one being a few feet below the first. This leads to the theory that two distinct forest ages existed and that the lower bed of gum is much older than the upper one. Large quantities of product of an inferior grade are obtained from swampy lands, which it is often necessary to drain. The lumps of gum vary in size from that of a potato to a half-bushel basket. When taken from the ground the gum is usually encrusted with a white earthy substance. The diggers scrape this off and the chunks present a beautiful appearance. The gum is then sorted according to grade and is bought and weighed in the field. The scraping and classifying are done in the evening, when the day's labor in the field is over. The women and children of the camp or household often help in this work. The gum is re-scraped after it comes into the hands of the merchant in Auckland, and in this manner the grade is improved and a higher price obtained for the product.

BUYING GUM IN THE FIELD.

It is a nomadic life that many of the diggers follow. They wander from one field to another, turning up the earth in search of the valuable gum wherever they may wish. It is thought that the Auckland province will continue to produce the gum in large quantities for many years to come. There are still areas of land that have been little explored. The surface deposits are practically exhausted and the supply of the future must come from underground and from the living kauri trees.

It is desired by the men who are engaged in supplying the American and European markets with the product that there be no large increase made in the annual output, as it would mean an oversupply of the demand and a fall in prices. On the other hand, it is contended by the handlers of the gum abroad that if prices go any higher the manufacturers of varnishes and linoleums will use a substitute and the industry will suffer in consequence. It is the kauri gum that gives the handsome finishing touch to varnish and the increase in the demand is due to the growth of the varnish trade.

The Dominion government is offering encouragement for the settling of the lands which have been mined for the gum. It is claimed that where these lands are properly drained they are well suited for agricultural purposes, particularly for dairying. As an inducement to the Austrians and others to make permanent homes in the kauri country, the government has divided the worked over lands into small tracts which may be homesteaded upon payment of a nominal fee. It was formerly supposed that the gum-producing lands were worthless for crop growing, but tests show, it is claimed, that they produce grass abundantly and that a variety of other products may be grown upon them. The original forests were probably destroyed by fire or by a volcanic disturbance.

Blast-Furnace Practice at Mount Lyell, Tasmania

By ROBERT STICHT

*The Mount Lyell orebodies are wonderful, even though they are thought to be only the 'roots' of a great pyritic mass. They may be assumed to be the lower portion of a once much larger mass, into certain parts of which lower portion the meteoric waters, in times gone by, have concentrated the copper, silver, and possibly the gold contents of the upper portion, which is now gone by erosion. The country is heavily glaciated. In the silicious North Lyell mine, orebodies are found that resemble a bunch of carrots or sweet potatoes, they are so long and chimney-like, and there is reason to think that there was once a more pyritic body above them. The local geologists are careful learned men, but they are eclectic, not original, and have not been able to devote sufficient time to a study of the deposition of this ore.

As regards smelting, when I arrived at Mount Lyell the pyrite method was still a problem. I had enjoyed opportunity to carry it out in its purity, for short periods, whenever the ores were suitable, in Montana and Colorado, and had no fear, on an empirical basis, that it would not be possible to carry it on continuously where the ore was so favorable as at Lyell.

The Mount Lyell company started with three blast-furnaces in 1896, and then installed converters. This plant was gradually enlarged to six blast-furnaces. A second plant was built with five furnaces. When hot blast was abandoned, after six years' use, the first plant was dismantled, and all the work was done in the second. This plant received an extra furnace in the course of time, so that it has six, but usually only three are operated. The most interesting development, perhaps, was the discarding of hot blast. I do not think I would now recommend it under any conditions.

MOUNT LYELL SMELTER AT QUEENSTOWN, TASMANIA.

The furnace column reaches 18 ft. above tuyeres, and 64-oz. blast pressure is used. The work is based on the assumption that the inside of a furnace is occupied by a honeycombed mass of quartz, the passages of which are traversed by the blast and the molten sulphide, in opposite directions, the incandescent silica effecting simultaneous oxidation of the latter, by the oxygen of the blast, and the union of the FeO, thus formed, with the

*Abstract from *Bull.* 79 of Min. & Met. Soc. of America. An address before members at the November meeting.

silica itself. This forms the slag, while the unoxidized portion of the sulphide makes the matte. Our matte runs from 45 to 50%, rarely under 35%, and sometimes as high as 60 to 65% (a 20:1 concentration). When the matte becomes too high, we reduce the silicious ore; when too low, we increase it. The proportion of pyrite in the charge is constant; also the limestone. The only variables are silicious ore and coke, but the latter is changed much less frequently than the former.

Percentage of Coke

As regards the percentage of coke used, I regret to say that the time when only 1.5% (and sometimes as little as 0.1%, with hot blast) was used is now merely historic. It is now necessary to smelt more of the silicious ore, and, at the same time, the iron and sulphur in the pyritic ore have diminished, owing to the inclusion of a little galena and zinc-blende and a little more gangue. As a consequence, from 3.5 to 5% coke is used, figured on the materials charged (except coke). The coke is our own make, but high in ash, and wet from the rainfall, which is 110 in. annually. The slags are also more silicious than they used to be, averaging 35 to 37% SiO_2, against 30 to 32% in the past. The campaigns used to be three months or less; now they are a good deal longer, easily six months, the stoppages being caused by leaky jackets or the forehearth.

Concerning shape of bosh, I am unable to see that it makes any difference. The furnace creates its own internal lines, which may be entirely different from those of the designer. One can alter the position of the smelting zone, that is, the focus, by changing the blast. The focus can be driven up by increased blast; in fact, it may be driven clear to the top of the column.

One might think the works old-fashioned, but they have kept fully in touch with all modern improvements and tendencies in the United States, but it has not been found that advantageous use could be made of the most striking ones. This is true as well of economic as of purely metallurgical points. Each furnace is run individually as regards momentary composition of charge, and the principal factor in their operation is the feeding. One has to be very particular about this, and cannot resort to mechanical appliances intended to serve unchanging average conditions of feed, because the process is so sensitive to variations in the relative proportions of silica, sulphide, and air, and to the physical way in which these three come together. It is not possible to run a number of pyritic furnaces all in the same manner and obtain the present grades of matte with satisfactory constancy. You would have to reduce the grade to, say, 20%, and be satisfied to re-treat this.

In the subsequent discussion by D. H. Browne, J. Parke Channing, and A. H. Rogers, Mr. Sticht argued as follows:

In a blast-furnace you find lumps of silica and lumps of pyrite in contact. In the Knudsen converter you find fused slag and fused matte; hence the blowing occurs under different conditions as to spacial distribution of air, sulphide, and silica, affording different facility for reaction.

Most of the iron in the Mount Lyell ores is burned off, that is to say, 95 to 96%, and in the burning it is also sacrificed and forms the slag. However, I am of the opinion that the materials must be in big lumps to do the work.

Too much stress is often put on the utility of the sulphur in pyrite as a source of heat in this process. That extra atom of sulphur is not burned; it goes off altogether by sublimation, is distilled. The FeS_2 turns practically to pyrrhotite at once, and even to something like Fe_7S_8, or Fe_6S_7, in the lower part of the furnace; and it is this particular sulphide which supplies the heat. In many ways, I think, a pyrrhotite ore is probably easier to smelt pyritically than a pyrite ore, but I may repeat that the most essential condition for the process is to have free SiO_2. What experience I had with pyrrhotite ores in Colorado made me feel that they were easier to treat than pure pyrite. In addition to keeping the throat more free, they seemed to run hotter. But it was necessary not to be afraid to reduce the coke, that is, to a minimum which would ordinarily seem dangerous.

Height of Smelting Column

There ought to be several feet leeway in the height of a smelting column. In reconstructing the Mount Lyell works, I raised the charge floor 8 ft. above the former one. A separate blower for each furnace is desirable if one can afford it, but that is only a minor point when there are not too many furnaces. When formerly using hot blast, the stoves standing between blowers and furnaces, it complicated matters to have a blower for each furnace, and we did not do that at Mount Lyell. The practice now is to supply about 20,000 cu. ft. of cold free air per minute to each furnace. The 64-oz. pressure is only an incidental feature of the blast, and is due merely to the resistance encountered in forcing a given volume of air through a certain size of tuyere in a given time. Roughly speaking, it is volume rather than pressure that counts.

Regarding the composition of the furnace gases, since the figures were first published, I have occasionally repeated the analyses, and still find practically no oxygen in the gases leaving the furnace, nor at a depth of 7.5 ft. below the top of the column. The determinations were last made a few months ago, with a water-cooled apparatus.

The top of the charge looks hot. This is due to the large amount of sulphur distilling off, which burns as it comes in contact with oxygen of the air above the charge. It is possible to run the furnace on matte and pyrrhotite with a satisfactorily cold top. On pyrite, however, this is impracticable, for this low temperature can be achieved only by operating in a manner which leads to rapid formation of crusts around the throat. The furnace is run so as to avoid crusts, and thus appears to have a fiery throat. One must, however,

not contemplate the combustion of the sublimated elemental sulphur, but judge throat conditions rather by the phenomena at the top of column. The top of the furnace is really not hot, for the pieces of charge glow slightly only around the walls, and are black and cold over the full inner area of the top. Between these cold pieces a whitish flame is visible, which changes into a heavy cloud of sulphur vapor, a foot or two above the top of the charge; this then ignites and forms the usual dense white smoke characteristic of the work. The furnace acts as its own crusher; all materials are charged in as massive lumps as the men at the mines and quarries can readily handle. Possibly, if we crushed them first, they would so decrepitate in the furnace that the latter would choke tight, and we could not practice pyritic smelting at all.

Chilean Nitrate Statistics

*The Iquique branch of the Nitrate Propaganda Association reports that the production of nitrate in November 1914 was 2,659,875 quintals (of 101.6 lb.), compared with 4,885,869 quintals in November 1913, and that 54 plants were working in November 1914, against 127 plants in November 1913. The production from January to November in 1913 amounted to 55,193,034 quintals, and in 1914 to 51,071,286 quintals. For the first five months, July to November, of the nitrate year 1914-15, the production was 18,925,310 quintals, compared with 25,100,257 quintals during the corresponding period of 1913-14. In November 1914, 1,910,930 quintals was exported, as against 5,655,841 quintals in November 1913, and the stock on hand November 30, 1914, amounted to 24,168,428 quintals.

El Nacional states that 46 plants will continue to work in December. To November 30, 1914, the loans to nitrate companies by the government amounted to ₱25,836,207, paper, of which ₱3,434,154 had been repaid. The value of the Chilean paper *peso* fluctuated as follows: July, 1914, 20c.; August and September, 18c.; and October and November, 15c. Sales of importance in November were made at $1.45 per quintal. Exports of nitrate from July 1 to November 30, 1914, totaled 11,300,353 quintals, a decrease of 13,000,000 quintals from the exports for the corresponding period of 1913.

THE CONDITION of the copper market in Japan is worse than ever, with no prospects of relief, according to a consular report of December 2. The Mainichi (Osaka) reports the latest quotations for electrolytic copper at 10.65c. per lb., and 98% quality at about 10.50c., but these quotations are only nominal, as there are no buyers.

NEW ROLLING STOCK for railroads in the United States consisted of the following in 1914 and 1913:

	1914.	1913.
Freight cars	104,541	207,684
Passenger cars	3,691	3,296
Locomotives	2,235	5,332

*Report of David J. D. Myers, consul at Iquique, Dec. 15.

Firing Boilers

By ALEXANDER M. ALLEN

*It is well known that boilers working in batteries, though of the same size and style, will not evaporate the same amount of water per hour. In a battery of three 100-hp. boilers, for instance, the centre one will evaporate 3000 lb. (its rated capacity), the one on its right will evaporate only 2000 lb. (1000 lb. below its capacity), while the one on its left may evaporate 4000 lb. (1000 lb. above its rated capacity). Twenty minutes later these conditions may be reversed. This method of getting up steam is not only uneconomical, but unreliable, and may result in injury to the entire battery. Feed water regulators and feed pumps together with raising the temperature of the feed water may help considerably in maintaining a uniform steam pressure and a consequent uniform evaporation, but all of the foregoing auxiliaries are not half so effective as the care and skill to be exercised and practised continually in the fire-room.

Most firemen coal entirely too heavily, and thus permit the fire to lag for one-half hour, sometimes, before it is hot enough to make steam. Evidently time is wasted and the method incorrect. Coal should be burned as rapidly as possible to secure the best results. Since a pound of coal contains a certain number of heat units (B.t.u.), whether it burns for one minute or one hour, it is to advantage to extract this heat and transfer it to the water in the boiler in the shortest possible time in order to get up steam quickly.

To know the necessary amount of air to be admitted into the ashpit of the boiler for the proper combustion of the coal is important, because an oversupply of air may easily chill the furnace. With a grate having an 18% air space and a fire bed of rice coal 8 in. thick, an air pressure of 1.5 in. of water gage was found to be correct. This gage will differ, however, for various styles of grates and kinds of fuel.

A recent experience impresses all the more the importance of correct firing. At a boiler plant the output of which was 150 hp., a fireman was cleaning a rice-coal fire that was about 12 in. thick. First he pushed the good coal back and dropped the front; then he pulled all the good coal ahead and dropped the back, after which he proceeded to spread the partly burned coal equally over the grate. The coal bed was then about 5 in. thick. So far so good. The next move was the turning on of the air-blast and applying fresh coal. The fireman then fed (by count) 140 shovels of coal which at 20 lb. per shovel made a total of 2800 lb. A liberal allowance of coal to make one boiler horse-power is 6 lb. per hour. From this figure it can be seen that the fireman coaled enough to last three hours. Ridiculous, it may be said, yet many men who call themselves firemen have been doing this very same thing all the time.

*Abstract from *Employes' Magazine* of the Lehigh Valley Coal Company.

DISCUSSION

Readers of the MINING PRESS *are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.*

Johnson Electric Furnace

The Editor:

Sir—In the *Press* of January 2, I notice an inaccuracy which should be corrected concerning the work of the Johnson electric furnace. Mr. Keeney, in his review of 'Electric Smelting in 1914' (page 26) makes the statement that "much publicity has been given to an experimental run on 17 tons of zinc ore in the Johnson electric furnace at Hartford, etc."

The following are the results of the 42-day run. During this period there was treated 60,525 lb. of ore, yielding 17,245 lb. of spelter, 3478 lb. of 12% copper matte, 2437 lb. of 116-oz. lead bullion, and 45,850 lb. of slag. During this time ores from New Hampshire, Nevada, Colorado, and other western states were treated, having the following range in composition: zinc, 21.75 to 44.1%; lead, 0 to 17.5%; copper, 0.5 to 2.25%; iron, 4.5 to 32.87%; sulphur, 0.15 to 6.23%; lime, 1 to 3.8%; alumina, 1.13 to 8.5%; insoluble, 8.37 to 20%; silver, 2.6 to 23 oz. per ton; and gold, 0.04 to 0.4 oz. per ton. The recovery of zinc for the entire run was 86.1%. Spelter produced direct was 77.87%. The electrode consumption per ton of ore treated was 6.05 lb. Arrangements have been completed for the erection of the first 10-ton furnace of a 100-ton commercial plant.

JOSEPH STRUTHERS.

New York, January 12.

Precision of Thought

The Editor:

Sir—Of course, you have my cordial sympathy in your effort to obtain clarity of expression by your note on 'Precision of Thought.' The good humored attack of W. S Prosser will have left you, I trust, undismayed. The subject came to my mind this morning in reading the American note, couched in terms of exemplary frankness and courtesy, to the British government, on contraband of war and the searching of ships trading with neutral countries. In that note, signed by the American Ambassador, who, I may add incidentally, fully maintains the peculiarly fine traditions of his honorable office, there is a curious confusion in the use of the singular and plural in respect of the idea denoted by the word 'Government.' In the text as published in our morning papers it is stated variously:

"The Government of the United States *have* viewed, etc."

"This Government *has* so often exhibited."

"The British Government *were* satisfied."

"This Government *is* forced."

"The Government of the United States *do* not intend."

"This Government *is* informed."

"The Government of the United States *are* informed."

"The Government *believes*."

"The Government of the United States *expresses*."

Apparently the singular and plural forms are employed with impartiality. I submit to you that the Government *is* a unit; it represents the administration as an entity. The members of the Government *are* united for the purposes of national administration.

In England the same mistake is equally common. Papers and politicians often speak of the Cabinet, the Ministry, and the Government in the plural form, although each of these words connotes the idea of unity. The Cabinet *is* a select committee of the party in political control, the members of the Cabinet *are* men of various aptitudes. The United States *is* a great country; the United States *are* more numerous than at the time of the Civil War, and so forth. Undoubtedly the discriminating use of the singular and plural forms facilitates clearness of thought, and, therefore, of expression. That is why the difference of form was evolved.

T. A. RICKARD.

London, January 1.

Solution Control in Cyanidation

The Editor:

Sir—Mr. Harai Layng's contribution to the above discussion in your October 17 issue would have been more to the point had he chosen to criticize the alkalinity method used in my series rather than to condemn a method which, after much experimenting, I had previously decided was unreliable, and which I neither mentioned in my article nor in subsequent discussion.

Mr. Layng, after correctly summarizing the scheme of tests I advocated, adds: "That this method is doubtful may be proved by the following: In the first step of Mr. Allen's method, where he adds caustic alkali before titrating for total cyanide, the following reaction would occur:

(1) $2KCN + AgNO_3 = KAg(CN)_2 + KNO_3$

(2) $K_2Zn(CN)_4 + 4KOH + 2AgNO_3 = 2KAg(CN)_2 + Zn(OK)_2 + 2KNO_3 + 2H_2O$."

As these equations appeared, with acknowledgement, in my original article, it is obvious that, so far, Mr. Layng agrees with me that the addition of alkali to a

working solution containing the double cyanides does not necessarily regenerate free cyanide, and that the ordinary Liebig test, with KI as indicator, is useless for determining free cyanide content.

The criticism then continues: "In the tests for protective alkalinity he does not add any caustic alkali, but adds the same amount of $AgNO_3$ to it before titrating for protective alkalinity as he added to his test for total cyanide." The need for adding caustic alkali to a cyanide solution before testing for protective alkalinity certainly did not strike me as a sane procedure, but let me state that I do not add the same amount of $AgNO_3$, but an excess (in amount to be determined). This fact is of importance, and I cannot understand why Mr. Layng should take the trouble to state a fact in his preamble and omit it when he criticizes in detail.

Mr. Layng continues: "If his solutions contained no protective alkalinity the following reactions in the case of the $K_2Zn(CN)_4$ would occur on the addition of the same amount of $AgNO_3$ as was added to his total cyanide test:

$$(3)\ K_2Zn(CN)_4 + 2AgNO_3 = 2AgCN + Zn(CN)_2 + 2KNO_3."$$

The equation is no doubt interesting, but the point is foreign to the present discussion, and the reaction shown cannot and does not occur in, or as a preliminary to, the alkalinity test I outlined. In the free cyanide test the addition of KI insures the selective reaction resulting in yellow opalescent AgI in preference to the precipitate of silver cyanide.

Mr. Layng continues "But if the solution contained some protective alkalinity, though not sufficient to supply the alkali for the reaction (2), the result of adding the amount of $AgNO_3$ found necessary for the total cyanide would be the formation of more or less alkaline zincate, according to the amount of caustic alkali contained in the solution." The point which Mr. Layng entirely ignores is that *potassium ferrocyanide is added before the $AgNO_3$*. It is again a curious coincidence that whereas in his summary he acknowledges that I am using Green's alkalinity test, when he comes to detailed criticism he discusses another test altogether. The use of ferrocyanide is the crux of Green's test, and by its addition before the $AgNO_3$ the formation of alkaline zincate is avoided. The equation, according to Bettel, is:

$$2K_4Fe(CN)_6 + 3K_2Zn(CN)_4 = K_2Zn_3Fe_2(CN)_{12} + 12KCN.$$

The excess of $AgNO_3$ subsequently added renders the solution neutral by the formation of $KAg(CN)_2$.

The remainder of Mr. Layng's criticism deals at length with his opinions as to the behavior of zincates in cyanide solutions, but as he also suggests that the zinc in a working solution may exist entirely as double cyanide, his remarks lose force. He concludes by suggesting that I did not prove that zinc does not exist in solutions (in general?) as a zincate of an alkali. Having attempted no such impossible task, I agree with Mr. Layng. What I did prove by analysis was that, in the solution in question, the tests outlined gave substantially accurate results as an alternative to Liebig's test with KI indicator, which gave no true measure of free cyanide content.

Mr. Layng confuses the theoretical considerations as to what would happen if caustic alkali were added to neutral potassium-zinc-cyanide solution with the practical question as to the result of the addition of alkali to a working solution carrying zinc as the double salt and protected with free cyanide. In the former case a certain amount of dissociation will undoubtedly result, but, as I maintain, not in the latter. If Mr. Layng will refer to the original article he will find that all my tests were made with working solution.

An impression is common that the double cyanides only act as solvents for gold after the addition of alkali. Mr. Layng subscribes to this belief and states boldly that "zinc double cyanide * * * would not be available for extraction purposes unless it should be treated with caustic alkali." As an argument in favor of the alkaline regeneration theory it is worthy of attention, but I am unaware that it has any foundation in fact. Goyder's results are, I think, conclusive. He states*: "I prepared some of these double cyanides and purified them by crystallization, several times repeated, and found that zinc-potassium-cyanide dissolves gold in the presence of oxygen and produces gold-potassium-cyanide and oxide of zinc." The equation is as follows:

$$K_2Zn(CN)_4 + Au_2 + O = 2KAu(CN)_2 + ZnO.$$

In practice it has been found that the presence of the double cyanide seldom adversely affects the efficiency of result. With regard to the effect of the addition of alkali, it has been shown by Julian and Smart† that the increase in dissolving power is almost the same with a solution of KCN as it is with a solution of $K_2Zn(CN)_4$.

Where the zinc double cyanide does make itself felt is in the precipitation department, an excess of the salt lowering the efficiency of this part of the process unless a proportionately high free cyanide strength is maintained, which results in an increased consumption of solvent and precipitant.

A. W. Allen.

London, December 23, 1914.

Bucket Elevators

The Editor:

Sir—In the article on the Plymouth mill which appeared in your issue of October 31, Mr. Caetani mentions trouble with the head pulley of bucket elevators. On similar work under most exacting conditions I have used the following arrangement: A pulley with a solid hub, bored to take a taper wedge similar to the Blanton cam fastener. Such a pulley needs no attention after once being placed in position.

William Seward Mann.

Cisco, California, December 15, 1914.

Chemical News, Aug. 23, 1895.

†'Cyaniding Gold and Silver Ores,' p. 105.

CONCENTRATES

Readers of the MINING PRESS *are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.*

A SILVER-TIN LODE is being mined at the Aramayo Francke property in Bolivia. This peculiar ore is shipped to England, but a lixiviation plant is to be erected to treat it locally.

TRANSIT SHOTS amounting to 600 were taken in eight hours by a surveyor with the Morgan Engineering Co., of Memphis, Tennessee, during 1914. This is a record for topographical work. A Berger transit was used.

THE FUEL VALUE of 2 lb. of wood is roughly equivalent to that of 1 lb. of coal. This is given as the result of certain calculations now being made in the Forest Service laboratory of the U. S. Department of Agriculture.

WOODEN CROSS-TIES used by steam and electric railroads in the United States totaled 123,751,000 in 1909, at a cost of $60,320,700. Of these ties, 16,437,000 were required for new construction and 107,314,000 for renewals.

TUBE-MILL AND CLASSIFICATION PLANT at the Champion Reef mine, India, started on September 26. It consists of three 4-ft. 9-in. by 19-ft. mills, fitted with ribbed manganese steel liners. Classification is done in two primary cones, 5 by 7 ft. 6 in. each, and six secondary cones, 7 ft. 3 in. by 9 ft. each. Two 6-in. and one 9-in. air-lifts are used for elevating pulp in the plant.

'SAFETY FIRST' of the Nevada Consolidated Copper Co. shows the following results of this work in the past two years:

Men employed at—	1913.	1914.	Reduction, per cent.
Veteran mine, underground	304	144	52.6
Copper Flat, open pit	581	490	15.6
Steptoe concentrator and smelter	1584	1214	23.3
Average number men employed daily at all operations	2469	1848	25.1
Fatalities:			
Number of accidents	11	4	63.6
Men killed	13	8	38.5
Disabling accidents:			
Men injured	399	173	56.6
Days incapacitated	4933	1807	63.4

The reduction of 'safety first' from a crude abstract to a tangible reality can be accomplished by concentrating your thoughts on safety; roasting to a friable state all refractory opposition to safety; reverberating the slogan till its echoes make careless men think of safety; and converting your careless habits into habits and thoughts of safety.

SAFETY FIRST CAMPAIGN was started by the Anaconda Copper Mining Co. on January 1, 1914, and has resulted in a reduction of the number of accidents, according to J. J. Corrigan, safety engineer. Fatalities were reduced about 50%, yet greater care by the men is needed. In the mines at Butte, figures compiled by the Company show that accidents occur from various causes in the following percentages: Fall of ground, 43.21; caught by mine cars, 12.97; handling tools, 14.54; handling material, 11.87; falling, 10; falling timber, 3.62; explosives, 0.70; machinery, 1.11; around cages, 0.74; and miscellaneous, 1.24 per cent. Falling in chutes, a form of accident which heretofore resulted in about 10% of the fatalities, has been greatly reduced, and if all will obey the rules which are now in force this class of accidents should be almost entirely eliminated.

CONSIDERABLE INJURY in mines and mills may be traced to the use of loose-fitting wrenches, splintered or broken shovel handles, and other uncared-for hand tools. The largest contributors to injuries in the latter class are chisels, punches, wedges, blacksmith's tools, stonecutter's tools, and similar small hand tools which are subjected to frequent hammer blows, in consequence of which their heads become readily 'mushroomed.' A mushroomed head presents a dangerous condition, for the next hammer blow may break off one of the slivers of steel hanging to the body of the tool and send it flying through the air with great risk of injury to the man handling the tool or to others nearby. The remedy costs little, is well known, simple, and effective. When the head of such a tool is found to be chipped, cracked, or mushroomed, it should be promptly laid aside and not used again until the head has been ground down or dressed to its proper shape. A good practice applicable to cold-chisels and other tools that must be sharpened frequently is to grind down their heads every time the tools are sharpened, thus preventing the development of a mushroomed condition, at the same time retaining the hammer-hardened ends which will not spread so rapidly in the future life of the tools; this practice also avoids much waste of the steel which would otherwise have to be cut off if the heads of the tools were re-forged. As a further precautionary measure, all steel hand tools that are likely to be struck by hand hammers or sledges should have the upper part of the shanks shaped round, and slightly tapered from the top downward, before they are used; care should also be taken to make such tools of the right grade of steel, else the battered overhanging portions of the tools will readily break off.

FLAT CREEK, SHOWING YUKON GOLD CO.'S DREDGE.

MINING IN THE FAR NORTH*

The Iditarod District—Dredging and Placer Operations

By EMIL EDWARD HURJA

The Iditarod mining district is about 150 miles southwest of the Ruby district, which was reviewed in the *Press* in the preceding article. It comprises the streams flowing into the Iditarod river. Most of the producing creeks head into the dike mass cut by Flat creek. The first gold in the Iditarod district was found in 1909 and the few years following that were marked by a great inrush of people. The rush and reports of fabulous placers attracted engineers of the Yukon Gold Co., a Guggenheim corporation, which obtained options on many claims and conducted thorough prospecting. Because of the inability to arrive at satisfactory terms with the owners of the ground, the taking over the ground was not completed until the winter of 1911-12. In the summer of 1912 a dredge was dismantled at Dawson and taken to Iditarod, to be hauled to the Marietta Association claim on Flat creek. Its coming put an end to most of the old-time placer mining, where the individual reigned supreme. The small plants that used to line the creeks and employ hundreds of men gave way to the dredge, with its picked crew.

The general relief of the district is low, although high hills in the region are not uncommon. They are the result of igneous intrusions. There are three settlements in the Iditarod district. One is the town of Flat, situated at the mouth of that creek. The other is the town of Iditarod, situated at the head of navigation on the Iditarod river. The third is the town of Discovery Otter, on a claim of that name. In Iditarod the 1911 production was about $3,000,000, compared with $825,000 during the summer of 1910. In 1912 and 1913 about $2,500,000 to $3,000,000 was produced. The winter of 1910-11 marked the first transportation of gold from Iditarod to the coast by dog-team. This was necessary as the mining season continued until the season of navigation had closed and the clean-ups of the month or six weeks had to be carried outside overland. The development of Iditarod has been hindered to some extent by the early practice of staking association claims, thus blanketing large areas of possible gold-bearing ground and withholding it from development. The Iditarod ground usually is shallow, and the operations are conducted by open-cutting. Considerable attention has been given of late to the Kuskokwim district, which adjoins the Iditarod. Drills have been taken over from Iditarod, and plans for dredging enterprises are said to have been recently completed.

The principal gold-bearing streams of the Iditarod camp are Flat creek, tributary to Otter creek, and Otter creek itself. Some mining has been done along Glen gulch and Black creek, as well as Happy gulch and Willow creek. By far the greatest production has come from Flat and Otter creeks, on each of which a dredge worked last year.

At the extreme head of Flat creek, on the hillside, Strandberg & Aitken are ground-sluicing into the boxes, using a 3-in. nozzle in the work, and a 16-hp. steam derrick to hoist the big boulders. Aitken also has a crew of 30 men working on the Mading bench claim on the left limit of Flat creek opposite the Yukon Gold Co.'s dredge. The gold occurs mostly in bedrock, so the overburden must be ground-sluiced off. The streak has a width of 150 ft. The 'pay' is hoisted on a dump, to be sluiced through three strings of boxes underlying it when water conditions permit. An automatic dam controls the water for the claim. Aitken's operations on Idaho creek, a tributary of Flat creek, are conducted only when water conditions permit sluicing to be done. The Yukon Gold Co. dredge is operating on the Wildcat ground. Its operation was touched upon more in detail in the article

*[Previous articles in this series by Mr. Hurja include a general survey of the mining situation in the more important districts throughout Alaska.—EDITOR.]

STEAM POINTS THAWING GRAVEL AHEAD OF RILEY & MARSTEN DREDGE.

dealing with the operations of the Yukon Gold Co. which appeared in the October 10, 1914, issue of the *Press*.

On the upper end of Discovery claim, Otter creek, Riley & Marsten completed the installation of a gasoline-operated dredge early in the summer. The dredge was built by the Union Construction Co. of San Francisco. It cost $80,000, including the freight to its final destination on Otter creek. A 12-mile haul from Iditarod was necessary. Freight from San Francisco was $80 per ton. The dredge has 3½-ft. buckets and a daily capacity of 2000 yd. It is operated by two 60-hp. Union gasoline engines. The dredge started operations May 27, 1914. It had worked downstream a distance of 100 ft. by September 1, working the ground for the whole width of the claim. At present the dredge is on the Beaton ground on 1 Below, Otter creek.

Riley & McMillan, working on 1 Below bench claim on the left limit of Otter creek, started work on June 15. They are scraping with a three-drum hoist and a battery of boilers with 50 hp. capacity. A three-inch nozzle was used to clean off the 'muck.' The ground is from seven to ten feet deep, with the 'muck sheet' ranging from four to five feet in thickness. A Bagley scraper is used. It unloads the dirt into a car which runs up an incline to the dump box. On August 15, 85,000 sq. ft. of ground had been cleaned up ready for scraping into the boxes, and it was expected this amount could be worked easily before the season came to a close. For next season's work, 150,000 sq. ft. of 'muck' has been removed from virgin ground. This was possible because of the abundance of water this summer. Twenty-two men were employed throughout the sluicing season on the claim. Pole riffles with iron straps of half-inch iron are used in the sluice-boxes to save the gold, with one undercurrent of perforated iron plates and cocoa matting to catch the finer particles.

Bates Brothers, on Discovery bench on the left limit of Otter creek, have ground-sluicing in progress as well as the scraping of waste gravel. When the work of sluicing started, fifty men were put to work. The dirt is shoveled into wheel-barrows, which are dumped into buckets. The dirt is hoisted from 8 to 14 ft. to the sluice-boxes. The season's output was in excess of 80,000 sq. ft. Riley & Marsten are working on the creek claim, on Discovery claim, Otter creek, with a three-yard scraper and a 90-hp. donkey engine. The dirt is scraped into a car which travels 25 ft. to the sluice-boxes. Where the bedrock is hard, the 'pay' is shoveled into wheelbarrows, to be hoisted in buckets to the top of the cut into the sluice-boxes. As considerable gold occurs in bedrock, sometimes as much as five feet of the bedrock is taken out. Sixty men were working during the summer. The season's probable output was placed at from 47,500 to 50,000 sq. ft. Frank Dawson is operating on Crane gulch, a tributary to Otter creek. Crane enters Otter on the left limit at Discovery. Three miles of ditch has been built from the head of Slate creek, which delivers water to the 3-in. nozzles with a 90-ft. head. The nozzles are used to strip the ground of 10 ft. of 'muck' which covers four feet of 'pay-gravel.' The gravel is hoisted to the top of the cut, a distance of 16 ft., where the boxes are placed. The 'pay' averages $1.50 per sq. ft. The season's output is estimated at 10,000 square feet.

John Olstrom and Frank Hurkos, working on the left limit of Otter creek, on No. 2 Above, bench claim, worked 28,000 sq. ft. of ground during the summer. The ground is 22 ft. deep. Twenty feet of 'muck' and waste gravel was ground-sluiced off, the rest shoveled into the sluice-boxes as 'pay.' Shield & Neumier did not have as good a season as they expected on the upper end of No. 2 Above, left limit bench claim, because of a scarcity of water for sluicing operations. Ten men were employed. Gravel was hoisted from the cut to the sluice-boxes above. 'Red' Ellis worked on No. 2 Above, creek claim, during the summer. He took out a fair-sized block of ground and expects to work next season for a time. Louis Stetzer and George Riley are working on the upper end of No. 2 Above, creek claim, with a scraper operated by a 60-hp. donkey engine. A 6-in. centrifugal pump is used to supply water for the sluice-boxes during dry weather. The season's output is given as 200,000 sq. ft. Forty men are employed when the operations are on bedrock. Usually the crew consists of from 10 to 12 men.

On Black creek, Fred Smith and Olaf Olson had a crew of 10 men working a greater part of the summer. The gravel was hoisted from a depth of 12 ft. The first cut was 8000 sq. ft. in extent. It averaged 60c. per sq. ft. A second cut of 10,000 sq. ft. was completed before the end of the season. Many other plants operated in a small way on the other creeks surrounding Iditarod. Considerable prospecting was done last winter, and reports are that even more will be done the coming winter, because the depressed fur market will drive trappers to take up prospecting for their winter's work.

RILEY & MARSTEN DREDGE, OTTER CREEK, IDITAROD.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

KALGOORLIE, WESTERN AUSTRALIA

STATE GOLD RETURNS IN 1914 A DECREASE.—EDNA MAY, GREAT BOULDER, HORSE-SHOE, CHAFFERS, IVANHOE, AND OTHER MINE DEVELOPMENTS.

The year 1914 has been a disappointing one for gold mining in this state, and the total output is not likely to exceed $26,000,000, against $27,908,000 in 1913, and $27,318,000 in 1912. No new discoveries of any importance have been reported, and, in many cases, there has been a steady decline in the yield of certain districts. The chief exception to this depressing state of affairs has been the Edna May, at Westonia, a mine which owed its discovery to the widespread prospecting caused by the Bullfinch boom of 1910-1911, during which the adjoining mine, taken up by the Greenfinch company, was located by Frank Weston early in 1911. The lode in the Greenfinch area, although containing $20 per ton, was intruded every few feet below 50 ft. by successive horizontal bands, or floors, of granite, which cut through it without either displacing the lode or affecting its value. Eventually, however, solid granite was met with, which completely cut off the lode before a depth of 100 ft. was reached, and all operations were suspended. Owing to this fact, geologists

THE MEEKATHARRA FIELD AS SEEN FROM THE INGLISTON EXTENDED. A PROMISING DISTRICT WHICH PRODUCED $1,500,000 FROM 129,123 TONS IN 1913, AND ABOUT $12,500,000 FROM 850,000 TONS TO THE END OF 1914.

and mining engineers have been extremely cautious in expressing an opinion regarding the continuation in depth of the Edna May lode, and this is still a question.

The mine which has best maintained its position during the year is the Great Boulder, which, during the expired 10 months, has yielded $2,494,100, and earned $1,165,100 in profits, against $2,364,100 and $1,124,600, respectively, in 1913. This mine has ceased sinking for three years since the lode passed into the property of the Golden Horse-Shoe. Recent drilling from the Perseverance into the Boulder has been of considerable importance.

Regarding the Horse-Shoe mine, a practically new area is being opened up in the south end of the claim from the 1300 to the 2000-ft. level, where the ore-shoot has been proved to gradually lengthen as far as Chaffers boundary instead of becoming barren 600 ft. from it, as in the upper levels. In addition, developments on the Great Boulder main lode between the 2480 and 2900-ft. levels prove that high-grade ore, containing telluride and free gold in places, continues. At 2900 ft. the shoot in the north end has ranged from $31.60 to $66.26 per ton for the full width of the drift, and, in the south end, from $10.20 to $10.70 per ton. The width of the lode, where cross cut at this depth, is 15 feet.

Regarding Chaffers, the first return of 6138 tons for $27,500, and a loss of $5500, is distinctly disappointing even if, as officially stated, $10,000 was absorbed by the plant. The Company finances are somewhat strained. With the exception of a shoot 181 ft. long, worth $25.80 per ton, in No. 3 west lode at No. 16 level, the average of the ore opened up is no better than that treated prior to the reconstruction of the Company, or say $6.50 recoverable, and the profit is not likely to exceed 60c. per ton. The money raised was for exploring the mine to a greater depth for the continuation of the Golden Horse-Shoe shoots, as advised by John Morgan; but this was not done, and a further reconstruction is probable.

None of the other mines on the Golden Mile has improved its position, but the Ivanhoe is still sinking and is down 3215 ft., and the Lake View & Star is developing well in the Star property.

During the year the Great Fingall, Bullfinch, and Victorious have proved disappointing. This is especially the case with the Great Fingall, as the grade of ore treated since the mill resumed operations has only averaged $6.84, against $9.40 per ton estimated, and the 40-stamp mill has only run about half time. With regard to the Victorious, it seems doubtful whether the Associated Northern Co. will recover the $105,000 spent on development and equipment since treatment stopped for erection of the sulphide mill.

The Oroya Links report for the third quarter of 1914 shows that 37,300 tons of ore yielded $5.06 per ton, and a total profit of $14,500. Working costs totaled $3.89 per ton.

NEW YORK

NEW KEYSTONE-INSPIRATION AFFAIRS.—COPPER RANGE CONSOLIDATED COPPER.—COPPER COMPANIES, DIVIDENDS, STOCKS OF METAL, AND EXPORTS.

The proposal to consolidate the New Keystone with the Inspiration was carried by a small majority of the stockholders at a meeting last week. The matter is, of course, not completely settled yet, for it is possible for a disgruntled minority to make almost indefinite trouble in a legal way, as is seen in the case of the litigation against the Old Dominion. There seems to be some hope, however, that the insurgents may be reconciled and the consolidation proceed quietly. It is said that troubles never come singly, and a further difficulty developed when the labor dispute arose which was dealt with in the *Press* of last week and the current issue. Construction work is so near completion on the Inspiration and the smelter, that the strike was not very serious as far as they are concerned, because as long as copper remains at its present low price there seems to be no particular incentive to start them.

The Copper Range Consolidated changed its selling arrangements a short while ago, and its copper, which formerly was sold by the United Metals Selling Co. will now be marketed by the Copper Range itself. The United company now has no Lake copper to sell, as the distinction between Lake and electrolytic copper has yearly been growing less, and is not nearly so strong as it used to be. The Copper Range copper has a

peculiar market of its own, as it contains just enough arsenic to make it especially suitable for the making of tubes, the rolling of sheets, and various other special purposes for which it is finding a ready market without any difficulty.

The directors of the Shattuck-Arizona Copper Co. have resumed dividend payments, and 50c. per share will be paid February 20 ——Amalgamated Copper has also resumed dividends with a 50c. quarterly payment.——The Calumet & Arizona board of directors has created a committee of three to handle all the details of the financing of the Ajo property. Work on the method of leaching to be adopted is well advanced, and it is probable that some announcement will be made before long. The Granby Consolidated has blown in four of its furnaces at Grand Forks, while two are running at Anyox.——It was reported that the Calumet & Hecla was to resume dividend payments, but a statement by the vice-president of the Company states that the matter has not even been discussed by the directors, and unless the price of copper improves before the end of March, it is not probable that there will be any distribution at present.

Consumers of copper are insisting that the producers will increase their output soon, while the producers fail to see the necessity of any such move. The National Conduit Co. has calculated that on January 1 the stocks of refined copper amounted to 223,000,000 lb., which scarcely indicates any necessity for an increased yield. What producers are asserting their strategy for, is to get prices up to a point at which there is some possibility of their making profits on operation before increasing their output. Consumers, of course, are interested in doing everything they can to keep prices down to the lowest level possible. That is, of course, to their advantage, but it is very much to the disadvantage of the copper mining industry and therefore to the country as a whole.

Exports of copper from New York for the week ended January 2 totaled 12,000,000 lb., and for the week ended January 9, 16,000,000 lb. Exports from New York for the seven weeks ended January 15 amounted to 70,400,000 lb. Russia has been buying copper lately in considerable amount, and it is reported that some of the shipment will be sent to Japan, where it will be manufactured into munitions of war for the Russian army. The story seems highly improbable, since copper has been ruling at a very low price in Japan for some time, as some of the Japanese copper comes to this country for refining. The story illustrates the many improbable statements that are made concerning conditions while the war prevails. In Germany the National Council has fixed a maximum price for refined and scrap copper. This, of course, only applies to dealings within the country to prevent unscrupulous dealers from taking advantage of their fellow countrymen, but will not serve to restrict the prices that German consumers might pay in order to get copper from outside. There have been no developments of importance in regard to the question of exports of copper in the past week, and the matter has simply become one of the various questions to be considered in connection with the protest which the U. S. government has made to England in regard to American shipments.

TORONTO, ONTARIO

The Nickel Controversy Again.—Hollinger Dividends, Mill, Air-Compressors, and Future.—Porcupine Crown, McIntyre, Hurionia, and North Thompson Mines.—Cobalt Silver Production.

The controversy regarding the ultimate destination of nickel, refined from Canadian ores, still continues, although official statements by Sir Robert Borden, premier of Canada, and Ambrose Monell, president of the International Nickel Co., have definitely refuted the allegations made against the Company. Mr. Monell stated that there was no nickel being shipped to Germany or its allies, and that there was no foreign influence in the affairs of the Company, as had been given out by a considerable proportion of the influential Canadian press. The statement by the Canadian government was to the effect that it, acting for the British government, was thoroughly in touch with the situation, and was kept constantly informed regarding all shipments of nickel, whether for domestic or foreign consumption. An auditor, acting for the government, regularly inspects the books of the International Nickel Co. to see that the information regarding shipments is correct. It was further stated that an examination of the list of shareholders showed that the majority of shares was held in the United States. The British government also has expressed itself as being satisfied with the precautions taken. While in the beginning this agitation arose from a genuine fear that Ontario nickel was being sent to Germany to be used in the manufacture of munitions of war, the belief is now growing that the present continued stirring up of this subject is an attempt to drag the matter into the realms of party politics, and that this attempt is being fostered by those who are interested in the sale of nickel properties which are at the present time unsalable. The agitators have already demanded that all the nickel be refined in Canada, and the next move in the game will probably be that a bounty be paid for nickel so refined. If those interested were successful in getting what they want, they would have a much greater opportunity to dispose of the properties which they have been so long unsuccessfully trying to market.

The rapid and continued rise in Hollinger shares has been the outstanding feature of the mining market for the past few weeks, and is explained by the action of the directors in increasing the dividend, as mentioned in the *Press* of January 23. Present earnings seem to justify the increase, and with the new addition to the mill which is nearing completion, profits should be maintained even with a considerably lower grade of ore. It is understood that the intention is to keep on gradually adding to the capacity of the mill as development progresses on the Hollinger, Acme, and Miller-Middleton, which are all controlled by the Canadian Mines & Finance Co., with the idea of ultimately arriving at a capacity of 3000 tons per day. Before this stage is reached, however, the three properties will be consolidated. The large central plant for supplying compressed air to the three properties is nearly finished. At the present time one Fraser & Chalmers and two Nordberg machines, each having a capacity of 5000 cu. ft. of free air per minute, are in operation, while a third Nordberg machine of equal capacity is being installed.

The Dome company has placed an order for a 36 by 48-in. jaw-crusher, to be installed in the bottom level of the mine.

After a great deal of prospecting, the Porcupine Crown company has succeeded in locating the extension of its main vein below the 500-ft. level, and the drifts being opened on the ore show that it maintains its usual width and value. About eight months ago, in sinking below 400 ft., the vein cut out, and although a large amount of work had been done with a view to finding the continuation, it was only recently that the Company's efforts met with success.

The McIntyre has started sinking the main shaft from 500 to the 600-ft. level. Recent developments have been satisfactory, and the Company expects to be able to maintain a monthly output of between $60,000 and $70,000.

The Hurona mine, in the Larder Lake district, recently shipped $3000 as the result of a two weeks' run. The Company is now receiving power from the plant of the Goldfields, Limited, and expects shortly to be in a position to operate the mill regularly. The results being obtained on the Huronian have resulted in two adjoining claims being taken under option by the Trethewey company of Cobalt.

The North Thompson Associated Gold Mines, Ltd., is the somewhat lengthy name of a new company, recently regis-

tered in London, which will operate the North Thompson properties in Porcupine, taken under option by Erlich & Co. about a year ago. The new concern has a capital of £200,000 in £1 shares and it will make an agreement with the Associated Gold Mines of Western Australia, the parent Company regarding the Porcupine property. Directors are to receive £100 per year salary and 5% of the profits, with a maximum of £1000 per year.

It is expected that the output of silver from Cobalt in 1914 will be about 23,000,000 oz., a decrease of 5,000,000 oz. from the preceding year, and a decrease of about 10,000,000 oz. compared with the record year of the district. This falling off is due in part to the lower prices for silver and to the fact that when the war started several of the mines were closed down, but it is also partly due to the gradual exhaustion of the mines themselves. The year 1915 will probably show further decreases, as some of the mines are having a hard struggle to maintain the present rate of dividends. In these properties the ore reserves are practically depleted, and the possibilities for further discoveries are not promising, so that it is only to be expected that some mines will close permanently during 1915.

LORDSBURG, NEW MEXICO

Recent Ore Shipments from Lordsburg, Bonney Mining Co.—Mogollon.—Ore Treatment Problems at Pinos Altos.—Sierra County Mines.—Steins.—Burro Mountain Mine.

The month of December in the Lordsburg district was one of the smallest, as regards ore shipments, in many years. Constant rains, making ore freighting impossible, was the cause. According to official reports, the total was 40 cars, 150 cars being the average during curtailment. Starting January 5, operations on a large scale were resumed at the 85 mine, it being possible to haul ore to the A. & N. M. railroad. A night shift has been added to the working forces.

At the annual meeting of the Bonney Mining Co., held at Lordsburg on January 1, it was decided to sink No. 3 shaft to a depth of 511 ft., drive on the 300-ft. level to No. 2 shaft, and explore intermediate ground. The new power plant at the No. 3 mine is in operation and is supplying compressed air for operation of hoist and drills at the No. 2. Work will continue at the latter mine, and shipments made from the vein now being operated. Shipments will probably average 12 to 15 cars per month.

Trains from Lordsburg to Clifton and Morenci, Arizona, are now running on schedule time, the wash-out between York and Sheldon being repaired. Traffic to these places was congested on account of the Gila river floods.

Mogollon, in Socorro county, suffered for the lack of supplies during the high-water period. Cableways were washed downstream, and mail was transferred from bank to bank at a great risk of life. Conditions are at the present time such that traffic is being carried on in safety. The Socorro Mining & Milling Co., of Mogollon, has asked the state engineer for an extension of time in which to complete its power project on Whitewater creek. This was granted and the time extended until January 25, 1917. Unforeseen difficulties and increased expenses are the causes assigned for the delay in completing the project.——No word has yet been received of M. Cooney, a pioneer Mogollon mining operator, and one of the regents of the New Mexico School of Mines, who is believed to be lost in the Mogollon mountains. Many searching parties are out. He has been missing since October 25.

Stauber and Wright, who hold a lease on the property of the Savannah Copper Co., are considering the erection of a mill on the Pacific No. 2 property to treat the complex Pinos Altos ores, containing zinc (sulphide), copper, gold, iron pyrite, and silver. This has been attempted many times, but each time was a failure. The Empire Zinc Co. has solved the problem of the Cleveland and Otter zinc sulphide ore but the gold-bearing veins are still to be solved. It is claimed that the lessees will be compelled to erect some kind of an ore-treatment plant, this being a condition in their lease. This statement, however, is unconfirmed. The high-grade gold content of Pinos Altos ore is as formerly.

Work is progressing in the Snowstorm mine at Kingston, Sierra county, and some manganese ore is being developed.

Lessees on the Lookout mine report prospects as being favorable. The Southern Cross mine is again being operated by J. W. Jensen. Carter and O'Neil are developing properties in Pickett Springs gulch.——The Illinois and Saratoga mines at Kingston have been sold to C. T. Brown, of the Empire Zinc Co., for $5000, according to court records. The properties were large producers in the early days, but have been dormant for some time past.

CRUSHER STATION OF CHINO COPPER CO. AT SANTA RITA, NEW MEXICO.

Occasional shipments of ore are being made from Steins, near the Arizona border, by the November Mining Co. and the National Gold & Silver Co.——Free gold has been uncovered in several places near Steins by claimholders doing assessment. Work in the Steeple Rock district has been retarded by the Duncan bridge being washed away during the Gila river floods. Supplies are being sent over the stream by cableway.

According to reports from Tyrone, Phelps, Dodge & Co. will complete the first unit of its 1000-ton capacity mill about the middle of January. Work is progressing fast at the Burro Mountain property, and the mining forces are expected to be doubled in 15 days. Thomas Parker, well known in Tyrone, has given $25,000 for the erection of a hospital in the camp, the Burro Mountain Copper Co. to furnish a similar amount.

PETROGRAD, RUSSIA

Russian Copper in 1914: Factors Influencing Output, Figures for Eight Months, and Estimates for the Year.—By-products from Smelters.—Lead Resources of Russia.

The probable effect of the war on the copper industry of Russia is difficult to determine. It is subject to two influences: first, the great demand from the military point of view, and second, the serious inroads made on the supply of labor for the mines due to the calling of men to the colors. The state of war strikes the industry at a moment when it is in a very unpromising condition. In the past few years copper production of the country has grown surprisingly fast, and it was freely prophesied that the present year would see the end of the importation of foreign copper into the country and the beginning of the exportation of Russian copper abroad.

But last year this growth was arrested. The reasons given might be held to be satisfactory, if all true, namely, that a number of companies had stopped production for the purpose of renewing and extending their plants. Unfortunately, this view had to be taken, however, with a knowledge that the slackening in progress affected more than one important copper-producing district, and it seemed remarkable that the country's industry should have started marking time just at a period when industry generally in Russia was unprecedentedly good, and the demand consequently a large one, and one to be taken advantage of, so that when the inevitable general trade depression should arrive, the alterations, admittedly so much required, could be made. A fresh complication, as far as the Caucasus is concerned, has supervened through the military activity of the Turks, who, it is reported, have got control of the largest Caucasian copper property, which it is said to be the intention of the Russians to promptly recover possession of, if for no other reason than the desire to deprive the Germans of this source of supply of an article of which they stand in such reported urgent need.

Due largely to the business instinct of the foreign element that is so largely exploiting the Urals copper deposits, a development has taken place considerably adding to the value of the business in that district, namely, the manufacture of sulphuric acid from the sulphur fume liberated in smelting copper ore. This will no doubt act and react to the advantage of the industry. There are considerable deposits of phosphates within practicable reach of the copper works, and, in the manufacture of superphosphate, acid had to be brought great distances. But the new sources of acid supply will not only facilitate the existing superphosphate business, but, owing to the cheapness of the acid, the superphosphate production will be stimulated, and so call for more of this by-product of the copper industry. Notwithstanding this, the cessation of operations referred to took place, and has since developed into not only a positive but a very serious setback in the production of copper.

This setback has been progressing in intensity in the chief producing districts during the course of the current year. Thus, in the first six months, the production of copper amounted to 16,112 tons, against 17,103 tons in the corresponding six months of 1913, a decline of 991 tons, or 5.8%. Including July, the total is 18,709 tons, against 19,822 tons, a decline of 1114 tons, or 5.62%. The improvement is accounted for by a better return from Siberia; but, on the other hand, the other districts, Urals and Caucasus—that is, the most important—had declined in a slightly greater ratio. The latest returns received are for the first eight months of the year, including one of the war, namely, August. This shows a total production of 21,061 tons, compared with 22,664 tons in the corresponding eight months of 1913. The decline amounts to 1602 tons, or 7.7%. The slight improvement in Siberia during the first seven months loses its value in the eight months, having declined from 3.41 to 1%. The following table shows eight months' production, in tons:

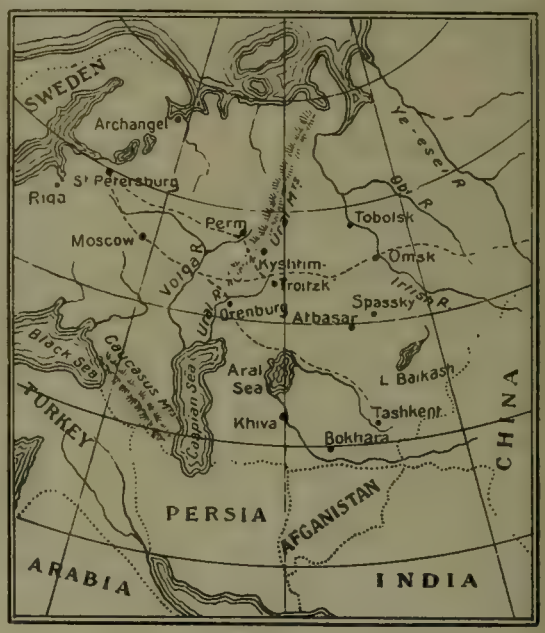
	1913.	1914.	Per cent.
Urals	11,467	10,518	—8.3
Caucasus	6,574	5,946	—9.5
Siberia	3,661	3,700	+1.0
Chemical works and refineries.	9,060	896	—6.6
	30,762	21,060	7.7

These chemical works and refineries produce largely from other than copper ores and recover the copper simply as an associated metal. From this it follows that the production of copper improved only to a slight extent in Siberia, but other production districts show serious declines.

It is interesting to note the estimated production for the year, which was 28,258 tons of common and 11,516 tons of electrolytic copper from the houses that work in agreement, plus about 1129 tons of common copper expected from the Ushkoff and Kreines company. Thus the total anticipated in the past year of all kinds of copper makes 40,903 tons.

The reason given for the decline as suggested above is not altogether convincing. It looks rather as though it were the result of an understanding. It has been persistent, and, as can be seen from the foregoing statement, practically general, and even Siberia now looks like showing a decline when the next returns are issued. Russia, therefore, will probably remain a good buyer of copper, that is, electrolytic copper, for a considerable time to come; for with an increasing population, an improving industrial position, and a declining production, reason points to no other direction.

Owing to military operations, there is a great demand for lead in Russia, and a review of the various domestic sources from which it can be obtained should be of interest. Although the deposits of lead ore on the western shore of



MAP OF PART OF THE RUSSIAN EMPIRE, SHOWING CAUCASUS COPPER DISTRICT AND ARCHANGEL.

Murman, which is on the White sea, east of Varangerfiord, were discovered many years ago, and investigated to some extent by many Russians, including Kamensky in 1875 and Bartanoff in 1889, and again by Povalishin in the nineties, lead mining has not progressed. In the summer of 1903 the right to exploit the mineral was obtained by Nikolaieff; but he did not take advantage of the permission. This deposit required a geological investigation and the expenditure of a considerable sum of money in order to test its value. In 1905 new lodes were discovered, and the examination was in charge of an officer named Stefanovich and a merchant, Edward Ostrem, from the town of Abo. Their work showed the importance of the deposits, and at the present time negotiations are being carried on to organize a company to start proper development. Recently these engineers completed preliminary prospecting and discovered 50 new lodes, of which about 40 are within the area at their disposition. They have rights over 13 areas or lots, of which four are to be worked. In the autumn of 1914 a certain quantity of lead ore was delivered at Archangel, in which town it is proposed to carry on smelting operations.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press

ALASKA

The report of the governor of the territory, J. F. A. Strong, for the fiscal year ended June 30, 1914, has recently been published. The area of Alaska is 590,884 square miles, and the report deals with general conditions, population, railroads and other transportation, forests, reindeer, mines, fisheries, fur, labor conditions, oil, roads, mails, water-power, Indians, future, and a list of operating companies.

KETCHIKAN

(Special Correspondence.)—Just before the European war, many inquiries were made as to the mining possibilities of this district. Several companies began investigations, but as they were financed mostly by foreign capital, operations were suspended when the war started. However, the Granby Consolidated, having secured some good copper and gold properties, will probably resume operations, especially as the copper outlook seems more favorable. The lack of adequate capital and intelligent management for going ahead with development, and not the absence of mineralization, has been the drawback of this district, as pointed out by a recent U. S. Geological Survey report of the Ketchikan district.

The Rush and Brown mine, although under good management, is handicapped by inadequate capital to carry on the mining on a large scale, and is the only copper mine which operated throughout the year in southeastern Alaska.——The Jumbo mine, at Sulzer, discontinued shipment after the fall in copper.——The Granby company is developing the old Mamie mine at Hadley, and expects to ship 300 tons of low-grade and 30 tons of high-grade ore per day from the 'It and Dean,' near Kassan.——Development work was done during the year at Big Harbor, Mt. Andrew, Red Wing, Copper Mount, and other properties.——The Apex and Adit, and Veta claims, between McLean's arm and Mallard bay, are being developed by the owners. Although 2 ft. of ore assaying $7 gold and 7% copper has been opened 45 ft., and over 100 ft. in a large low-grade area adjacent thereto, it will take years to bring this property to the producing stage unless capital can be raised to expedite the work.——Some of the gold properties at Helm Bay, Hollis, Sea Level, and Dolomi are being opened by local capital.

Practically all of the properties in this district are from a few hundred feet to two miles from salt water. Timber and water-power are abundant, and the climate is mild. Operations can be conducted the year round.——Mining and developing companies could no doubt find a profitable field for investment and speculation in this promising district.

Ketchikan, January 7.

ARIZONA

GILA COUNTY

The sequence of events in the labor troubles during the past week are as follows: There are over 1500 men on strike in the Miami district. It is rumored that employees at the Old Dominion mine and smelter at Globe would also come out. The general manager of the Company, P. G. Beckett has addressed a note to the men explaining its attitude. He later said that provided copper sales in January averaged 13c. per pound, an increase to the old rate of May, 1912, would be made in wages from February 1. When the metal rises to 14 and 15c. further increases are proposed for miners, millmen, and smeltermen. Generally, good feeling exists among the strikers. A broken water main at the Inspiration was repaired, and a car of dynamite unloaded. George Powell, president of the Miami Miners' Union stated that the men are ready at any time to submit the dispute to an impartial board of arbitration. Governor Hunt has promised to try to help settle the trouble.

The managers of the Miami and Inspiration companies, B. Britton Gottsberger and C. E. Mills, respectively, have notified the miners that they are willing to take the same action as the Old Dominion company.

Work was resumed at all points on January 24, on account of an agreement as to wages to take effect on February 1. Under the agreement the machinists, electricians, boilermakers, carpenters, helpers, and common laborers will get the

CLAIM MAP OF MIAMI DISTRICT, ARIZONA.

wages that were paid before the 10% cut was made in August. Miners and hoisting engineers will work on a sliding scale. There is to be no discrimination against any of the men on account of the strike. The scale is as follows: machinists, electricians, carpenters, and boilermakers, $4.25; miners, minimum wage, $3.50, with copper at 13c.; $3.65 with copper at 14c.; and $3.75 with copper at 15c. per pound. Hoisting engineers, with copper at 13c., $4.25 on single-drum hoist, $4.50 on double-drum; firemen, $3.75; oilers, $3.50; and pumpmen, $4. With copper at 14c. they will receive a raise of 15c., and at 15c. another 10c. per day will be added to the wages. Laborers, $2 per day. Both the Miami and Inspiration companies are bound by the agreement.

CALIFORNIA

Oil production of the state in 1914 is estimated by the Standard Oil Co. at 103,623,695 bbl., against 97,867,148 bbl. in 1913. The average was 283,901 bbl. per day. Stocks at the end of the year totaled 58,526,274 bbl., compared with 47,870,177 barrels at the end of 1913.

The State Mining Bureau will exhibit at the Panama-Pacific International Exposition, and about 400 sq. ft. of floor space in the Palace of Mines and Metallurgy will be devoted to case exhibits of California's mineral products. Fletcher McN. Hamilton, state mineralogist, will detail from his staff a competent mining engineer whose duty it will be to furnish information to visitors as to the extent and value of the mineral resources. The Bureau would gladly have taken more

extensive part in the Exposition, but the funds were not available, owing to the fact that during the past two years it has been necessary to send engineers over the entire state to gather data for the preparation of a new general report on the mines and mineral resources of the state. The Bureau with its extensive collection of minerals, and the library and statistical department regularly maintained in the Ferry building, will doubtless serve a good purpose in conjunction with its headquarters to be established at the Exposition. All mineral producers wishing to exhibit are invited to communicate with the state mineralogist, Ferry building, San Francisco.

Amador County

A cross-cut out 200 ft. from the 380-ft. shaft at the Hayward mine, three miles from Ione, has cut a wide vein of $6 to $28 copper-gold ore. This old mine was only reopened late in 1913, after being closed for 50 years. The Allen Estate Co. is doing the present development work.

Final returns of the Plymouth Consolidated for December show the following: ore milled, 10,200 tons; value of output, $42,053; surplus in excess of working costs, $19,697; and total costs, $2.687 per ton.

Inyo County

At the Skidoo mine the 10-stamp mill is working. The mine is being developed by adits, three of which have opened about three years' ore, according to the manager, J. H. Cooper. It is proposed to add five stamps to the plant. About 35 men are employed. Costs total $6 per ton.

In Wild Rose cañon, L. C. Mott, of San Francisco, is working an antimony mine and experimental reduction plant. Twenty-two men are employed, and the matte produced contains 93% metal.

Randsburg is reported to have a fairly prosperous appearance, a number of small mines and mills being operated. The Yellow Aster 100-stamp mill is crushing about 500 tons per day.

Shasta County

The Balaklala Copper Co. is shipping three large cars of ore to the Tacoma, Washington, smelter. The last ore sent to that place was in March 1914.——The Russell placer claim at Igo is being prospected by a Keystone drill.

Sierra County

Alleging 40 days' wages is due them, 21 miners at the Twenty-One mine, at Alleghany, have 'downed tools.' G. W. Mitchell is in charge now with five men.

Trinity County

(Special Correspondence.)—Prospects of future mining in Trinity county are bright. During the past year there has been considerable new development, with no shut-downs recorded, and extensive new work is contemplated for 1915. Hydraulicking is holding its own. Quartz mining is steadily increasing, with some good producers on the list, and more probably starting. While the Trinity River area is attracting a great deal of attention for dredging, in the east fork district there is only one property that might be classed as a mine, namely, the Enterprise, which has a depth of about 1300 ft. on the incline. Near it and for five miles to the north and northeast on the east fork, east branch, and Yellow Jacket streams, are to be seen several prospects that look promising. Among them are the Golden Chest, Bonanza, Oversight, and Yellow Jacket. On the three last mentioned, development will prove the orebodies. The Enterprise mine, which has been a producer on and off for more than 25 years, never looked as well as at present. There is 7 ft. of good ore in the face. Ten stamps are dropping 24 hours per day, and 12 men are on the payroll. This mine has produced some high-grade ore during the past three years, and the average was good during 1914. Judging from the present indications, 1915 will be the banner year of its existence. The Globe Consolidated, at Dedrick, has recently cut new orebodies. The mill is treating 125 tons per day.

Helena, January 15.

Tuolumne County

(Special Correspondence.)—It is reported that operations will be resumed at the Santa Ysabel mine during the early part of February, with J. A. Prentice in charge.——B. F. Southerland and others have secured a lease on a portion of the Fleming property from Messrs. Booker and King, and will begin development at once.——A plant is being installed to work the tailing of the App mine, on which D. L. Mann has a long lease. Mr. Mann also has an adjoining claim where he has impounded a large quantity of tailing carried by Woods creek from nearby mines.——Sinking is still in progress at the Black Oak, and it is said to be the intention to continue this work until the shaft has attained a depth of 2000 ft.——Operations have been resumed at the Louisiana mine, near Tuolumne.

Sonora, January 23.

The McAlpine Mines Co. has been organized by San Francisco people to operate the McAlpine group of four quartz claims in the southwestern part of the county. Extensive work has been performed at this group in the past, and much good ore has been extracted at numerous points.

COLORADO

Products of the Colorado plants of the American Smelting & Refining Co., namely, the Globe, Pueblo, Arkansas Valley, and Durango in 1914 are as follows:

Source of ore.	Ore, tons.	Gold, ounces.	Silver, ounces.	Lead, pounds.	Copper, pounds.
British Columbia	5,349	171	166,962	442,122	37,834
*Colorado	573,009	304,723	7,258,427	66,501,208	5,711,714
Canada	4,128	.....	2,417,419	650	44,272
Idaho	80,142	.....	2,816,849	80,818,870	201,209
Montana	558	34	26,598	19,162	9,598
New Mexico	147	767	227	179	2,035
South Dakota	524	979	865	278	3
Utah	1,364	10	1,545	596,558	1,383
Total	665,221	306,684	12,688,892	148,379,027	6,008,048

*This includes ore shipped to other of the Company's plants outside of Colorado.

The total value of all the metals was $19,821,206.

Gilpin County

Steam power at the U. P. R. stamp-mill at Black Hawk has been superseded by electric motors, a 25-hp. driving the crusher and a 50-hp. motor driving eight batteries. Steam is used for the mine hoist and heating purposes.——R. Demeter is manager, and C. Cox, mill superintendent.——The old Happy Five claims near Apex, which have been developed, equipped, and lain idle for many years, are to be reworked.

Lake County (Leadville)

Transformers, motors, and other General Electric equipment have arrived at the Penrose shaft of the Down Town Pumping Co., and the Colorado Power Co. is installing it. The centrifugal pumps will arrive early in February.——The Big Five Operating Co. is to work the Big Four with electricity, and the power company will install an 82-hp. hoist, and 100-hp. compressor, in place of the present steam-driven plant. Olie Strom is manager of the Big Five.

Ouray County

Now that the Wanakah smelter has a capacity of 200 tons per day, that Company and the Ouray press are trying to stimulate prospecting and ore production. Since March 1, 1914, the plant received custom ore weighing 1489 tons, for which $20,952 was paid. Of the 94 lots, 46 were less than 10 tons each, while the average shipment was 15.85 tons.

About 572 tons netted the owner less than $5 per ton. The Wamukah Mining Co. pays cash for ore. The furnace is not working nearly at capacity. The Company is about to help the development of this and nearby counties. According to *The Ouray Herald*, one great drawback to progress in this direction is that every mineralized area is staked, and if not patented is held by assessment work only.

TELLER COUNTY (CRIPPLE CREEK)

In its *Press Bulletin* No. 201, the U. S. Geological Survey has the following to say regarding the Cresson discovery:

"Whenever any discovery is made in science or technology there appears to be an irrepressible tendency on the part of those who supply news to the general public to state that the new information 'upsets all previous theories.' This stock phrase may generally be put down as an exaggeration, and in many of its applications is wholly untrue. The phrase is in particular favor with the reporter of mining news, to whom the discovery of a new orebody in a district is the signal for immediately consigning all previous geologic opinion concerning that district to the scrap heap. This predilection is well illustrated by the press accounts of the wonderfully rich body of ore recently found in the Cresson mine at Cripple Creek at a depth of 1200 ft. Most of these accounts state that the find 'upsets all previous theories of the U. S. Geological Survey.' Of course, no such disaster has occurred. Anyone who will take the trouble to read for himself the brief chapter of 16 pages in the Survey's report on the Cripple Creek district, published in 1906, which sums up the geologists' conclusions on the origin of the ores and the future of the district, can easily ascertain that the statements there made have been fully confirmed by the mining developments of the last eight years. Moreover, the occasional discovery of rich orebodies, even below a depth of 1000 ft., was distinctly predicted. It is well known that all scientific conclusions are subject to modification in the light of new data, for science is always progressive, but it should be better known that press reports of the total destruction of scientific conclusions by a new fact are likely to be 'grossly exaggerated.'"

On No. 5 level of the Midget mine on Gold hill, lessees are opening a lode 12 ft. wide, assaying up to $100 per ton. The superintendent of the property, W. Allen, states that the mine's output is 30 cars per month from 10 sets of lessees.—Lessees on No. 2 level of the El Paso mine have deposited in a local bank five sacks of ore worth $1000 per sack.——Cripple Creek people, headed by A. P. Mackey, have acquired the Red Lion claims in the southern part of the Goldfield, Nevada, district.

IDAHO

The Idaho State Mining Association closed its annual convention at Boise on January 20. The officers elected for the ensuing year are J. F. McCarty, of Wallace, president; A. E. Carlson, of Boise, vice-president; and Ravenal MacBeth, of Mackay, secretary. The directors are H. L. Day, Wallace; Irvin E. Rockwell, Bellevue; Frank E. Johnesse and A. G. Vaneman, Boise. Seven sets of resolutions were passed by the Association. One resolution strongly indorses the Deadwood Creek highway bill, providing for the building of a star route into the Deadwood mining district. Another highly commends the Public Utilities Commission for its recent decision in permitting legitimate competition in the power business in Idaho. A third recommends passage of a bill providing for an extension of water-power resources of Idaho, incorporation with the federal government, and an appropriation of $20,000 for carrying on the work. A workmen's compensation law along safe and sane lines was recommended.

SHOSHONE COUNTY (COEUR D'ALENE)

Mining and business conditions in the Coeur d'Alene are reported to be quite satisfactory, when everything is considered. However some of the operators in the district do not think so as a number of the largest properties are closed and prices for lead and silver are low, copper unsatisfactory, zinc being the only metal showing strength. At the same time it is conceded that this part of Idaho is probably as prosperous as the rest of the country.

The Hecla company paid 1c. per share, or $10,000, on January 20, making $3,200,000 to date. Over 70 tons of zinc concentrate per day is being produced by the magnetic separators at the Success. A flotation plant may be added. Seven feet of zinc ore has been cut in the Terrible-Edith mine above Murray. Carbonate and galena have been cut in the Square Deal claims. The Castle Rock on Placer creek has sent its first shipment, amounting to 40 tons of 15% copper ore, to Tacoma. The mine is developing well.——The Antimony Mining Co., on Pine creek, has opened 10 in. of 55% ore for a length of 60 ft. ——Shipments are to be made.

MICHIGAN

HOUGHTON COUNTY (THE COPPER COUNTRY)

'Rock' from the conglomerate lode of the Calumet & Hecla is now producing about 100,000 tons per month, and the amygdaloid lode between 80,000 and 87,000 tons. Eighteen months ago the respective tonnages were 140,000 to 150,000 tons, and 100,000 tons.

The daily output of 'rock' from the district is about 32,400 tons, some of the shipments being as follows: Calumet & Hecla, 8500; Quincy, 4200; Copper Range, 5000; Mohawk, 2500; Allouez, 1600; Isle Royale, 2100; Kearsarge, 3000; Wolverine, 1700; Centennial, 700; Mass Consolidated, 700; Superior, 750; Victoria, 250; and Osceola, 650 tons.

MONTANA

SILVERBOW COUNTY

Repairs at the Leonard mine are finished, and the shaft is in operation again, after being closed for 21 days. Ore hoisting was to have been suspended at the Gagnon and Original mines, but will continue for a time. The Anaconda company is making numerous improvements at its Mountain View shaft. Save the copper being sent to the Great Falls refinery, the Company will start in February to send from 1000 to 1500 tons of metal to Tacoma, and load there on steamers for New Jersey, by way of the Panama canal.

NEVADA

CHURCHILL COUNTY

The Nevada Hills company's output in December was 6200 tons of $6.666 ore, of which 75.5c. per ton was profit, the total being $4683. Mine development amounted to 402 ft. The resources of the Company are $256,546, of which $24,703 is silver on hand. Temporary arrangements have been made for the disposal of the silver produced in the future. The annual report will be mailed about February 1.

ESMERALDA COUNTY

Cripple Creek people, headed by A. P. Mackey, have acquired the Red Lion claims in the south part of Goldfield, adjoining the Yellow Tiger mine. The manager of this property, C. D. Wilkinson, will superintend work for the Colorado investors. ——A 100-hp. motor is on its way to the Yellow Tiger to drive the 8-drill compressor.——Stoping has been started in the Jumbo Extension; and January profits are estimated at $60,000. ——An incline rise above 250 ft. in the Florence has cut 4 ft. of $40 to $70 ore.

HUMBOLDT COUNTY

The Rochester mining district is described by Frank C. Schrader in *Bulletin* 580-M of the U. S. Geological Survey. The work covers 48 pages and is accompanied by a geological map and several small illustrations. The writer visited the district in May 1913, and a preliminary review was published

in the following month. The area is about 25 square miles in the Humboldt range, which is 75 miles long, and has Star peak as its highest point, 10,000 ft. above sea-level. The report discusses the history, geology, rocks, lodes, minerals found (53), mining development, and gravels of several areas in the district. Regarding the future of the district, Mr. Schrader wrote as follows: "From the deep-seated character of the deposits and their close association with the major geologic structures, which are shown to have been impressed upon the rocks of the region from the tops of the mountains to some distance below the floors of the deepest valleys, the deposits may reasonably be expected to extend to considerable depth. In the sulphide zone, however, they will probably become leaner and more regular in tenor than in the present workings, which are chiefly in the oxidized zone."

LYON COUNTY

Forty-five men are employed on construction of the Nevada-Douglas leaching plant, and good progress is being made.——The Smith Valley mine is being examined by G. W. Lloyd. The property is in the hands of a receiver, but has good prospects.

NYE COUNTY

Twelve hundred tons of material is to be hauled to the Round Mountain company's placer property by the Wittenberg Warehouse & Transfer Co. The pipe-line will be 8½ miles long. It is hoped to have water on the claims in May.

Tonopah produced 10,395 tons of ore worth $213,070 during the third week of January. Some December returns are as follows: Belmont, 14,865 tons yielding 3422 oz. gold, 315,452 oz. silver, and a profit of $117,604; Extension, profit of $66,485, and $456,712 in 1914; and Jim Butler, profit of $13,339, and $279,290 in 1914.——The drift at 1230 ft. in the Merger has passed through the fault and cut the orebody.——Ore taken

WEST END MILL, TONOPAH.

out during development of the Montana is to be treated at the West End mill. The Montana company is to prospect its northern portion through the Umatilla company's ground.——On account of the illness of Curtis H. Lindsay the Jim Butler-West End suit argument has been postponed to the middle of February.

NEW MEXICO

GRANT COUNTY

(Special Correspondence.)—At Lordsburg, the 85 Mining Co. is shipping 325 tons of ore per day to the Calumet & Arizona smelter at Douglas, and the smelter at El Paso, but the former has issued a notice that it is not in the market for any more ore.

Lordsburg, January 22.

SIERRA COUNTY

The newly organized Las Animas Peak Gold Mines Co. has started shaft sinking at the El Oro claim. Machine-drills are to be used later on. C. J. Hutchinson is manager.

OREGON

BAKER COUNTY

The new stamp-mill of the Golden Gate mine at Greenhorn is now working. There is about 42 in. of snow at the mine.

JEFFERSON COUNTY (RECENTLY PART OF CROOK COUNTY)

Locations of gravel claims covering 20 by 40 miles, along the Deschutes and Crooked rivers and Squaw creek were filed on January 13, with the clerk of this new county. Extravagant reports are being circulated about the discovery, such as $1.50 to $15 gold, $2.40 platinum, and $2 silver per ton, also 24½ milligrams of radium per pound of ore, tin and nickel. One person interested stated that "the discovery means $100,000,000 per year to the business of Portland, and untold wealth and a development of this state never dreamed of."

JOSEPHINE COUNTY

Practically all the indebtedness of the Almeda Mining Co., of Grants Pass, has been paid, according to the president, T. S. Burley. Within 90 days it was hoped to have the concern adequately managed. It is proposed to erect a 200-ton concentrating plant in addition to the existing 100-ton smelter. With the power-line to be constructed, the improvements will cost $75,000. Iowa, Ohio, and Portland, Oregon, people are interested, the president residing in the latter city.

UTAH

BEAVER COUNTY

At 150 ft. the Beaver-Butte Mining Co. has opened the vein for 20 ft. in width, assaying from $5 to $10 per ton.

JUAB COUNTY

The south end of the Van stope of the Iron Blossom is yielding on an average of 500 oz. silver per ton.——A drift is now developing ore cut by the diamond-drill in the Chief Consolidated, which promises to be a good shoot.——Development in the Grand Central is confined to the 1100-ft. level, which is being extended to cut the vein opened at 900 and 1000 ft.——Zinc ore in the Gold Chain winze below 1200 ft. is mixed with the gold-silver ore, and is a nuisance, as it means a penalty on shipments. The 700 and 1000-ft. levels are producing copper, and lead-silver-gold ore.

SALT LAKE COUNTY

The annual meeting of the Salt Lake Stock & Mining Exchange was held on January 23. The president, R. J. Evans, spoke on the Exchange keeping open throughout the war, when others in the world were closed. There are 68 members at present, the limit being 75. The building is worth over $70,000. Transactions during 19 years totaled 230,000,000 shares worth $120,000,000.

SUMMIT COUNTY

The Daly-Judge company is shipping over 500 tons of 45% zinc concentrate per month. The ore comes from between the 500 and 1200-ft. levels, where a large tonnage is ready for stoping.

WASHINGTON

FERRY COUNTY

(Special Correspondence.)—A new electric hoist has been installed at the Surprise mine by the Western Union Mines Co.——At 250 ft. in the Knob Hill, 4 ft. of $27 ore has been cut. The metal is mainly gold. S. H. Richardson is the new manager.——The Superior Court of the county has issued an order in favor of the Quilp Mining Co. for a survey and examination of the formerly disputed ground surrendered to the Company by the Republic Mines Corporation, and now under bond and lease to the Western Union company.——M. H. Joseph has been elected city treasurer of Republic.

Republic, January 16.

CANADA

British Columbia

The Old Sport property in the Quatsino district on Vancouver Island, comprising 27 patented claims and embracing approximately 2000 acres of ground, has been sold by W. E. Cullen, of Spokane, and W. M. Bacon, of Butte, Montana, to the Stewart Mining Co., of Kellogg, Idaho. Thirty miners from the Stewart passed through Spokane recently en route to Quatsino. Another party of 20 is scheduled to leave Kellogg soon. The Old Sport group comprises a part of the original holdings in the Quatsino region of Conrad Wolfe and Sidney Rosenhaupt and other Spokane men, and was taken over from them several months ago by Mr. Cullen and Mr. Bacon under lease and bond for $500,000, of which $20,000 already has been paid, and the remainder has been provided for. The consideration involved in the last deal cannot be learned.

Yukon

The wood-hauling season is in full swing, to Dawson and

POSITION OF THE CANADIAN KLONDYKE CO.'S NO. 2 DREDGE AT THE END OF 1914, WHICH SANK DURING OCTOBER.

the various creeks in the Klondike, and many teams will deliver thousands of cords up to the end of March.

PHILIPPINE ISLANDS

(Special Correspondence.)—The Philippine government is badly in need of more revenue, having had a loss of about ₱7,000,000 in 18 months, and has under consideration an output tax on gold produced in the Islands. The mining interests are strenuously opposing this, but it is expected that a tax of 1.5% on the year's yield will be imposed. The property tax may be removed, but this is doubtful. The proposal of the former collector of customs was a 4 or 5% tax. The present time is not suitable for increased burdens, and the legality of the measure is doubtful. As the government has stopped railroad and other work, labor is plentiful.

The Colombo Mining Co., in charge of H. B. McCoy, is mining 150 tons of ore per day. After paying two 5% dividends in 1914, the surplus was ₱400,000. This is invested in New York 6% bonds.——The Syndicate at Masbate is also doing well. A 6 by 16-ft. tube-mill has been added to the mill. ——At the Benguet Consolidated, mill machinery is going to the mine, but the hydro-electric equipment has not been received. C. M. Eye is manager.

Manila, December 13.

According to the U. S. Geological Survey, the gold output of the territory steadily increased and was over $1,000,000 in 1914. The Philippine Dredges Co. produced 1080 oz. gold in December. One boat was under repair

PERSONAL

Arthur W. Burgess is now at 539 Holbrook building, San Francisco.

R. B. Lamb is examining gold properties at Grass Valley, California.

L. F. S. Holland has returned to Los Angeles from Searchlight, Nevada, where he has been making an examination.

Howland Bancroft has just returned to Denver from an extended trip into British Columbia and is now engaged in professional work in Colorado.

A. J. M. Ross, of the engineering department of the Homestake Mining Co., South Dakota, is in charge of the Company's exhibit at the Panama-Pacific Exposition.

Bayliss C. Clark has recently returned to California from Antioquia, Colombia, where for the past year he has been examining placer properties for Breitung & Company.

Bruce C. Yates has been appointed assistant superintendent of the Homestake Mining Co., South Dakota. He has been with that Company for twenty years, being chief engineer for some time.

William H. Kritzer has returned to San Francisco from El Dorado, California, where he has been supervising alterations in the three unit 150-ton Lane slow-speed Chilean mill plant of the Shan Tsz Gold Mines Company.

Robinson T. White, formerly of Butte, Montana; Salt Lake City; Bayonne, New Jersey; and Coram, California, was manager of the Caucasus Copper Co.'s mines, Russia, when the Turkish troops attacked that place, but eventually escaped to Batum.

Thomas Walters has resigned as superintendent of the Jones & Laughlin Ore Co., the Inter-State Iron Co., and the Leetonia Mining Co., after a period of service of over 30 years. He will continue to act as superintendent of the Pittsburgh & Lake Angeline Iron Co., and the Lake Angeline mine until the two small bodies of ore still remaining in the mine have been worked out.

Schools and Societies

The Idaho Mining Association met at Boise on January 19 to elect officers and discuss matters of interest.

The Montana section of the A. I. M. E. meets at Butte on February 5 for election of officers and reading and discussion of papers by Theodore Simons and Paul Billingsley.

The A. I. M. E. will hold its New York meeting on February 15 to 17. About 50 papers will be presented, besides other discussions. Some of the Society's by-laws will be submitted for amendment.

The Australasian Institute of Mining Engineers will meet in the west coast mining districts of Tasmania in the latter part of February or early in March. The Mt. Bischoff tin, Mt. Lyell copper, and other mines and works will be visited.

The Canadian Mining Institute's Cobalt branch met on January 15. The topic of discussion, led by R. B. Watson, of the Nipissing mine, was on the essential features of a report on a mining subject. The president of the Institute, G. G. S. Lindsay, attended.

Inauguration of the Engineering Foundation was held in the Engineering Society building, New York, on January 27. The Engineering Foundation, inaugurated by the United Engineering Society, is the name given to a fund to be "devoted to the advancement of the engineering arts and sciences in all their branches, to the greatest good of the engineering profession and to the benefit of mankind."

THE MARKET PLACE

Weekly Summary of Prices of Shares and Metals

Metal Prices

San Francisco, January 28.

Antimony	18 —18¾
Electrolytic copper	14½—14¾
Pig lead	3.95— 4.90
Quicksilver (flask)	$52.50
Spelter	7½— 7¾
Tin	34½—36
Zinc dust, 100-kg. zinc-lined cases	10

EASTERN METAL MARKET

Our weekly telegram giving metal prices in New York has been delayed in transmission.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.		Average week ending	
Jan. 21	48.87	Dec. 16	49.83
" 22	48.50	" 23	48.66
" 23	48.75	" 30	48.65
" 24 Sunday		Jan. 6	48.65
" 25	48.87	" 13	48 98
" 26	48.87	" 20	48.98
" 27	48.75	" 27	48.77

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	63.01	57.58	July	58 70	54.90
Feb.	61.25	57.53	Aug.	59 32	54.35
Mch.	57.87	58.01	Sept.	60.53	53.75
Apr.	59.26	58 52	Oct.	60.88	51.12
May	60.21	58.21	Nov.	58.76	49.12
June	59.03	56.43	Dec.	57.73	49.27

The past week's market was steady. The 'Persia' took $85,451, or 180,000 oz., from San Francisco to the Orient on January 23. Diamonds from India and the Continent have enabled London dealers to dispose of some metal. Samuel Montagu & Co.'s 'Annual Bullion Letter' is now at hand, and should be secured by silver producers; also Pixley & Abell's chart showing silver business for 82 years.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Dec. 31	52.50	Jan. 14	50.00
Jan 7	51.50	" 21	52.50
		" 28	52.50

Monthly averages.

	1913.	1914.		1913.	1914
Jan.	39.37	39.25	July	41.00	37.50
Feb.	41.00	39.00	Aug.	40.50	80.00
Mar.	40.20	39.00	Sept.	39.70	76.25
Apr.	41.00	38.90	Oct.	39.37	53.00
May	40.25	39.00	Nov.	39.40	55.00
June	41.00	38.60	Dec.	40.00	53.10

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
Jan. 14	6.13	Dec. 9	5.50
" 15	6.13	" 16	5.50
" 16	6.13	" 23	5.37
" 17 Sunday		" 30	5.40
" 18	6.13	Jan. 6	5.50
" 19	6.13	" 13	5.85
" 20	6.13	" 20	6.13

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	6.88	5.14	July	5.11	4.75
Feb.	6 13	5.22	Aug.	5.51	4.45
Mch.	5.94	5.12	Sept.	5.55	5.16
Apr.	5.52	4.98	Oct.	5.22	4.75
May	5.23	4.91	Nov.	5.09	5.01
June	5.00	4.84	Dec.	5.07	5.40

Zinc ore at Joplin has varied from $50 to $58, the highest grade of 63% metal realizing $60 per ton. Spelter is firm at 7.20 to 7.45c. per pound.

COPPER

Prices of electrolytic in New York, in cents per pound.

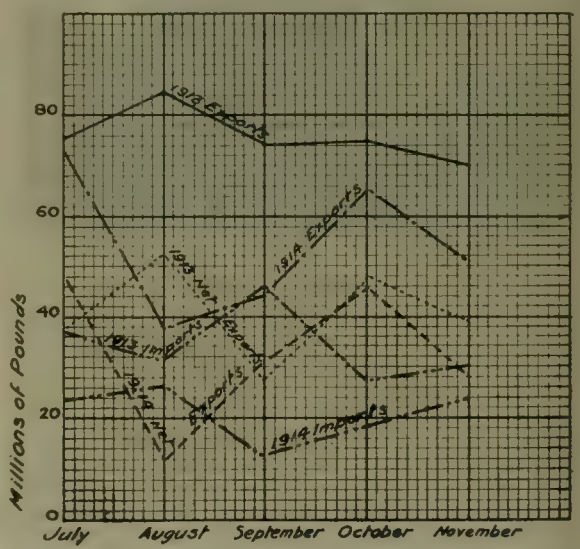
Date.		Average week ending	
Jan. 14	13.53	Dec. 9	12.72
" 15	13.53	" 16	12.70
" 16	13.53	" 23	12.84
" 17 Sunday		" 30	12.75
" 18	13.53	Jan. 6	12.92
" 19	13.53	" 13	13.30
" 20	13.53	" 20	13.53

Monthly averages.

	1913.	1914		1913.	1914.
Jan.	16 54	14.21	July	14.21	13 26
Feb.	14.93	14.16	Aug.	15.42	12.34
Mch.	14.72	14.11	Sept.	16.23	12.02
Apr.	15.22	14 19	Oct.	16.31	11.10
May	15.42	13.97	Nov.	15.08	11.75
June	14.71	13.60	Dec.	14.25	12.75

Copper is firm at 14.25 to 14.50c. per pound.

The Calumet & Hecla has advanced its selling price to 14.75c., which the National Conduit & Cable Co. states is too high, as domestic stocks are large. Exports last week totaled 23,057,055 lb., against 7,836,759 lb. in the previous week. The American Smelting & Refining Co. is selling electro to Russia. December output of Utah Copper was 6,795,567 lb., and Nevada Consolidated 2,651,658 pounds.



Copper exports, imports, and net exports for the United States, July to November, inclusive, 1913 and 1914. Compiled from reports of the Department of Commerce.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Jan. 14	3.70	Dec. 9	3.80
" 15	3.70	" 16	3.80
" 16	3.70	" 23	3.80
" 17 Sunday		" 30	3.80
" 18	3.70	Jan. 6	3.80
" 19	3.70	" 13	3.70
" 20	3.70	" 20	3.70

Monthly averages.

	1913.	1914.		1913.	1914
Jan.	4.28	4.11	July	4.35	3.80
Feb.	4.33	4.02	Aug.	4 60	3.86
Mch.	4.32	3.94	Sept.	4.70	3.82
Apr.	4.36	3.86	Oct.	4.37	3.60
May	4.34	3.90	Nov.	4.16	3 68
June	4.33	3.90	Dec.	4.02	3.80

TIN

Tin is steady in New York at 35.45 to 36.25c. per pound. There has been a good rise in prices in London.

MINING DECISIONS

FORFEITURE OF CLAIM—PLEADING AND PROOF

Although it is the general rule that the forfeiture of a mining claim for non-performance of assessment work must be specially pleaded, just as any other forfeiture must be pleaded, a sufficient proof and finding of the facts constituting a forfeiture will cure the defective pleading. The opinion of a laborer as to the value of the work is proper evidence, even though he be not qualified as an expert.

Cache Creek Mining Co. *v.* Brabenberg (Alaska), 217 Federal, 240. October 13, 1914.

MINING LEASE—INVALID SURRENDER

An implied surrender of a mining lease does not arise from mere notice of the lessee's intention to give up the lease, and pay no further rentals and his failure to make such payments. There must be an actual surrender of the lease by one having authority so to do. If the lessee is a corporation it must be authorized by corporate action. The president of the corporation has no inherent power to surrender. Right of lessor to recover rentals sustained.

Laing *v.* Price (West Virginia), 83 Southeastern, 497. October 29, 1914.

EMINENT DOMAIN—PRIVATE USE

A mining company sought to condemn a right-of-way through the property of an adjoining company for a tunnel for transportation of ore. Both ends of the tunnel were in perpendicular shafts on the private property of the plaintiff, and said tunnel could therefore not be used by mine owners generally except by plaintiff's consent. The Arizona constitution provides (sec. 17, art. 2): "Private property shall not be taken for private use except for private ways of necessity, and for drains, flumes, or ditches, on or across the lands of others for mining, agricultural, domestic, or sanitary purposes." Held, that the tunnel right-of-way sought in this proceeding did not come within the designation of "private way of necessity" in the absence of express legislative determination to that effect.

Inspiration Consolidation Copper Co. *v.* New Keystone Copper Co. (Arizona), 144 Pacific, 277. November 25, 1914.

This interesting case has been discussed in the *Press*, and the dispute has been settled by the plaintiff buying the defendant's property.

OIL LOCATIONS—VALIDITY

Several persons interested in a location of oil land conveyed their rights to one of their number for convenience in handling the land for their benefit. He neglected to do the assessment work for one year, and being of the opinion that the original locators could not re-locate after such failure, he was not guilty of fraud in procuring a re-location by other relatives for the benefit of the original parties. In February 1909, the claim was conveyed to the Obispo Oil Co., which thereafter expended considerable sums in drilling, without making a discovery, however. The location was then conveyed to the Pacific Midway Oil Co., which, after an expenditure of $24,000, discovered oil and proceeded with continuous development. Held, that as no showing of fraud was made and a discovery proved prior to the passage of the act of June 25, 1910, that act was inoperative as to the vested rights in these claims. The executive withdrawal order of September 1909 has already been held invalid.

United States v. McCutcheon (California), 217 Federal, 650. September 1, 1914.

BOOK REVIEWS

HEATON'S ANNUAL, 1915. Commercial handbook of Canada and boards of trade register. Edited by Ernest Heaton, J. Beverley Robinson, and W. J. Dobson. P. 514. Index. Heaton's Agency, 32 Church street, Toronto. Price, $1, and 12c. for postage.

Like the 'World' and 'Whitaker's' almanacs, in the United States and England, Heaton's is almost indispensable as a reference work on the Dominion of Canada. The work covers everything of interest going on in that country. Fourteen pages are devoted to the mining industry. The 'Where to Find It' pages are an economic bibliography of all government reports. The promptness with which the book is issued makes it valuable for the past and current years.

THE CANADIAN MINING MANUAL. Edited by Reginald E. Hore, of the *Canadian Mining Journal*. P. 273. Illustrated. Mines Publishing Co., Toronto. For sale by the *Mining Press*. Price, $2.

Originally this annual was founded by the late B. T. A. Bell, and eventually passed to the present publishers, who now issue the first number under their direction. The work might be termed the 'Skinner' of Canada, as it gives details of nearly all the operating companies of the Dominion, covering them in from three lines to as much as eight pages, according to their importance. Coal mining in several provinces is discussed by writers, and short chapters devoted to the important minerals and metals recovered. Numerous illustrations are included, the lithographic work being excellent. It is a fitting handbook for an industry which produced $144,031,047 in 1913.

UNIVERSAL SAFETY STANDARDS. By Carl M. Hansen. P. 312. Ill., index. Universal Safety Standards Publishing Co., New York, 1914. For sale by the *Mining Press*. Price, $3.

This valuable work is a reference book of rules, drawings, tables, formulae, data, and suggestions for use of architects, engineers, superintendents, foremen, inspectors, mechanics, and students, compiled under the direction of and approved by the Workmen's Compensation Service Bureau, New York. It is a handbook of concrete examples of safeguarding, and rules for practice in machine shop and foundries, and is the first one of a series of books to be issued by this Bureau. The author strikes the keynote of industrial safety when he lays down the principles of safeguarding in such a way as to make one realize that he is fully capable of handling this immense problem. Compensation laws have made indemnity for accidents compulsory. This indemnity is one of the large items in the cost of production. To reduce this cost and effect a saving in operation, accident prevention is one of the most prolific fields. Employers and others interested in safety, need authoritative information on the methods of assuring safety, which will meet the requirements of the ruling of their insurance companies. The book describes and specifies conditions and machines, and safe means and measures for guarding these conditions and machines. With each specification is shown a detailed drawing of what the specification means, all of which is the application of the principle of safeguarding. This arrangement makes everything absolutely clear even to the machine operator. Interesting examples are the treatment of stairways, steam engine devices, and grinding-wheel protection. The book is profusely illustrated, there being 206 pages of line-cuts showing how to protect employees from dangerous equipment, the important features being colored in green. Generally it should be in the hands of employers and employees, who will find in it much food for thought and practical value.

COMPANY REPORTS

DE BEERS CONSOLIDATED MINES, LTD.

This is a great diamond company of Kimberly, South Africa, and the report is for the year ended June 30, 1914. Results were as follows:

	1914.	1913.
Diamonds sold and increase in stocks	£5,123,335	£6,297,782
Balance from previous year	513,521	807,388
Other income	228,770	143,068
Total revenue	£5,865,626	£7,248,238
Cost of mining	2,205,985	2,080,622
Depreciation	253,700	706,035
African taxes	262,125	426,465
Interest and sinking fund	234,900	235,932
Profit	2,672,836	3,799,183
Deferred dividends	1,250,000	1,500,000
Bonus	.....	250,000
To reserve fund	51,253	140,060
Unsold diamonds	919,320	595,601
Balance to current year	447,864	513,521

The Vorspold mine was bought for £394,023. The stock of 'blue' ground on the floors is 11,331,022 loads (1600 lb. each), compared with 10,803,054 loads. The value of this ground varied from $3.06 to $4.24 per load, and the value of the diamonds from $11.60 to $20.16 per carat. Owing to the war the ordinary working of the mines has been suspended.

IRON BLOSSOM CONSOLIDATED MINING COMPANY

This Company operates in the Tintic district, Juab county, Utah, and the report covers the year ended December 1, 1914. Details of the output are as follows:

Ore mined, dry tons	40,480
Average metal content:	
Gold, ounces	0.1454
Silver, ounces	28.11
Lead, per cent	9.78
Copper, per cent	0.238
Value per ton	$22.23
Gross value	$899,943
Cost of mining, etc.	242,232
Cost of freight, sampling, and smelting	351,561
Profit	306,150
Dividends	400,000

Cash at the end of the year was $127,034, and bills receivable, $215,000. Development in the mine totaled 8755 ft., making 46,789 ft. to date, and was more in the way of drifts and cross-cuts to and through the orebodies in order that mining might be done more economically. The east fissure has proved to be an extensive orebody. At 1900 ft. the drift is out 2500 ft. from No. 1 shaft. This is for exploration of certain country. There is a large tonnage of first and second-class ore on hand. Mining costs, $5.36 per ton, increased owing to the necessity of filling old stopes, whereby 950 ft. of cross-cuts and 1369 ft. of rises were driven in waste to secure the required filling material.

SULPHIDE CORPORATION, LTD.

This is one of the most important companies operating at Broken Hill, New South Wales. Its operations cover the Central mine and concentrating mill at Broken Hill, smelter at Cockle Creek near Newcastle on the east coast, and works in England. The mill treated 209,074 tons of ore averaging 12.1 oz. silver, 14.4% lead, and 16.9% zinc, yielding 34,317 tons of lead concentrate and 64,798 tons of zinc concentrate. The extraction was 89.1% silver, 93% lead, and 93.9% zinc. The net profit for the year was £165,227, against £280,947 in the previous period. Dividends amounted to £200,000, but on account of the war further distributions are inadvisable.

The report contains a great deal of interesting discussion on the increased cost of mining and development, capital expenditure at Broken Hill, income tax, slime treatment, the Mond gas plant which is producing by-products, superphosphate production (10,027 tons), cost of realizing lead concentrate, German bombardment of the east coast of England where the Central Zinc works are situated, and Germany's influence in the sale of lead and zinc concentrates. Of 131,316 tons of the latter produced during the past two years, 19,633 tons was treated in England and 116,296 tons was sold to Beer, Sondheimer & Co., of Frankfurt. The war stopped further shipments to Germany, which was a severe setback to the Company.

RECENT PUBLICATIONS

DEPOLARIZATION OF LE CLANCHE CELLS By M. de Kay Thompson and Ernest C. Crocker. Paper for American Electrochemical Society's meeting, Atlantic City, April 22-24, 1915. P. 14. Illustrated.

A FINGER LAKE BED IN ASHLAND AND WAYNE COUNTIES, OHIO, WITH TILTED SHORE LINES. By George D. Hubbard. Reprint from *The American Journal of Science*, May 1914. P. 7. Illustrated.

THE MINING INDUSTRY IN NORTH CAROLINA IN 1911 AND 1912. By Joseph Hyde Pratt. *Economic Paper* 34. P. 342. Ill., map, index. Raleigh, 1914. The mineral output in 1911 and 1912 was $2,933,878 and $3,514,892 respectively. Gold in the latter year amounted to $166,014. Stone and clay products accounted for $2,696,305.

U. S. Geological Survey publications, Washington, D. C., 1914:

RESULTS OF SPIRIT-LEVELING IN WISCONSIN, 1897 TO 1914, INCLUSIVE. R. B. Marshall, chief geographer. *Bulletin* 570. P. 86. Ill., index.

GEOLOGY OF THE HANAGITA-BREMNER REGION, ALASKA. By Fred H. Moffit. *Bulletin* 576. P. 56. Ill., maps, index. A résumé of this work was published in the *Press* of January 23.

RECONNAISSANCE OF THE GEOLOGY AND OIL PROSPECTS OF NORTHWESTERN OREGON. By Chester W. Washburne. *Bulletin* 590. P. 111. Map, index.

University and Society publications:

TERTIARY MAMMAL BEDS OF STEWART AND IONE VALLEYS IN WEST CENTRAL NEVADA. By John P. Buwalda. University of California bulletin. P. 7. Ill., map. Berkeley, 1914.

A STUDY OF THE EFFECTS OF HEAT ON MISSOURI GRANITES. By W. A. Tarr and L. M. Newman. University of Missouri *Bulletin* 27. P. 64. Illustrated. Columbia, 1914.

PRELIMINARY REPORT ON THE CLAYS AND SHALES OF MINNESOTA. By Frank F. Grout and E. K. Soper. *Bulletin* 11. University of Minnesota. P. 175. Ill., charts, maps, index. Minnesota, 1914.

PROCEEDINGS OF THE LAKE SUPERIOR MINING INSTITUTE. 19th annual meeting at Marquette range, Michigan, August 31 and September 1-3, 1914. Volume XIX. P. 323. Ill., maps. Ishpeming, 1914. Like the previous volume, this one is full of interesting and valuable matter pertaining to the mines of the Marquette range, which produced 2,463,973 tons of iron ore in 1914. Abstracts will be made for the *Press* from the articles published.

New Machines and Devices

Large Jaw Crushers

In crushing rock or ore the first breaking of the solid material is done by drilling and blasting, the broken material is then taken to crushers for the next step in the operations of crushing. In studying the economics of the operations the question arises whether it is cheaper to break the material in small pieces in blasting or to break it in large pieces and continue the reduction mechanically with crushers. In any individual instance other factors enter and complicate the problem, but speaking generally, the decision hinges on the relative cost of drilling and blasting, and that of mechanically breaking in large crushers. In order to use the powder efficiently in blasting, it is necessary to place it to the best advantage, which involves a good deal of drilling, and drilling is expensive. Even where most of the rock is broken in fairly small pieces, there will be some large ones which must be re-drilled or bulldozed to reduce them to a size which will enter the jaws of the crushers, and this special work is expensive. In open-cut work, especially, the total cost can often be lowered by providing crushers large enough to take the largest pieces. The importance of this consideration has been appreciated by the Traylor Engineering & Manufacturing Co., of Allentown, Pennsylvania, which has developed large primary crushers. The Company has furnished to the H. S. Kerbaugh Co. at Valhalla, New York, a mammoth jaw crusher with a jaw opening 60 by 84 in., which eliminates to a great extent the bulldozing and plugging or mud-capping of rock, as any rock which can be picked up by a six-yard steam-shovel can be fed into the jaw opening. The Kerbaugh crusher is used for crushing rock for the building of the Kensico dam, which is a part of the $200,000,000 water-supply system of the city of New York. This crusher had a large part in establishing a world's record by the Kerbaugh company when it placed in the dam, in 25 working days, 8-hour shifts, 83,000 yd. of concrete.

Another crusher of the same size has been built for the H. W. Johns-Manville Co., to be used in crushing the asbestos rock at the mines of this Company in Canada. Even these crushers were not large enough, so the Traylor company is now building for the Rockland Lake Trap Rock Co. a crusher with jaw opening 66 by 86 in. to be used for crushing trap rock. This machine will be installed just outside of New York City, and will weigh over 520,000 pounds.

A notable feature in the manufacture of these large crushers is the fact that practically the whole machine is constructed of cast steel throughout, thoroughly annealed, so as to eliminate all internal strains. This machine is, according to information furnished by the Traylor company, approximately 26 ft. long, 18 ft. high, and 20 ft. wide; the crushing plates are made of manganese steel, and also the cheek plates and toggle seats, giving these wearing parts the longest possible life. The pitman is of extra heavy construction, made of cast steel, of the box section type, and fitted with internal ribs and with a removable cap so as to facilitate handling. The pitman is also fitted with removable bushings, babbitted and water-cooled. The use of bushing for this part greatly facilitates the rebabbitting of the eccentric or pitman whenever necessary and eliminates the necessity of shutting down the crusher for two or three days, which would be the case if the babbitt was poured in place in the pitman. Large crushers of this kind usually have a set of spare bushings, thoroughly babbitted, which allows of the quick rebabbitting of this essential part of the machine. The bearings on the side frames are also fitted with removable bushings, water cooled, and babbitted. This also allows of the quick rebabbitting of the bearings, if by any chance the operator should allow the babbitt to burn out. Under normal operating conditions, however, the babbitt need not be touched in a whole year's operations. In fact, in the large crushers which are running, the babbitt is not touched except when the plant is shut down for two weeks in the winter time for overhauling. It is not necessary, however, to do this, as it has been found at the end of the year that the babbitt was in as good condition as when the crusher started.

The water cooling features on these large crushers must not be overlooked, since it is thereby possible to run the crushers continuously without any possible chance of the bearings

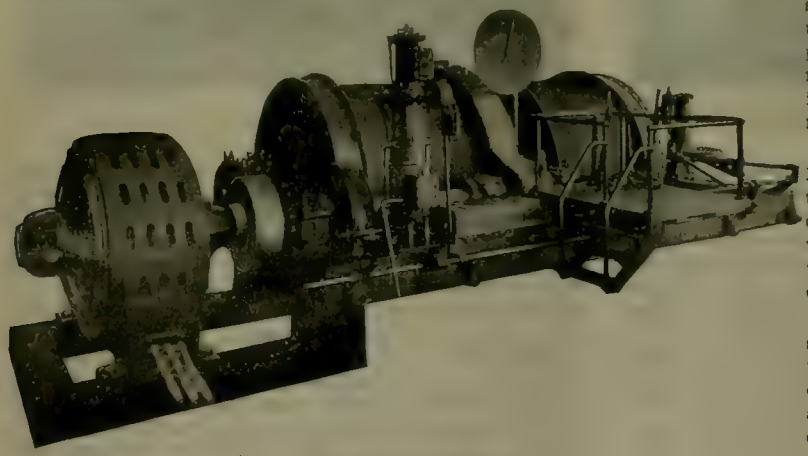
TWO GIANT JAW CRUSHERS BUILT BY THE TRAYLOR ENGINEERING & MANUFACTURING COMPANY.

heating, and the lubricating expense is greatly reduced; only about one-third of the lubricant necessary under ordinary conditions is used with water-cooled bearings. This water-cooling device has worked so satisfactorily on these large crushers that the Traylor company has adopted this design for all of its jaw crushers. In addition to the saving in quarrying cost, owing to the large openings on these large crushers, the machines have such an enormous capacity that the cost of crushing is also reduced. The crusher for the Rockland Lake Trap Rock Co. will have a capacity of 400 tons per hour, crushing down to about 10-in. ring, and will use from 180 to 240-hp. in crushing; estimating from actual operating conditions of the other large crushers in use.

While the Kerbaugh crusher at Valhalla was stopped through some oversight, ten tons of rock was dumped into the machine. It was absolutely prohibitive to dig out all of this, so the power was turned on and there was enough momentum in the crusher and also power in the motor to start the crusher and clean itself, without having to dig out a single piece of stone. At another time the crusher was fed with ten tons of rock, and as the car was dumped the power went off, but there was enough momentum in the fly-wheels to operate the crusher until all of the rock dumped into the hopper had been crushed. This is an important feature to operators who purchase their power, as it is impossible for them to know when the power will go off a line. With a gyratory crusher, for instance, it would be absolutely impossible to crush a load, if by any chance the crusher was full and the power went off. The box section type of crusher, shown in the cut, was built for the Kerbaugh company, while the ribbed section was built for the H. W. Johns-Manville Co. The Johns-Manville crusher has a large band wheel, 16 ft. diameter, and will receive the belt power direct from an electric motor. The Rockland Lake crusher will be driven direct from a countershaft and the main pulley will be 12 ft. diameter and 44 in. wide.

The Largest Induction Hoist

The largest induction motor, shaft hoist equipment in America was placed in operation in November 1914, at Lansford, Pennsylvania. The driving motor is rated at 750-hp., 300 r.p.m., three-phase, 25 cycle, and drives through a single reduction gear. Positive control of the hoisting speed is secured by means of an improved type of liquid rheostat and high-tension air-brake contractors, the motor circuit being 2300 volts. This hoist serves a 600-ft. vertical shaft hoisting 11,500 lb. per trip at the rate of 90 trips per hour, with a maximum rope speed of approximately 1600 ft. per minute.



LARGE INDUCTION HOIST.

The liquid rheostat was developed primarily for mine hoist service, and insures safe operation at quick reversal. It employs two sets of fixed electrodes at different elevations. One set is widely spaced, while the other set has large electrode areas and has small spacing in order to obtain a very low final slip. The two sets of electrodes are connected in parallel after the electrolyte has reached a certain level corresponding to a predetermined decrease in rotor voltage. All parts of the rheostat itself are stationary, thus insuring absolute reliability. The electrolyte level is varied through the operation of a movable weir and a small motor driven pump. The electrical equipment was supplied for this hoist by the General Electric Co. of Schenectady, New York.

Commercial Paragraphs

CHALMERS & WILLIAMS, Chicago Heights, Illinois, is installing two 6 by 14-ft. patent adjustable quick-discharge tube-mills at the Hunter mill in Shoshone county, Idaho.

The WEBSTER MANUFACTURING CO., Tiffin, Ohio, in a recent leaflet illustrates the 'car pullers' manufactured by this Company. These are made in various forms and adapted to a wide variety of purposes.

WOOD DRILL WORKS, Paterson, New Jersey, make drills from the 8-in. 'giant' weighing 2600 lb. to the little 2-in. 'baby' of only 83 lb. A recent folder illustrates the 2600-lb. 'giant' manufactured by this Company.

The LAGONDA MANUFACTURING CO., Springfield, Ohio, has issued a bulletin entitled 'Lagonda Boiler Tube Cleaners' in which are illustrated and described the new type of cleaners manufactured by this Company.

ARTHUR D. LITTLE CO., Boston, Mass., in a recent number of *The Little Journal*, publishes a short article entitled 'Raw Materials and the War,' the purpose of the article being to show the effect of the European struggle upon the American market.

The DODGE SALES & ENGINEERING CO., Mishawaka, Indiana, has been organized and incorporated to distribute all of the products of the Dodge company. Duncan J. Campbell, for several years general sales manager for the old Company, goes to the new corporation as vice-president and general manager, and C. R. Trowbridge continues in charge of advertising and sales promotion.

DAVIS INSTRUMENT MANUFACTURING CO., Baltimore, Maryland, has for distribution leaflets descriptive of the sighting compasses, pocket mining hygrometers, water gages, and psychrometers manufactured by this Company. Prices are quoted on these instruments.

C. L. BERGER & SONS, Boston, Massachusetts, is distributing a folder calling attention to the large stock of transits and other surveying instruments which are always kept on hand at the Boston headquarters. Visiting engineers are invited to call and inspet the products of the Company.

The MESTA MACHINE CO., Pittsburgh, Pennsylvania, is the manufacturer of what is claimed to be a highly efficient and reliable condensing device. The Helander barometric condenser is simple in construction and erection, and is built entirely of cast iron, and hence is unaffected by acid or oily water. There are no rivet holes to become leaky, and the condenser is capable of a large overload without impairing the efficiency.

MINING PRESS

Issued Every Saturday

SAN FRANCISCO, FEBRUARY 6, 1915

Buyers Directory Page 28
Advertisers Index Last Page

1915 FEBRUARY—SECOND MONTH 1915

What was the sudden transition from poverty to riches enjoyed by the poor wood-cutter of Bagdad to that experienced by some of our miners in a single day?—*Mining and Scientific Press, Feb. 7, 1865.*

SUNDAY FOR REST

SUN.	MON.	TUE.	WED.	THU.	FRI.	SAT.
•	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28						

SATURDAY THE PRESS

Comstock tunnel chartered	Feb. 4, 1865
Anthracite coal discovered at head of White river, Alaska	Feb. 5, 1912
Fremont proclaimed annexation of California	Feb. 8, 1847
Gold discovered in New South Wales	Feb. 12, 1851
Annual meeting A. I. M. E., New York City	Feb. 15, 16, 17
Opening of Panama-Pacific Exposition	Feb. 20
Washington's Birthday	Feb. 22

"Careful observance of accepted practice seems to suggest that if you want to name a rock and have no idea what it is, refer to it as porphyry."—*The Cynical Superintendent.*

A FEBRUARY DAY IN MONTANA—KENDALL MINE

MINING PRESS

Established May 24, 1860 as **The Scientific Press**; name changed October 20 of the same year to **Mining and Scientific Press**; shortened January 2, 1915, to **Mining Press.** Controlled by T. A. Rickard.

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Price, 10 cents the copy. Annual subscription: United States and Mexico, $3; Canada, $4; other countries in postal union, 21s. or $5.

VOL. 110 SAN FRANCISCO, FEBRUARY 6, 1915 No. 6

TABLE OF CONTENTS

EDITORIAL Page.

Notes 205
Barium and Strontium 206
The Mine Mule 206
Molybdenum 207

ARTICLES

LOOKING FORWARD 208

Sixty-five per cent of the copper produced in the United States is exported to Europe, and of the exports Germany absorbed about 30%. When the war started, copper was declared contraband by England, consequently shipments to Germany fell off greatly, resulting in copper mines of the United States curtailing production to about 50% capacity. Exports of copper to neutral countries in Europe have gradually increased of late, but England declares its right to detain cargoes of copper, unless they are specifically bound for known firms, or will not be allowed to pass into German hands from the neutral countries. The subject is of considerable importance.

LAKE SUPERIOR COPPER MINING: PRESENT AND FUTURE—II.

By Thomas T. Read 209

This is the second article of the series on this important district, the first appearing in the *Press* of December 5, 1914. In the present one, Mr. Read discusses mining methods from all points of view, beginning with a short résumé of the history of timbering and what conditions have altered the systems. The general scheme of mining consists of sinking incline shafts in the lodes, starting levels 100 ft. apart, and beginning stoping as near the shafts as is possible with safety. The Michigan mines are worked to a great depth, resulting in increased costs for many reasons. Hand tramming is a feature underground, on account of the drifts following the ore, making anything but straight runs. A great amount of ground is kept open, this being a peculiarity resulting from the price of copper. One-man drills are coming into general use in the world's mines, and their work in the Copper Country is described. Filling worked-out stopes is a problem everywhere, the Michigan mines being no exception to this rule, but the sand from the stamp-mills will probably solve the question. Mr. Read's article concludes with cost data of mining at the principal properties.

THE MEKEEL TUNNEL.

By Charles S. Shaunessy 216

A short account of driving a tunnel in connection with the water supply of the city of New York.

ORGANIZATION AT THE TREADWELL CYANIDE PLANT 217

Co-operation between employers and employees is desirable in any industry, and a better understanding is growing in the mining districts of the United States and in those of many other countries. The Alaska Treadwell Gold Mining Co. has furthered this idea in many ways with satisfactory results.

LATENT POSSIBILITIES AMONG CALIFORNIA MINERAL RESOURCES.

By E. S. Boalich 218

Mineral output of California is valued at approximately $100,000,000 per year, of which 50% is from petroleum and 20% from gold. The state contains deposits of most of the industrial minerals, but generally speaking there has been no incentive to develop them and produce any large quantity. Now that the war has cut off supplies of certain of them, such as antimony, asbestos, chrome ore, magnesite, and manganese ore, these should be worked.

A WEIR IN BURMA 219

The illustration accompanying this note shows native construction of a weir in jungle country, for determining stream flow preliminary to installing a water-wheel.

GERMAN IRON AND STEEL INDUSTRY 219

The output of iron and steel dropped considerably early in the war, but is now increasing.

THE PATO AND NECHI PLACER PROPERTIES, COLOMBIA.

By W. A. Prichard 220

These dredging claims of the Oroville Dredging Co. have been the subject of a great deal of interest to mining men. After a year's work, Mr. Prichard reports as to the amount of gravel available for the dredges. The Pato is estimated to contain 22,419,490 cu. yd. worth $7,092,100, and the Nechi 6,855,900 cu. yd., valued at $4,926,600.

BURRO MOUNTAIN PORPHYRY COPPER DEVELOPMENTS.

By Faris V. Bush 222

The Burro Mountain mine at Tyrone, New Mexico, is the newest porphyry deposit being developed and gradually brought to the producing stage.

GOLD MINING IN EASTERN ASIA 224

These notes describe methods used by the Celestials in various regions, and show that they are not wanting in skill.

THE RAND'S LARGEST CENTRAL POWER-STATION.

By V. Pickles 225

The Rand is a mining centre of enormous production, and great plants are necessary for this output. Mr. Pickles describes the largest of the many power-plants, the air-compressing system being of importance.

DEPARTMENTS

DISCUSSION:

Dissolution of Silver and Gold in Thickeners.

By Frederick A. Voorhees 227

At the Commonwealth mill, Arizona, the counter-current replacement system is used in the thickeners, and an interesting table shows the silver dissolved in passage of pulp through them.

Who Will Engineer the Engineers?

By A. Engineer 227

This is one of the many views on the 'always with us' topic of mining graduates and mining engineers.

CONCENTRATES 229

REVIEW OF MINING: Special correspondence from Rochester, Nevada; Deadwood, South Dakota; Toronto, Ontario; New York; Helena, Montana; Kalgoorlie, Western Australia; Washington, D. C. 230

THE MINING SUMMARY 234

PERSONAL 238

SCHOOLS AND SOCIETIES 238

THE MARKET PLACE:

Metal Prices 239
New York Metal Review 240
Current Prices of Ores, Minerals, Chemicals, Oils, and Candles 241

COMPANY REPORTS 242
MINING DECISIONS 243
RECENT PUBLICATIONS 243
NEW MACHINES AND DEVICES:
Sectionalized Water-Wheel 244
Commercial Paragraphs 244

STOCK LIST

A WAREHOUSE OF HOISTING ENGINES
ONE HALF OF OUR YARDS
A ROW OF STEAM ENGINES
A WAREHOUSE OF HOISTS AND ENGINES
HOISTING ENGINES AND COMPRESSORS
A LINE OF SHOP TOOLS
CENTRIFUGAL PUMPS AND SHOP MACHINERY
A FLOOR OF GENERAL SUPPLIES

Immediate Shipment Second-Hand Material

The following pages list Machinery we actually have in Denver stock ready for immediate shipment.

These views give you a visual idea of a part of our plant.

We handle in and out of Denver over 600 carloads annually of used machinery.

Our yards have over a mile of tracks, nineteen warehouses, sheds and shops.

The value of our stock at new price of machinery is over $3,000,000.

Every plant dismantled in the West has been purchased by us. We dismantled and shipped to Denver, in 1914, 136 plants of mining, milling, and smelting machinery.

Seventy-five percent of the machinery listed on the following pages has been in actual use less than 90 days.

You can probably secure the very article you are figuring on new and save one-half the purchase price.

Write us your requirements. If you do not see what is wanted in the following lists, write us. We are continually buying plants and it is possible we have exactly what you want. Write us today.

The Morse Bros. Machinery & Supply Co.

DENVER, COLO.

MORSE BROS. DENVER STOCK LIST

Specifications and Prices

Specifications, giving all details as to size and conditions will be sent on request. Photographs of any article will also be sent. It is our desire to give you the most complete information in regard to any article you wish, so that you may have the complete data before you. More than one-half our business is mail orders and is purchased on our statement of condition and is guaranteed in every way.

We have new and different goods arriving daily, and if you do not see what is wanted in the following lists write us about it.

CRUSHERS

1—7x10 McFarlane-Blake.
1—7x10 Challenge-Blake.
1—9x15 Morse Bros. Blake.
1—9x15 Davis Blake.
1—10x20 Blake. 2—15x24 Blake
5—No. 4, 7x16 Sampson Crushers.
1—No 10 Symons, Gyratory
1—No 1 "D" Gates. 1—No. 2 "D" Gates.
1—No. 6 Gates. 1—No. 7½ Gates.
1—No. 3, 16x24 Aurora.
1—No. 2 Gardner.

ROLLS

1—6x10 McFarlane (new).
2—12x12 Colorado Iron Works.
1—12x12 Fraser & Chalmers, geared.
2—12x20 Davis.
1—12x20 Denver Engr. Works.
1—14x26 Colorado Iron Works.
2—14x27 C. I. W. Standard (new).
1—14x27 C. I. W. Vezin Type.
1—14x27 Hendrie & Bolthoff Parallel.
1—14x27 McFarlane.
1—14x27 Walker Mfg. Co.
1—15x36 Allis-Chalmers.
2—16x36 C. I. W. Standard (new).
1—16x42 Colorado Iron Works.
3—24x 6 Triplex. 1—18x15 Triplex.

STAMPS

60—1050 lb. Stamps. 3?— 850 lb. Stamps.
45—1000 lb. Stamps. 25— 750 lb. Stamps.
The above complete with tappets, dies, shoes, cams, boxing, shafting, etc.
1—E. M. Davis D. I. Mortars
1—Allis-Chalmers, S. I. Mortars.
6—Colorado Iron Works S. I. Mortars.

MILLS

1—3½' "Huntington"
2—5' Top Drive Huntingtons
3—5' Allis-Chalmers 5' Huntingtons.
2—6' Ft. Hy Anaconda Type Allis-Chalmers Huntingtons.
1—5x22 Abbey Tube Mill (Tyre Type).
1—6' Allis-Chalmers Civilian Mill (new).
1—No. 4 Abbey Tube Mill.
1—3½' Griffin Mill
1—Lane Shoe Speed Mill
1—26"x16' Solid Trunion Tube Mill.
1—5x22' Allis-Chalmers Tube Mill (Silex lining).
1—Gates Ball Mill
12—10 ton Chlorination Barrels.

CONCENTRATING TABLES

6—No. 6 Willey Tables.
10—"Willey" Tables.
3 Card Tables.
9—Sutton, Steele & Steele Dry Tables.
8—No. 3 Overstrom. 4—4' Frue Vanners.
2—No. 2 James. 1—Sperry Slimer
10—6' Frue Vanners. 1—Bartlett Table.
2—Gilpin Co. Bumping Tables.
2—Ding Magnetic Ore Separators.

JIGS AND CLASSIFIERS

2—25' Hancock Jigs. 3—Hartz (6) Comp.
1 Six Comp. Richards Pulsator.
Richards (4) Comp. Pulsator.
2—3" "Ishell" Classifiers.
2—2" "Ishell" Classifiers.
2—3" Standard Classifiers.
1—Richards Classifier.
8—8' Callow Tanks.
1—Dorr Classifier. 1—Dorr Thickener.

SAMPLE GRINDERS

2—No. 1 Sample Grinders.
2—No. 2 Sample Grinders.

AMALGAMATING MATERIAL

Five (5) foot Clean-up Pan, all iron
32" Clean-up Pan, all iron.
7 Amalgam Safes.

SCREENS

7—Revolving Screens.
7—Imperial Ore Screens.
3—"Wild" Screens.
Single Newago Screen.
Double Newago Screen.
1—Impact Screen.
5—C. I. Wks. Impact Screens (new)
1—Columbian Screen.
4—Keedy Ore Sizers.

STEEL TANKS

72" dia. x 60" High Steel Tanks, 3/16" Steel; Cap. 1050 gallons.
72" dia. x 36" High Steel Tanks, 3/16" Lead Lined; Cap. 630 gallons.
9' 6"x6' 6" High Steel Tanks, ⅛", 5200 gallons
16'x10' High Steel Tanks, 3/16", 15,000 gallons.
5—Sand Tanks, 8,000 gallons, with slat bottoms; sides No. 10 Ga., bottom 8 Ga., steel.
1—Stock Tank, 9,000 gallons.
2—Sump Tanks, 8,000 gallons
4—16x12 Solution Tanks.
3—38x 5 Leaching Tanks, 2 discharge gates, filter cloths, cocoa mats, bored false bottom.
6—17x6 Sump Tanks, 2½" Angle iron at top.
2—15x8 Water Tanks.
4—Conical Tanks, 10' dia., 7' to cone; cone 4' 8" opening.

MISCELLANEOUS

No. 1 "Vezin" Double Sampler.
20 Assay Balances.
1 Variable Speed Regulator.
7 Challenge Ore Feeders.
7 Challenge Ore Feeders.
12x24 Pierce Amalgamator.
1 Pierce Amalgamator, 32x24.
Perrin Filter Press, 24 plate bot. disch.
Lot of Mill Side Dump Cars
7 Belt Elevators complete.
2 Link Belt Elevators complete.
1 Split Sampler.
2 Belt Driven Samplers.
1—4x4 Standard Mine Cage.
Lot of 6", 3" and 2" Pipe
Lot of 8, 12, 16, 24, 35 and 50-lb. Relaying Rail.
Lot of one cubic foot Zinc Boxes.
6 Dble Zinc Box, 18 comp. in each box, 24x24, 20" to top of screen; Trays and Rods.

ROASTERS AND DRYERS

9—18-foot 6-hearth McDougal Roasters. Main shaft and Rabble arms water cooled. Each machine driven by clutch pulley from main shaft. In excellent condition in every respect.
Revolving Ore Dryer, 60"x18'
1—D. E. Wks. Multitubular Ore Dryer.
1—90-ton Cummer Ore Dryer 11x28'6".
3—Revolving Ore Dryers, 5x22'6".
2—Davis Revolving Ore Dryers.
1—90' Edwards Duplex Roasting Furnaces
2—Howell-White Revolving Roasters, 36x 5' x7½".
60x8 Edwards Roasting Furnace, self contained steel girder frame.
5—No. 139 Prinz & Rau Perfection Dust Collectors.

BLAST FURNACES

1—48x186 Allis-Chalmers Blast Furnace.
2—39x168 Allis-Chalmers Blast Furnaces
These furnaces are all in fair condition. The jackets are more or less warped. The large furnace has been re-set and has never been in use. The bottoms are of cast iron resting on jack screws. Complete blast and down-take pipes and fittings.

REVERBERATORY FURNACES

1—17x55'. 1—17x42' 1—17x52'
The iron work of all these furnaces is as good as new, is I beam buckstays, 1½" binder rods, charging hoppers, doors, grates, etc

FURNACE AND CONVERTER EQUIPMENT

9 Elliptical Slag Cars, 66x51x57, gauge 48, wheels 24.
4 Steel Bowl Slag Cars, Elliptical, 72x54x 41 gauge, 30".
2 Larry Cars, 57x78", bot. disc., electrical driven, 250 v.d.c.
4 Matte Ladles or Pouring Spoons, cast steel.
5 Mould Cars, 92" long, 42" gauge.
60 Hand Slag Pots, 28" dia. bowl, 25" wheels.
2 Cast Iron Turntables, 42" gauge.
44 Reverberatory Matte Pans, 52x18x9.
56 Reverberatory Matte Bells, 7x10 base.
1 Ingersoll Tamping Machine for Converters.
2 Steel Scrap Boats.
11', 16' and 16' Matte Settling Wells
50' Cast Iron Trough for furnaces.
25 tons of smelter bars and tools.

RADIAL DRILL PRESSES

1—Alfred Box & Co., belt drive, drills to center of 60" circle.

ROLLS FOR SHEET IRON

1 set 36"x3½" Sheet Iron Rolls, Bertsch & Co.
1 set 50"x5" Doty Geared Rolls, hand power.

HAMMERS

1—Flint & Lomax Trip Hammer.

PLANERS

1—22" Putnam Iron Planer, Bed 19"x5'.
1—24 Ames Mfg Co. Screw Drive, Bed 19"x5'.
1—E. C. Dickey Pulley Key Seater.

PIPE MACHINES

1—No. 46 Forbes Pipe Machine for power and hand.
1—No. 7 Jarecki Pipe Machine. Cuts ¼" to 2" pipe.
1—Curtis & Curtis Pipe Machine. Capacity 2½" to 6", with countershaft.
1—Curtis & Curtis Pipe Machine. Capacity 2½" to 6", direct connected to 1 H.P. D. C. 1280 RPM. Westinghouse motor.
1—N. O. Nelson Pipe Cutting Machine. Capacity ½" to 2", with countershaft.

BOLT MACHINE

1—No 2 Putnam Bolt Cutter, ⅜" to 1½", with taps and dies and countershaft.
1—Reliance Bolt Cutter, complete with taps and dies and countershaft.
1—No. 1 General Electric Oil Tempering Bath with basket for same, including "M" Panel pipe supports, rheostat, switchboard and thermometer.
1—¼ to 1½ Wiley & Russell Bolt Cutter.
1—Wells Bros Nut Tapper.
1—Brown Bolt Machine, ⅜ to 1½.

DRILL SHARPENERS

1—No. 1 Sinclair drill sharpener and bull-dozer with extra dies.
1—No 1 Leyner drill sharpener and bolt header with dollies and dies.

MISCELLANEOUS

1¼ Yard Vulcan Steam Shovel on R. R. trucks.
No. 500 Victor Steam Shovel on R. R. trucks.
1 Yard Thew Automatic Revolving Shovel, traction wheels.
Model 10 Marion Steam Shovel on R. R. trucks.
New Erg Grader, complete.
17 CF Municipal Cube Mixer with boiler and engine.
No. 5 Smith Mixer on skids.
Sack Cole, Concrete Mixer on skids with gasoline engine
1 Steam Derrick, mast 16x12, 4x6 double steam engine, direct connected to derrick windlass.
2 Hand Power Derricks, 10x10 mast.
2 Marble Gang Stone Saws.
1 Marble Planer.

WATER TUBE BOILERS

3—300 H. P. Rust Vertical Boilers.
2—200 H. P. Babcock & Wilcox.
1—200 H. P. Moraine Water Tube.
1—150 H. P. Heine Water Tube.
2—250 H. P. Cahall Vertical.
1—125 H. P. Sterling Water Tube.

HORIZONTAL TUBULAR

Diameter inches, first; length in feet, second; number of tubes; third; size of flues, fourth.
15—150 H. P., 78x18, High Pressure Butt strapped, quadruple riveted, Otis steel, 86, 4" tubes.
1—125 H. P., 72x16, 70, 4".
1—100 H. P., 66x16, 72, 4"
1—100 H. P., 60x18, 82, 3".
1— 80 H. P., 60x16, 50, 4".
1— 80 H. P., 60x16, 82, 3".
2— 80 H. P., 60x16, 52, 4".
2— 80 H. P., 60x16, 44, 4".
1— 80 H. P., 60x16, 44, 4, Butt strapped
1— 80 H. P., 60x16, 58, 3¼".
1— 80 H. P., 60x15, 32, 4½".
1— 80 H. P., 60x16, 56, 3½".
1— 80 H. P., 60x16, 46, 4".
1— 70 H. P., 60x14, 81, 3".
1— 70 H. P., 54x16, 48, 3¼".
1— 70 H. P., 54x16, 54, 3½".
1— 70 H. P., 54x16, 44, 3½".
1— 60 H. P., 54x14, 64, 3".
3— 60 H. P., 54x14, 46, 3¼".
1— 60 H. P., 60x12, 82, 3".
1— 50 H. P., 54x12, 64, 3".
1— 50 H. P., 48x16, 49, 3".
1— 45 H. P., 48x14, 28, 3¼".
1— 40 H. P., 44x14, 38, 3".
1— 40 H. P., 48x12, 40, 3¼".
1— 40 H. P., 44x14, 44, 3".
2— 40 H. P., 44x14, 52, 3".
1— 35 H. P., 42x14, 38, 3".
1— 30 H. P., 42x12, 32, 3"

MORSE BROS. DENVER STOCK LIST

1 — 30 H. P. 42x12, 40 — 3"
1 — 30 H. P. 44x10, 42 — 3"
1 — 30 H. P. 42x12, 38 — 3"
1 — 30 H. P. 42x12, 34 — 3"
1 — 25 H. P. 40x11, 34 — 3"
1 — 20 H. P. 36x10, 28 — 3"

The following are new boilers purchased at receivers sale and will be sold at less than factory cost.

100 H. P. 66x18, 92 — 3"
100 H. P. 66x16, 76 — 4"
100 H. P. 66x16, 56 — 4"
80 H. P. 60x16, 44, 4"
60 H. P. 54x14, 44 — 3½"
50 H. P. 54x12, 74, 3"
50 H. P. 54x12, 64, 3"
50 H. P. 54x12, 44 — 3½"
50 H. P. 54x12, 34, 4"
44 H. P. 48x12, 52 — 3"
40 H. P. 44x14, 46, 3"
35 H. P. 44x12, 38, 3"
20 H. P. 36x10, 28, 3"

BOILERS—LOCOMOTIVE

250 H. P. Marine, Dia. 10', length 13', 137-3½"
100 H. P. Holthoff Internal Furnace.
100 H. P. Penn. Ret. Tubular Portable, 82-3" and 46-4" flues.
80 H. P. Erie Economic, Dia. 54", 78-3" and 42 flues.
60 H. P. Erie Economic.
60 H. P. Locomotive Type.
30 H. P. Erie Economic.
30 H. P. Locomotive, Dia. 36" 30-3 flues.

The following are new locomotive type, mounted on skids. These were bought at receivers' sale and will be sold at less than the manufacturer's cost.

60 H. P., 40" Dia., 64x38x50 fire box, 18 3" tubes.
50 H. P., 40" Dia., 60x34x44 fire box, 42 3" tubes.
40 H. P., 40" Dia., 60x34x14 fire box, 42 3" tubes.
25 H. P., 36" Dia., 52x30x40 fire box, 34 3" tubes.
20 H. P., 34" Dia., 52x28x38 fire box, 30 3" tubes.

VERTICAL

40 H. P., 48x96, 136—2" submerged flue.
35 H. P., 42x 9½, 84—2" full length tubes
35 H. P., 42x 9½, 109—2" full length tubes
30 H. P., 42x 9, 84—2" full length tubes
30 H. P., 42x 8½, 109—2" full length tubes
30 H. P., 42x 9, 85—2" submerged tubes
30 H. P., 42x 9, 82—2" full length tubes
30 H. P., 42x 9, 85—2" submerged tubes
30 H. P., 42x 9, 85—2" submerged tubes
25 H. P., 42x 8, 85—2" submerged tubes
25 H. P., 42x 8, 85—2" submerged tubes
25 H. P., 42x 8, 85—2" submerged tubes
25 H. P., 35x 9, 72—2" full length tubes
25 H. P., 42x 7½, 109 —2" full length tubes
20 H. P., 36x 8, 77—2" full length tubes
18 H P., 36x 7, 61—2" full length tubes
18 H. P., 36x 7, 61—2" full length tubes
12 H. P., 30x 7, 48—2" full length tubes
5 H. P., 24x 5, 31—2" full length tubes

The following are NEW and will be sold at manufacturer's cost.

1—25 H. P., 42x7½, 96—2"
3—20 H. P., 36x8, 72—2".
3—18 H. P., 36x7, 72—2".
2—15 H. P., 36x6, 72—2".
1—12 H. P., 30x7, 48—2".
5—10 H. P., 30x6, 48—2".
4— 8 H. P., 30x5, 48—2".
3— 4 H. P., 24x4, 28—2".

FEED WATER HEATERS

40 H. P. Webster.
50 H. P. Frost Tubular.
70 H. P. Standard. 100 H. P. Webster.
100 H. P. Wainwright
150 H. P. Standard Enclosed.
250 H. P. Standard Enclosed.

CORLISS ENGINES

1—20x42 "Allis" L. H., Girder frame.
1—16x42 "Fraser-Chalmers" R. H. Girder frame.
1—16x42 Filer & Stowell R. H., Heavy Duty frame.
1—16x36 Jackson L. H. Corliss.
1—14x42 "Fraser-Chalmers" L. H. Girder frame.
1—12x30 Allis-Chalmers R. H., Heavy Duty frame.
1—12x24 "Philadelphia" Corliss R. H., Girder frame.

COMPOUND ENGINES

320 H. P. 30x16x27 "Fitchburg" Tandem.
100 H. P. 9x12x20 "Atlas" Tandem.

AUTOMATIC ENGINES

1—150 H. P., Armington-Sims, 15x15, Automatic.
1—150 H. P., 16x24, Atlas side crank.
1—125 H. P., 15x16, Ball.
1—120 H. P., 13x12, Ball.
1—120 H. P., 13x15, Ball.
1—120 H. P., 13x12, Ideal.
1—100 H. P., 14x20, Atlas side crank.
1—100 H. P., 12x13, Ball.
1— 75 H. P., 12x12, Buffalo.
1 — 70 H. P., 11x13, Ames.
1 — 60 H. P., 12x20, Watertown.
1 — 50 H. P., 12x12, Hendey & Meyers
1 — 50 H. P., 10x12, Buffalo.
1 — 45 H. P., 10x12, Ball.
1 — 40 H. P., 9½x10, Armington-Sims
1 — 25 H. P., 7x10, Atlas.
1 — 25 H. P., 7x10, Armington-Sims.
1 — 25 H. P., 8x10, Hendey & Meyers
1 — 15 H. P., Rice Automatic

SLIDE VALVE ENGINES

80 H. P., 14x20, Atlas.
80 H. P., 14x18, Woodbury.
80 H. P., 14x18, Bay State.
80 H. P., 13x12, Ideal, center crank.
70 H. P., 14x18, Houston & Gamble.
65 H. P., 12x18, Woodbury.
60 H. P., 10x17, Hendey & Meyers.
60 H. P., 13x16, Chandler & Taylor slide crank.
50 H. P., 11x15, D. E. Works.
50 H. P., 13x16, Chandler & Taylor.
50 H. P., 12x12, Oil Well Link Motion.
50 H. P., 11x15, Hendey & Meyers slide crank.
50 H. P., 12x16, Star.
45 H. P., 11x16, Atlas (2).
40 H. P., 11x14, Jackson.
40 H. P., 11x14, Chandler & Taylor.
40 H. P., 10x16, Star center crank.
40 H. P., 10x15, W. B. & F. side crank.
35 H. P., 9x18, Horiz. center crank
35 H. P., 10x12, Card & Weber.
30 H. P., 9x12, Atlas.
25 H. P., 8x12, Hendey & Meyers (2).
20 H. P., 8x10, Denver Eng. Works
15 H. P., 7x10, Nagle.
15 H. P., 7x10, Atlas
15 H. P., 7x10, Mansfield.
12 H. P., 6x 8, Nagle, center crank.
5 H. P., 4x 6, Murray Iron Works.

VERTICAL ENGINES

20 H. P., 9 x9, Nagle.
15 H. P., 8 x9, Nagle.
15 H. P., 6½x7, Oil City Automatic.
15 H. P., 8 x9, New York Safety.
12 H. P., 7 x8, Vertical.
10 H. P., 7 x7, Nagle.
8 H. P., 5½x7, Climax.
7 H. P., 6 x6, Nagle.
5 H. P., 6 x7, O. & S.
4 H. P., 4 x4, Nagle.
4 H. P., 4 x4, Climax.
4 H. P., 4 x6, N. Y. Safety.
3 H. P., 3½x5, Nagle.

The following new vertical engines can be secured at less than the cost of manufacture.

15 H. P., 7½x10, Dutton.
10 H. P., 7½x 8, Dutton.
8 H. P., 6 x 7½, Dutton.
6 H. P., 5 x 7½, Dutton.

GASOLINE ENGINES

30 H. P. Weber. 25 H. P. Alamo, new.
25 H. P. Fairbanks, Morse & Co., horizontal.
1212 H. P. Fairbanks, Morse & Co., vertical.
8 H. P. Novo, horizontal.
6 H. P. Royal, horizontal.
5 H. P. Otto, horizontal.
4½ H. P. Royal, horizontal.
1½ H. P. Ingeco, horizontal.
1½ H. P. Royal, horizontal.
1 H. P. Jack Junior.

OIL ENGINES

85 H. P. De La Vergne, Type H. A.
80 H. P. Fairbanks-Morse, Type N., 180 R.P.M., 8x16.
3—17 H. P. Bull Dog Duplex, new, a bargain.

DIRECT CONNECTED UNITS

200 Kilowatt Chuse Automatic, 19x20. Direct connected to 2 Comp. "Bullock," 125 v. and 800 amperes, 200 R.P.M.

3 McIntosh-Seymour 18x40x36 Cross Compound 1000 H. P. Engines, direct connected to.

3 G. E. AC Generators, 600 K.W., 3 ph., 30 cyc., 52 amp., 6600 volts.

20 Kilowatt Direct Current, 250 volts, direct connected to 8x8 Racine Automatic Vertical Engine

ALTERNATING CURRENT MOTORS

1—300 H. P. Westinghouse, 3 ph., 60 cyc., 450 v., Synchronous Motor, 150 R.P.M., pulley 32x30, with control board. Complete in every detail.
1—250 K.W. Westinghouse Synchronous Motor, 3 ph., 60 cyc, 180 v., 150 R.P.M.
1—150 H. P. Westinghouse Motor, 3 ph., 60 cyc., 400 v., 580 R.P.M.
150 H. P., 3 ph., 60 cyc., 440 v., General Electric, 600 R.P.M.
100 H. P., 3 ph., 60 cyc., 440 v., General Electric, 720 R.P.M.
1—100 H. P. Gen. Elect., Form L, 3 ph. 60 cyc., 440 v., 125 amp., 600 R.P.M.
40 H. P., 3 ph., 60 cyc., 220 v., Westinghouse, 840 R.P.M.
50 H. P., 3 ph., 60 cyc., 440 v., General Electric, 600 R.P.M.
30 H. P., 3 ph., 60 cyc., 440 v., Bullock, 850 R.P.M.
25 H. P., 3 ph., 60 cyc., 440 v., General Electric, 900 R.P.M.
20 H. P., 3 ph., 60 cyc., 440 v., Bullock, 850 R.P.M.
20 H. P., 3 ph., 60 cyc., 440 v., Bullock, 1130 R.P.M.
10 H. P. Single Phase Wagner, 1750 R.P.M.
1—10 H. P., F. M. & C., 3 ph., 60 cyc., 220 v., 1200 R.P.M. Motor
½ H. P., 3 ph., 60 cyc., 440 v., General Electric, 1200 R.P.M.

DIRECT CURRENT MOTORS

1—50 H. P., Ft. Wayne, 3 ph., 60 cyc., 440 v., 600 R.P.M., Motor
10 H. P., 500 v., direct current, Northern, 625 R.P.M.
35 H. P., 250 v., Bullock, 610 R.P.M.
35 H. P., Crocker-Wheeler, 600 R.P.M., 230 v.
25 H. P., 250 v., Bullock, 900 R.P.M.
26 H. P., Crocker-Wheeler, 230 v.
20 H. P., 250 v., Bullock, 650 R.P.M.
20 H. P., 250 v., Bullock, 650 R.P.M.
1—20 H. P., Westinghouse, type S, 500 v., 1040 R.P.M., 34 amp., Motor
1—20 H. P., Northern Electric Co., 220 v., 80 amp., 725 R.P.M., Motor
1—20 H. P., Westinghouse, 500 v., 1050 R.P.M.
1—20 H. P., Northern Electric Co., 220 v., 35 amp., 725 R.P.M., Motor.
15 H. P., 110 v., Electron, 1200 R.P.M.
1—15 H. P., Westinghouse, 220 v., 1120 R.P.M.
15 H. P., Crocker-Wheeler, 800 R.P.M., 230 v.
13 H. P., Crocker-Wheeler, 230 v.
10 H. P., Gen'l Elec., 500 v., 800 R.P.M.
1—10 H. P., Milwaukee, 500 v., 1275 R.P.M.
1—7½ H. P., Crocker-Wheeler, type CCM, 875 R.P.M., 230 v., 28.5 amp. Motor.
1—7½ H. P., Crocker-Wheeler, type CCM, 875 R.P.M., 230 v., Motor.
5 H. P., Crocker-Wheeler, 230 v., 1300 R.P.M
5 H. P., Crocker-Wheeler, 250 v., 1229 R.P.M.
3 H. P., 500 v., Gen'l Elec., 1800 R.P.M
1—¼ H. P., G. E. Type C 2, 500 v., 2000 R.P.M.

DIRECT CURRENT GENERATORS

10 K.W. Crocker-Wheeler, 250 v., 1085 R.P.M.
26 K.W. Edison, 125 v., 1300 R.P.M.
7½ K.W. Kentucky, 220 v., 1050 R.P.M.
4½ K.W., 125 v., Westinghouse.
Jenney Elect. Co. Generator, 5 v., 60 amp., 2200 R.P.M.
3 K.W. Edison, 250 v.
3 K.W., Crocker-Wheeler, 125 v., 1220 R.P.M.
1½ K.W., Crocker-Wheeler, 125 v., 2075 R.P.M.

ELECTRICAL EQUIPMENT

200 K.W. Generator Set, Allis-Chalmers Bullock Type Motor A. C., H. P. 300, Volts 440, Amp. 354, R.P.M. 865, 60 Cycle. Generator, direct current, volts, no load, 240; full load 250; amperes 800; R.P.M. 865. Perfect condition.

3—100 K.W., each Oil Cooled Transformers, 44,000 to 440 volts, 60 cycle. Allis-Chalmers.

3—100 K.W., each Water Cooled Transformers, 44,000 to 440 volts, 60 cycle. Westinghouse.

1 Complete Set, 44,000 volts, Lightning Arrester.

1—5-panel Switch Board, marble, complete

1—2-panel Switch Board, marble, complete.

2—75 K.W. Pittsburg Transformers, high tension, 4600 to 10,000 volts.

3—100 K.W., each Water Cooled Transformers, 440 to 10,000 volts.

WATER WHEELS

36" Leffell Standard Vertical.
30" Samson Vertical.
24" Climax Water Motor.
18" Smith Globe Case Turbine.
17" Triumph Case Turbine.
15½" Leffel Globe Case Turbine.

STEAM PUMPS—Mine Pumps

18 and 28 and 42x10x35 Knowles Triple Expansion Duplex with 12x20x18 Vacuum Pump, capacity 1200 gal., 1000 lift.
18x34x9¼x36 Snow Duplex Compound Condenser Pump, 12x18x16, 800 gal., 100 feet lift.
26 and 15x8x24 Knowles Duplex Compound Pot Valve Pattern with independent jet condenser.
24 and 14x7x24 Knowles Duplex Compound with independent jet condenser. Solid cylinder pattern.
20x8x12 "Knowles" Duplex O. P. Plunger.
18x8x12 "Knowles" Duplex O. P. Plunger.
16x7x12 "Knowles" Duplex O. P. Plunger.

MORSE BROS. DENVER STOCK LIST

11x7x14 Knowles Duplex, outside end packed, solid cylinder pattern.
11x6x12 Knowles Single. 147 g.p.m.
12x7x12 "Knowles" Duplex O. P. Plunger.
10x6x12 Knowles Duplex. 204 g.p.m.
10x6x10 Snow Duplex. 188-205 g.p.m.
10x6x12 Knowles Duplex. 204 g.p.m.
2—10x5x12 Knowles Pressure Pumps.

SINKING PUMPS

No. 12 Cameron Sinker, 18x9x16.
1 No 1, No. 11 "Cameron" Sinker, 16x8x16.
2 No 9B "Cameron" Sinker, 14x7x13.
1 No. 9 "Cameron" Sinker, 12x7x13.
1 No. 7 "Cameron" Sinker, 10x5x13.
1 No. 5 "Cameron" Sinker, 7x3½x12.
Prospector's Sinker, 6x3x7.
Snow Duplex Sinker, 10x5x12
Snow Duplex Sinker, 7x3½x10.
Deane Sinker, 12x6x16

GENERAL SERVICE PUMPS

2—12x18½x12x10 "Deane" Compound Duplex Inside Plunger. Capacity 880 gal per minute.
16x10½x12 "Worthington" Duplex. 600 gal. per minute.
14x8½x12 "Snow" Duplex. 470 gal. per minute.
2—16x12x10 Laidlaw-Dunn-Gordon Piston Duplex, brass fitted.
14x10x12 Fairbanks-Morse Duplex. 1,020 gal. per minute.
16x9x12 "Knowles" Duplex.
16x8x20 Hooker Single.
14x7x24 No. 5 Cameron Special.
12x7x10 "Worthington" Duplex. 600 gal per minute.
12x6x12 "Snow" Duplex. 465 gal. per min.
10x6x10 "Worthington" Duplex. 220 gal. per min.
10x6x10 Davidson Boiler Feed.
8x5x12 Knowles Duplex.
8x8x12 Fairbanks-Morse Duplex.
8x12x18 Snow Single.
7x4½x8 Snow Duplex; Piston Pattern.
6x8½x10 "Snow" Simplex Tank. 260 gal. per min.
6x8½x12 "Snow" Simplex.
2 No. 6 Deane Single.
6x4x6 National Duplex.
6¼x4x6 Buffalo Duplex, outside center packed.
5¼x3½x5 Knowles Duplex.
5¼x3½x5 Buffalo Duplex, outside center packed.
5¼x3½x5 Worthington, outside end packed.
4½x2¾x4 Deane Duplex.
5¾x5x10 New Era Duplex.
Lot of Boiler Feed Pumps of Worthington, Blake & Knowles, Snow and other makes.

TRIPLEX, DUPLEX AND SINGLE POWER PUMPS

3—13x12 New Aldrich Triplex, 1000 g. p. m. against 250" head.
13x12 Aldrich Single Acting. Capacity, 900 g. p. m.
9x10 Deming Triplex, 75 lbs. pressure.
8x10 Gould. Fig. 1062 for open wells, cylinders below. Capacity, 244 g. p. m.
8x8 Gould Triplex, 43 lbs. pressure.
4½x8 Gould. Fig. 997. 44 g. p. m. 600 lbs. pressure, new.
8x8 Deming Single Acting. 287 g. p. m., 150 lbs. pressure.
5x8 Gould Triplex, 43 lbs. pressure.
5x8 Gould Triplex. 91 g. p. m. Fig. 924. 130 lbs.
4x6 Gould Triplex. 48 g. p. m. 130 lbs.
3x4 Dean Duplex. 100 lbs. 18 g. p. m.
3—4x6 Fairbanks-Morse Duplex Power Pumps, 78 g. p. m.
1—5x5 Goulds Pyramid Pumps, 40 g. p. m.
1—No. 11 Lucas Low Pressure, 40 g. p. m.
1—5x5 F., M. & Co. Bulldozer, 35 g. p. m.
1—5x5 Goulds Pyramid Pump, 34 g. p. m.
1—Goulds Deep Well Pump Head, 20" stroke.
1—National Deep Well Pump Head, 36" stroke.

CENTRIFUGALS

8" Morris Horiz. Mang. Lined Sand Pump.
7" Traylor, Horizontal Centrifugal.
6" Traylor Vertical Centrifugal.
6" Hodge Horizontal Centrifugal.
6" Louisville Horiz. Centrifugal.
5" Boggs Clark Horiz. Centrifugal.
5" Traylor Horiz. Centrifugal.
4" Kingsford Horiz. Centrifugal.
4" Fountain Vertical Centrifugal.
3" Buffalo Horizontal Centrifugal.
3" Boogs & Clark Horizontal Centrifugal.
2½" Byron Jackson Horiz. Centrifugal with extended base for motor.
2" Fountain Vertical Centrifugal
1½" Fountain Horizontal Centrifugal.

STEAM ACTUATED COMPRESSORS

1925 cu. ft. Norwalk compound air and steam compressor, 28 and 17½x18 and 30x30.
1314 C. F. Laidlaw Dunn Gordon, 18 and 30x26 and 16x24, compound steam and air.
1250 C. F. Rand Imperial Type 10, compound air and steam; 24 and 14x24 and 13x16.
1160 C. F. Norwalk Corliss Valve, steam, 14 and 26, air 22 and 13½, stroke 24".
800' Rand Imperial, Type 10, Compound Steam and Air, 20 and 12x19 and 11x16.
647 C. F. "Leyner" Straight Line, 16x18 and 11x22. Simple Steam Compound Air. (Have two of these.)
656 C. F. "Rand" Straight Line, Class "A"—18x18¼x24.
584 C. F. "Rand" Imperial, Type 10—9x16 and 9x12, Duplex Steam Compound Air.
558 C. F. "Norwalk"—14x16 and 9½x16 simple steam compound air.
558 C. F. "Norwalk" Comp. Air, simple steam, 16 and 9½x14x16.
498 C. F. "Ingersoll," Clas "A"—14x16¾x18, simple steam and air.
481.7 C. F. Leyner Simple Steam, Compound Air, 11½x16 and 10x18.
439 C. F. "Ingersoll," Class "H3," 11 and 19x18¼x10, compound steam, compound air.
417 C. F. No. 9 McKernan, 14x14x18.
282 C. F. Norwalk, High Altitude, 10x12 and 6¾x12.
274' Leyner, Simple Steam, Compound Air, 10½x12 and 7¼x14.
220 C. F. American 10x12x12. Straight Line, Type "A."
195 C. F. "Norwalk"—10x10x6¾x10, simple steam compound air
180 C. F. "Leyner"—10½x10x6¾x14, simple steam compound air.
153 C. F. American—8x10x12, simple steam, simple air.
80 C. F. Laidlow, Class "GB"—8x8x8, simple steam and air
31 C. F. Ingersoll, 6x6x6.

BELT DRIVEN AND DIRECT CONNECTED COMPRESSORS

1007' Ingersoll-Rand, Class J2—24¼ and 14¼x11.
530 C. F. Blaisdell Comp. Air, 18x12x12 enclosed frame.
1—30 Drill "Ingersoll-Sargent," 22x41x48, 100 lbs. pressure.
481.7 C. F. Leyner Straight Line Side Crank, 16 and 10x18. (We have two of these.)
247 Rand Imperial Type 10, 12x7½x10.
235 C. F. Leyner, 12x12.
154 C. F. Leyner, 10x10.
117 C. F. Franklin, 10x8.
48 C. F. 6x6 Curtis Automatic, 2 cyl., single acting.
34½ C. F. Clayton Single Open Frame, Climax, 6x6.

POSITIVE BLOWERS

1—No. X Garden City Positive Blower.
1—No. 3 Root "New Acme" Blower.
1—No. ¾ Wilbraham Blower.
1—No. ½ W. Baker Blower Co. Blower.
1—No. 4 Bakers Rotary Blower.
1—No. 4½ Baker Positive.
1—No. 5 Bakers Rotary Blower.
1—Piqua Positive Blower. Capacity 85 cu. ft. per rev.
1—100 cu. ft. Connersville.
1— 55 cu. ft. Roots.

VOLUME BLOWERS

1—No. 000 Champion, outlet 4¼".
1—No. 1 Buffalo, outlet 4⅞".
1—No. 2 Buffalo, outlet 6".
1—No. 4 Buffalo, outlet 9".
1—No. 5 Buffalo, outlet 10⅝".
1—No. 6 Buffalo, outlet 11½".
1—No. 7 Buffalo, outlet 14".
1—No 2 Sturtevant, outlet 7½".
1—No. 5 American Blower Co, outlet 11".
Buffalo Steel Plate, outlet 26x26.
Buffalo Steel Plate, outlet 21x21.

EXHAUSTERS

1—No. 3 Buffalo.
1—No. 6 Buffalo, outlet 11".
1—No. 4 Sturtevant, outlet 12".
1—No. 9 Sturtevant.
1—No. 7 Sturtevant, outlet 19".
1—No. 7 American, outlet 15".
1—No. 3, American, outlet
1—30" Sturtevant Steel Plate, outlet 11".
1—45" Garden City Steel Plate, outlet 14x16.
1—70" Buffalo Steel Plate, outlet 26x26.
1—70" American Steel Plate, outlet 27½x27½.
2—24"x8" Ventilating Fans.

ROCK DRILLS

1 Temple Ingersoll Electric Drill, complete.
40 Murphy Stopers, new.
10 Murphy Sinkers, new.
2 Waugh Stopers.
1—2 CA Sullivan. 4—2¼" US Sullivan.
1—3" UD Sullivan. 1—No. 4 Sullivan.
1—2¾" No. 12 Rand Slugger.
1—3¼" No 13 Rand Slugger.
8—3¼" 3B Rand Little Giant.
2—2" A Ingersoll. 2—2" A-35 Ingersoll.
5—3" D Ingersoll. 3—No. 5 Water Leyner.
2—No. 6 Water Leyner.
Also a lot of tripods, weights, columns, arms and clamps.

HOISTING ENGINES

18x36 Davis First Motion Double-conical Drums, for 1⅛-inch rope. Steam operated clutch and brakes.
16x30 Allis First Motion.
14x20 Ottumwa Link Motion Double Drum, wood-lagged.
22x36 Danville First Motion Double Drum Hoisting Engine, drums 7', post brakes.
10x30 First Motion Bolthoff Hoist, load 1000 lbs., 600'.
12¾x15 "Lidgerwood," Style 225 Single Drum, Link Motion Band. Clutch capacity, 6,500 lbs. at 450 feet.
12x16 Vulcan Geared, load 6500 lbs. Hoisting speed 575 ft. per min. 120 H.P.
12x12 Double Friction, Double Engine.
10x12 Friction Hoist.
10x14 Vulcan Geared.
8x10 Davis Geared, 8x12 Webster Geared.
6x8 H. & B. Combination Friction and Geared.
6x8 Vulcan Geared, 20 HP., load 2000 lbs. 350 ft. per min.
6x8 F. M. & Co. Friction, Cap. 2000 lbs., 20 HP., 300 ft. per min.
6x8 Vulcan Friction Hoist, Cap. 2000 lbs., 20 HP., 300 ft. per min.
6x8 Mine & Smelter Friction, 2000 lbs., 20 HP., 300 ft. per min.
6x8 Friction Hoist.
6x8 National Single Cyl. Eng., double friction Hoist, Cap. 1500 lbs. (Have 2 of these.)
5x6 Davis Geared Winze, 1200 lbs., 150 ft. per min.
2—5x7 H. & B. Geared Hoists.
1—Davis Horse Whim.
3—Reynolds Safety Horse Whims.
1—No. 1 Walker Mfg. Co. Hand Winch, cap. 10,500 lbs.
1—No. 2 Montgomery Hand Winch, load 5250 lbs.

CONTRACTORS' HOISTS

8¾x10 Lidgerwood Engine and Boiler, link motion drum, 32x23.
8¾x10 Lidgerwood Three-drum, Tandem Style, No. 2093.
7x10 Lidgerwood Double-drum Engine and Boiler, No. 71.
18 HP., Double Drum Hoist and Boiler. Drums, 12x24 and 10x19.
10 HP., 7x10, Lidgerwood Single Cyl. Friction Drum Engine and Boiler.
6 HP. Combined Boiler and Hoist.
1—Lidgerwood Belted Hoist, drum, 10x19. Capacity 1000 to 1500 lbs.

ELECTRIC HOISTS

15 to 25 HP. Electric Hoist. Motor to suit.
75 HP. Trent Eng. & Machy. Co. Electric Hoist.
Lidgerwood Double Drum Tandem, Drums 27x27 and 36x27.
Lidgerwood Double Drum Tandem, Drums 14x27.
Lidgerwood Double Drum Tandem, Drums 36x48 and 26x55.
Lidgerwood Triple Drum Tandem, Drums 44x39, 30x50 and 30x50.

GASOLINE HOISTS

34 H.P. Fairbanks-Morse.
15 H.P. "Alamo." 15 H.P. "Witte."
15 H.P. Fairbanks-Morse.
12 H.P. Fairbanks-Morse, vertical.
9 H.P. Fairbanks-Morse, vertical.

ELECTRIC LOCOMOTIVES

Jeffrey Electric Locomotive, 48" gauge, Ty DM Class, 105 volts 250; DB pull 6500 lbs., hand wheel brakes wheels 29", drum controller, trolley in center, extra motors and armature.
General Electric Locomotive, Class LM 103 A, volts, 250, gauge 24", DB pull 1200 lbs., speed 6 miles. Extra armatures and motor.
General Electric Locomotive, 5 ton, Form L, M. 103A, 24" gauge, 1200 lbs. DB pull, speed 6 miles, 500 v., direct current.
3-ton Atlas Storage Battery Locomotive, 24" gauge with 10 H. P. G. E., 220 v., direct current generator.

TRAVELING CRANE

45,000 lbs. Browns Hoisting and Conveying Co. No. 2012, span 40 ft.

GOLD DREDGE

1 Complete 5 C. F. Bucket Gold Dredge, electrically operated with separate 300 K.W. Electric Power Plant. Used three months. Digs 35' below water line. Can be secured at a bargain.
1 Uro & Snyder Gold Dredge, cap. 1000 yds. per 24 hours. Ladder 24'. 70 H. P. Miami boiler engine. Gold saving devices, etc. A good dredge for a small placer.

TRAMWAYS

1 Complete 6150' Leschen Tramway with buckets, terminals, rope, etc.
1 Complete 1800' Jig Back Montgomery Tramway.

EDITORIAL

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MINING companies in Arizona have complained in the past about the heavy taxation levied, and the new mine tax bill passed by the state senate last week will not lessen their complaints.

SUBJECTS bearing on finance and trade of this country were discussed by an influential gathering, including the President and the Secretary of State, at the third annual meeting of the Chamber of Commerce of the United States, in Washington, D. C., on February 3, 4, and 5.

ORES AND METALS produced in Japan are to be displayed in a considerable area of the Palace of Mines and Metallurgy at the Panama-Pacific Exposition. The booths are Oriental in style, being erected by native workers. A large relief map, in colored clay, of the mining regions is to be a prominent feature of the exhibit.

TRADE of the United States during the calendar years 1914 and 1913 was as follows: Exports, $2,114,257,539 and $2,484,018,292; and imports, $1,789,022,426 and $1,792,596,480, respectively. Considering the domestic depression, the continued farce in Mexico, and the war in Europe, the showing should be considered satisfactory.

AMONG the 2686 bills to be discussed by the State Legislature at Sacramento is one dealing with the gold-dredging industry. The measure is essentially similar to that introduced by Senator Kehoe in the session two years ago, and which was the subject of articles in the *Press* at the time. It is proposed to make the dredging companies leave the land in a suitable condition for farming; and also to place the industry under control of the Railroad Commission, which would have the power to grant permits for gold recovery by this means. These continual attacks on dredging, and smelters also, are very annoying to the respective operators, and in most instances unjustified. When the Legislature convenes again in March, we will discuss this matter further.

MINERS' PHTHISIS has been the subject of considerable controversy in Western Australia for many years; and, although attempts have been repeatedly made to make some provision for incapacitated miners, no good result has yet been attained. As a further effort, the state government convened a conference of employers and employees, and it is now hoped that the workers will be wise enough to accept the scheme proposed, which is an honest attempt to provide for sufferers of lung diseases, without crippling the industry by imposing too heavy a burden on the mine owners. In brief, the Mine Workers' Relief Fund will be raised by each employee paying 24 cents per monthly pay, the mine operators and government contributing a similar amount each. It is estimated that the annual total subscribed would be $120,000, from which the sufferers will receive adequate help.

SAFETY-FIRST publications increase in number, and the latest to reach us is *The Ingot*, issued by the General Safety Committee of the Raritan Copper Works, Perth Amboy, New Jersey. There were 599 men employed in the plant in December, and during the month there was a decrease of 46.57 per cent in the accidents compared with the same month of 1913. Previous months showed much greater decreases, and the committee should feel pleased at the results of its efforts. While on the subject of 'safety,' it may be mentioned that probably the highest award bestowed on any workman in the United States was accorded to Mr. Henry Vinton Neal, a mechanic in the shops of the Boston Elevated Railway Company, on January 29, at the dinner of the American Electric Railway Association, when the president of the American Museum of Safety, Mr. Arthur Williams, named the winner of the Anthony N. Brady memorial medal for safety work. In announcing the award to the recipient, Mr. Williams referred to it as "the highest American order of industrial merit."

THE German demand for Florida phosphates has reawakened, but it is difficult to secure cargo space in the present state of shipping. If more ships become available for carrying cotton to Germany, the two can profitably go forward together. Germany has no phosphate supplies of her own, but imports about a million tons each year from the United States, Belgium, Algeria, and Tunis. The last three are now unavailable sources of supplies, and the whole demand turns toward us. But Germany is not dependent on the natural phosphates for a supply of that necessary element in agriculture, as her Thomas blast-furnaces produce over 2,000,000 tons yearly of high-phosphorous slag, which is used as fertilizer. The iron industry in Germany is now on a 50 per cent basis, chiefly for lack of men, so that the supply

from this source will be correspondingly reduced, while the urgent necessity of keeping up the food supply of Germany is likely to cause the demand for phosphate fertilizer to increase rather than decrease.

BARIUM AND STRONTIUM

Low priced materials, which depend almost entirely on transportation costs, have naturally been most affected by the trade dislocations brought about by the war. In the eastern markets barite imported from Germany has set the basis of competition, as it is of excellent quality and can be laid down in New York at a low price. Barite deposits occur in North Carolina, Tennessee, Georgia, and Virginia, and the companies operating in these districts have heretofore found it difficult to meet the German competition; now that German supply is cut off they are in a correspondingly favorable condition. A large part of our domestic production of barite comes from Missouri, and serves the districts of the Middle West in which the imported article is at a disadvantage on account of the freight rates from the eastern seaboard. Barite is used in the manufacture of paints, preparation of rubber, making of wall paper and other paper, coating oilcloth, enameling and glazing industries, and a variety of other uses. Much of that imported has been prepared ready for use, so that the war has not only stimulated production of the crude mineral, but also its preparation for the market.

Strontium is of little importance; everyone knows that its salts are used to make the red fire of fireworks displays, and also the fuses used on railways. It occurs both as the carbonate and sulphate, the former is more desirable, but it is difficult to procure. There are some strontium sulphate deposits in this country, especially near Gila Bend, Arizona, and in San Bernardino county, California. As our previous supplies of strontium salts have chiefly come from Germany, inquiry has naturally turned toward domestic sources of supply; but nothing of much importance seems to have developed as yet. As the total imports of strontium salts in 1913 were less than $3000 there are apparently no fortunes to be made out of it.

THE MINE MULE

Considering his usefulness, it is remarkable how slight a measure of respect the mule enjoys. It has been said of him that he is "without pride of ancestry or hope of posterity," and possibly this may serve to explain his lowly social estate, so that a Missouri mule, selling in the open market for $200 or more, is the butt of ribald jest and the recipient of blows with a cudgel, while the cayuse, dear at $50, is regarded with respect and even affection. Mr. G. E. Wentworth, writing in *The Country Gentleman*, has taken up the case of the mine mule, and presents statistics as to his capabilities. The origin of the mule is ascribed to the shrewd sense of the peasants of southwestern Europe in the Middle Ages, who found that all their best horses were requisitioned by their overlords for service in their wars, and conceived the idea of breeding an animal larger and strong enough for agricultural purposes, but which would not be regarded as sufficiently dignified for service in the cavalry. The astute peasants doubtless, therefore, combined to cast obloquy on the mule, the better to retain his possession, and to this may be ascribed the low repute he enjoys. At any rate, in China, where mules have been bred for many centuries, but feudal conditions have never prevailed, the mule is not regarded with such disesteem.

Many, if not most of the popular beliefs regarding the mule, have no basis in fact, according to investigations made by Mr. Wentworth. The mule does not live and thrive on less food than a horse. Animals of equal weight require equal amounts of food to keep them in condition. With hay at $15.20 per ton and corn at $1.03 and oats at $1.25 per hundredweight, a 1258-pound mule costs 26.68 cents per day to keep on a feed of hay and oats, or 1274-pound mule 23.23 cents on a feed of hay and corn. A 1447-pound horse costs 31.45 cents per day to keep on hay and oats, or a 1535-pound horse 27.21 cents per day on hay and corn. For purposes of comparison, these should be computed to the basis of 1000 pounds weight of animal, on which basis the mule costs 21.2 cents per day and the horse 21.73 cents per day for a feed of hay and oats; or 18.23 cents and 17.71 cents, respectively, on hay and corn. Records of the Missouri Agricultural Experiment Station also support the inference that for animals of equal weight there is no perceptible difference in cost of keep. It is also said that mules live to a great age and can work day and night without being worn out. The rate at which mules are bought in the cotton-growing states of the South indicates that the average working life of the mule is about 5 years. It has been computed that the average working life of a mule underground is 4 years, but this computation was made some time ago, and the better care which mules now receive underground has doubtless lengthened their life. Mr. Wentworth is evidently not an admirer of the mule, for he says: "The average mule is an animal of bad conformation, though of fair size considering its parentage. It is comparatively narrow-chested, of light barrel, high in the leg, and deficient in courage. It is an animal slow of foot, slow of wit, nervous, timid, and distrustful. It is useful in mines where there is very little head room for a draft animal, but in high beds is greatly inferior to the horse." To this the reply might be made that the mule is amply provided with caution and displays no little good judgment in avoiding injury to itself. If it is indeed greatly inferior to the horse underground, then the many companies which have for many years employed mules rather than horses for underground haulage have been following a mistaken policy. We consider the mine mule worthy of his hire, and we offer the privilege of our columns to his defenders.

MOLYBDENUM

One of our subscribers writes to inquire whether there is much demand for molybdenum ores, what the visible supply is, whether the market is constant, and what difficulties are encountered in mining and milling the ores. As this metal is one of those which have been affected by the derangement of trade channels by the war, it will be of some interest to discuss present conditions in some detail.

The principal ore of molybdenum is the sulphide MoS_2, a mineral that so closely resembles graphite that the two are with difficulty distinguished. It occurs in veins in crystalline rocks in many parts of the United States. The Crown Point mine, in Chelan county, Washington, and the Holman mine, at Catherine Hill, Maine, are the best known of the many unsuccessful attempts to develop profitable mines; other deposits occur in Arizona, Utah, Nevada, Oregon, California, Colorado, and Idaho. The difficulty lies in the concentration of the ore, and no one with even a limited knowledge of milling operations will need an explanation why a graphite-like mineral is difficult to concentrate. It has been proposed to apply oil flotation, making use of the tendency of the molybdenite to float, and an excellent recovery can be made in this way, but another difficulty arises. The concentrate must be free from copper, arsenic, bismuth, and tungsten, all of which are highly objectionable impurities. If any of these are present they float along with the molybdenite. Copper is especially likely to be present, and an ingenious way of getting rid of it has been suggested by Mr. James Aston, who proposes to grind the ore in the usual way and then dry it before subjecting it to flotation. During drying, the copper sulphides oxidize on their surface and thereafter will not float, but the molybdenite is unaffected. This promising suggestion has not yet been put into practice, so far as we know. The various attempts to mine molybdenite in this country have all, so far, been unsuccessful, and there was no domestic production in 1913, according to Mr. F. L. Hess. Another molybdate mineral is wulfenite, a molybdate of lead. This is found in many places in New Mexico and Arizona, in the lead regions of Missouri and Wisconsin, at Phoenixville, Pennsylvania, and in Inyo county, California. Unfortunately the impurities which are present in wulfenite ores are highly objectionable in the production of molybdenum and its salts, and it is difficult to dispose of them. Molybdenum also occurs in nature as an oxide, but this is not important, as the sulphide is extremely resistant to oxidation.

Molybdenum is used to a small extent as metal, but chiefly in the form of ferromolybdenum, in the making of alloy steels; in the form of ammonium molybdate as a chemical reagent, chiefly for the determination of phosphorus in ores, iron, and steel by the molybdate method; and in the form of molybdic acid for coloring porcelain, dyeing silk and wool, and in coloring leather and rubber. The total consumption is not great, the equivalent of 7.8 tons of molybdenum, valued at $15,940, having been imported into this country in 1913, and even that small quantity was nearly three times the imports in 1912, or 3.9 tons, valued at $4670.

The making of ferromolybdenum in the electric furnace has been thoroughly studied by Mr. R. M. Keeney, of the Bureau of Mines, who finds that a satisfactory product can be made direct from the ore in a single melting, using lime as a desulphurizing agent. As already said, ores for this purpose must be free from copper, arsenic, bismuth, and tungsten, and must contain over 85 per cent MoS_2 to be acceptable in the market. Most of the concentrate sold contains 90 to 95 per cent. The chief use of the ferromolybdenum is for adding to alloy steels to make them self-hardening, the resulting steel (containing 8 to 10 per cent molybdenum) being used for the making of high-speed cutting tools. It is generally claimed that one pound of molybdenum is as effective as about two pounds of tungsten for this purpose, but there is some difference of opinion as to this. Last year there was a considerable increase in the consumption of ferromolybdenum, but no adequate explanation of the reason for this has yet been advanced. As the total consumption is small it does not require a large increase in amount to create a large percentage of increase.

As to the market for molybdenite, at present it is always good, and there is a steady demand, since, although the consumption is small, the production is even smaller. Most of the world's supply of ore comes from Australia, especially Queensland. The output of this state in 1913 was 66 tons, but the production increased greatly in 1914 until the war started, the second quarter yielding 28.5 tons valued at $58,000, and the third quarter only 1.75 tons worth $4000. The deposits of this mineral, with wolfram and bismuth, at Bamford, North Queensland, are described in a report of the assistant government geologist, Mr. Lionel C. Ball. Treatment of the ore is also discussed. The war resulted in the principal markets being shut off, but the government is aiding the miners by certain advances on production. Trial lots of ore from various places in the United States and Canada have been milled at various times of recent years, without leading to a steady output. The Noble Electric Steel Company of California has begun the production of ferromanganese in its electric furnace, and if a steady supply of ore of good quality were available, could probably undertake the making of ferromolybdenum as well. Whether the market could be sustained at its present price level in the face of any marked increase in production is more doubtful. Anyone planning to develop a deposit of notable size would need to consider the possibility of having to carry on operations in the face of considerably lower prices for molybdenite than now prevail.

One of the reasons for the keen demand for molybdenum during 1914 was the discovery in France of a process for the preservation of cordite in hot climates, where this explosive deteriorates rapidly.

LOOKING FORWARD

One of the principal points in the preliminary reply of Great Britain to the protest of the U. S. government at undue interference with our foreign trade, is that shipments of copper from this country to the neutral countries of Europe have shown a great increase since the outbreak of war, and that this is clear evidence that this copper is really intended to be surreptitiously forwarded to Germany. When the matter is carefully considered with a clear understanding of all the facts involved, it appears in quite another light. In the first place, there has been no enormous increase of exports of copper to the neutral countries near Germany. The exports of copper from this country to Holland from January to the end of November 1914 were 40,000,000 lb. less than for the same period of the preceding year. While England took from the United States nearly 75,000,000 lb. more copper in 1914 than in 1913, all the other European countries bought less than they had in 1913, with the exception of Italy and Scandinavia. These countries attempted to buy somewhat increased amounts from us, but much of this was held up in transit so that Italy received almost exactly the same amount as in 1913. The Scandinavian countries received about 16,500,000 lb. more than in 1913, but the United States sold to the whole of Europe, after deducting the excess of sales to England, over 150,000,000 lb. less copper in the eleven months of 1914 than in the corresponding period of 1913. England, the Scandinavian countries, and Italy were the only European countries which increased their purchases in 1914: England bought almost 75,000,000 lb. more copper than usual. Scandinavia and Italy together actually received only 17,000,000 lb. more than in 1913, though they tried to purchase some 30,000,000 lb. more, which was detained on the high seas. These countries increased their purchases by less than 35%; England increased hers by almost 75%. If England could take care of this increased amount without forwarding it to Germany, why should it be assumed that the increase in the purchases of the other countries was necessarily intended for Germany?

The next question is why should any European country increase its purchases of copper from us at this time, and this is not hard to answer. Germany is a great manufacturing country and a large part of the finished products which it makes and exports to other countries are made from imported copper. Nearly 70% of all copper used is employed in connection with the electrical industry, and Germany's exports of electrical equipment in 1912 amounted to about 250,000,000 marks. Of copper wire alone it exported 6,608,800 lb. to England, 3,574,000 to Switzerland, 3,509,100 to Spain, 2,939,200 to Denmark, 2,600,400 to Holland, 1,632,400 to Italy, 1,526,800 to Norway, 1,491,600 to France, 1,188,000 to Belgium, and 1,107,800 lb. to Brazil. Miscellaneous manufactures, in which Germany excels, use up large quantities of copper also. The automobile business is also a large consumer of copper; the Ford Automobile Co. alone uses 15,000,000 lb. of copper in a year. Germany does a large export business in automobiles, her exports in 1912 being valued at 65,000,000 marks. In short, while Germany buys large quantities of raw copper each year, this is used to manufacture products which are sold to other countries. Now this export business is totally cut off. Two things are the result. Germany needs only a part of the copper it formerly took, and the countries which formerly bought their manufactures of copper in Germany must now purchase them elsewhere or make them themselves. English manufacturers hope to get this trade which Germany has lost, but the manufacturers in other European countries would like to have a finger in the pie also. Nothing is more natural than that the few European countries which are not engaged in the war and have much hope of keeping out of it should endeavor to utilize the present opportunity to build up their home industries.

Another factor is also involved. Norway produces some 25,000,000 lb. of copper each year, Sweden 3,500,000 lb., and Italy over 5,000,000 lb. The price of copper in Germany has gone up to 30c. per pound, as compared to less than 14c. here. There is no rule of war to prevent the mines in these countries from selling their copper to Germany, nor can the Allies prevent them from doing so, since they neither control the North Sea nor communication between Italy, Austria, and Germany. It is the most natural thing in the world that producers there should take advantage of this opportunity to realize an increased price for their copper. As a result, manufacturers in those countries have to buy a correspondingly increased amount abroad. Another point which must not be overlooked is the present activity in the manufacture of ammunition and implements of warfare all over the world. Many small countries which formerly bought these in limited amounts from the great Krupp, Creusot, and the English works, now are trying, with feverish activity, to prepare themselves in case they are involved in the war, and cannot get any arms from these works, which are fully occupied with the orders from their own countries. In Italy especially, small works which are not known to the general public, but which do a large aggregate business, are working at top speed to execute the war orders of the Italian government and other countries. A good deal of copper is consumed in the manufacture of munitions of war, and this is another reason why some European countries should increase their purchases at this time. It would not have been surprising if the American sales to these countries had increased more than they have, and the depression of general business resulting from the war is doubtless the cause of poor demand for copper abroad, as it is here.

Including its own production, Germany can obtain about 95,000,000 lb. from adjoining countries, and is resourceful enough to secure other sufficient supplies.

Lake Superior Copper Mining: Present and Future—II

By THOMAS T. READ

The fairly uniform character of the deposits of this district naturally determines the methods of mining employed and insures that there will be no great diversity among different mines. This is subject to two qualifications, for the dip of the deposits about Painesdale is so much steeper than those near Calumet that differences in the methods employed are inevitable. Furthermore, methods at the Calumet & Hecla, for example, have been modified from time to time both as a result of the changing conditions met with increased depth, and because of the advance in the knowledge of the art. Thus the Calumet & Hecla conglomerate was first mined by the pillar and stall system. Later when the square-set system was devised by Philip Diedesheimer to meet the conditions at the Comstock, it was soon after adopted by the Calumet & Hecla, and for many years was a characteristic of the operations of that mine, though it was never used by the other mines of the district, none of which possessed ore rich enough to bear the expense of so much timber. Even on the rich Calumet & Hecla this cost was a burden and the sets, at first made of the best pine, were made of cheaper and cheaper material as the price of lumber rose yearly. Finally the use of the square-set was abandoned, the general practice now being to combine stulls in the stopes with pillars near the shafts in order to keep the working places open, allowing them to cave as soon as is practicable, except where necessary to maintain haulage roads and other main passageways.

General Mining Practice

The general scheme of mining, namely of sinking inclined shafts in the vein, turning off levels at 100-ft. intervals and beginning stoping as soon as a safe distance from the shaft has been reached, has obvious disadvantages and is apt to appear irrational to operators familiar with mining practice elsewhere who visit the district for the first time. So indeed it is, but the explanation of it is found in the conditions discussed in the preceding chapter, where it was pointed out that, owing to the character of the ore deposits, practically the only way to determine whether a prospect will make a mine and the only way to develop such deposits, is by sinking, driving, and stoping in the orebody itself. The case of the Arcadian, where the owners found that they did not possess a profitable mine only after huge sums had been spent, has already been cited, and there are numerous other instances that are less frequently mentioned. The result is that, having done this exploration work as cheaply as possible in order to lessen the total invested capital in case the venture prove a failure, the general features of the mining methods to be used are by it unavoidably fixed and the large amount of work already done must be utilized, even though it is easy to see in the end that it would have been better to have done it differently.

This situation is much like that of the manufacturer who starts in business in a small way and, finding the business profitable, gradually adds to his equipment, building ells and additions here and a lean-to there, until the final plant is neither well laid out nor convenient for operation; being, as it actually is, a sort of compromise with successive sets of changing conditions. In the case of a manufacturing plant it will frequently pay to scrap such a plant and build anew, since the lessened operating cost will, during the life of the new plant, repay the cost of reconstruction, but in the case of a mine this is seldom the case, for the period to be considered is not the life of the equipment, but the life of the mine as a profitable producer, which can seldom be counted on with certainty. Quite aside from the persistence of the deposits, almost any mine in the district except the Calumet & Hecla may cross the border line of profit in a comparatively short period for reasons which will become evident in the following discussion; and, above all, there is no counting on the price of copper. For a considerable period now the price of the metal has hovered near 12c. per pound. Most producers believe that it will, within a comparatively short period, advance to about 14c., a figure which there are many reasons for regarding as about the present normal price. Though im-

CALUMET & HECLA RED JACKET SHAFT.

TAMARACK No. 3 SHAFT.

probable, there is no impossibility involved in supposing that it may continue to decline to about 10c. per pound and remain near that figure, one at which the only dividends most of the mines of the district, and many of those of the whole country as well, could pay, would be those of the Irish variety. It is just this uncertainty which prevents the financial management of a mine being directed along as advantageous a line as that of an industrial venture, and it is my purpose to point out in this series of articles that through the concentration of the mining companies in the hands of a few strong organizations and the carrying on of operations on a large scale, it has been found possible to make mining in this district approach more closely to the security of an industrial undertaking and has assured a greatly increased productive life to the district.

Factors Increasing Mining Costs at Depth

As an example of the increase of operating cost due to working in depth along the lines laid out in earlier years the conglomerate lode of the Calumet & Hecla may be cited, where 300 men are kept continuously at work on the shaft, cutting out crushed timber, brushing down the sides and back of the shaft, putting in new timber, and repairing tracks, pump columns, and bell lines; work made necessary by the fact that the hanging and foot-walls are continually moving. These statements, as well as most of those elsewhere made regarding the Calumet & Hecla, are taken from the sworn testimony of the manager, James MacNaughton, before the Congressional Investigating Committee last March. As the total number of men employed underground in both the conglomerate and amygdaloid lodes is about 2400, assuming that two-thirds of these are employed in the conglomerate, leads to the deduction that 15% of the labor cost of mining in the conglomerate is due to the necessity for maintaining shafts in bad ground.

The details of the mining methods used in several typical mines have been given by T. A. Rickard in his interesting book, 'The Copper Mines of Lake Superior,' familiarity with which I have assumed on the part of my readers. I will not attempt here, therefore, to deal with mining in any comprehensive way, but merely refer to such features as serve to illustrate the points which seem to be of most significance as regards the future mining operations. The typical Lake Superior copper mine is operated through several inclined shafts placed from 700 to 2500 ft. apart, and generally lying either on the foot-wall of the lode or within the foot-wall near the lode, the latter being the more recent practice. There are only about a half dozen vertical shafts in the district, nearly all belonging to the Tamarack, which is not now being operated. The flat dip of the ore deposits, 30 to 40° around Calumet, does not lend itself to exploitation through vertical shafts, though the steep dip (70°) in the Copper Range properties would have led to the use of vertical shafts anywhere except in a district where inclined shafts are wellnigh universal practice. Drifts are turned off from these shafts at intervals of 100 to 125 ft., though the Quincy mine is now spacing drifts 200 ft. or more apart. It was formerly the universal custom to leave a sufficient pillar to protect the shaft and then at once begin stoping. Now, whenever practicable, drifts are driven through to the boundaries of the block to be stoped and stoping operations then retreat toward the shaft, the advantages being obvious. The more rational practice is not yet general partly because, as before mentioned, an inherited system cannot easily be changed, but chiefly because it is not the custom in the district to keep development work sufficiently far ahead of stoping to allow waiting until the development of a block of ground is complete before beginning to draw ore from it. This is discussed a little farther on.

Tramming Underground

The shafts are commonly in the lode, near the foot-wall, for most of the ore mined is taken from the amygdaloid flows in which the workable ore is commonly near the hanging wall. This usually results in keeping the shaft close to the ore and yet in fairly solid ground. The foot-wall side of the ore has no fixed position, the mine captain taking as much at any given place as his trained eye tells him will prove profitable to mill. As a result these drifts are commonly exceedingly tortuous, and one sees that tramming is practically everywhere done by hand. Two exceptions to this should be noted; the Quincy, which is in many respects the most advanced of all the mines in its practice, uses electric locomotives, and at the Superior, which the Calumet & Hecla management is now developing on a much larger scale than before, mules are used to haul back the empty cars to the faces, the full cars running to the shaft by gravity. According to the testimony of James MacNaughton the average length of haul and tons handled per day per trammer is as follows for the different mines of the district:

Hand Tramming, January 1 to June 30, 1913.

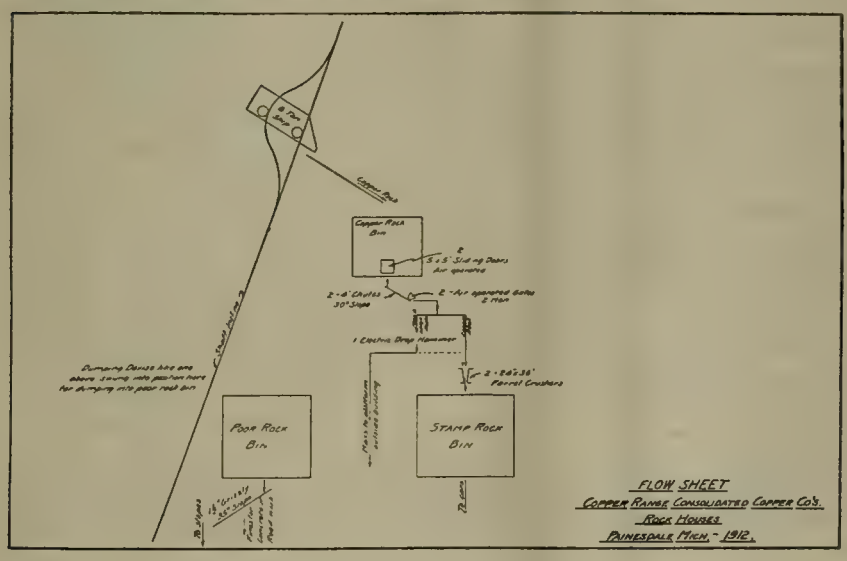
	Av. length of tram.	Tons per day per man.	Max. length of tram, ft.
Ahmeek	563	16.07	....
Allouez	753	8.86	....
Calumet & Hecla:			
Conglomerate	171	14.53	....
Osceola lode	582	19.48	....
Centennial	900	13.98	....
Isle Royale	750	14.54	....
North Kearsarge	702	13.36	1600
South Kearsarge	444	14.73	900
Osceola	850	12.71	2030
Superior	480	18.27	....
Tamarack	508	12.12	....
Average	609	14.42	....

In the above figures those given for the conglomerate lode of the Calumet & Hecla represent the average for 386 men, one-fourth of whom were working under contract and the rest on Company time. The figures for the Osceola lode are the average for 190 men, all on contract. The average daily wage of the trammers in all mines of the district during this period was $2.63 per day. It will be seen from the table that the average labor cost of tramming of 1 ton 609 ft. is 18.23c. The obvious line o[f]

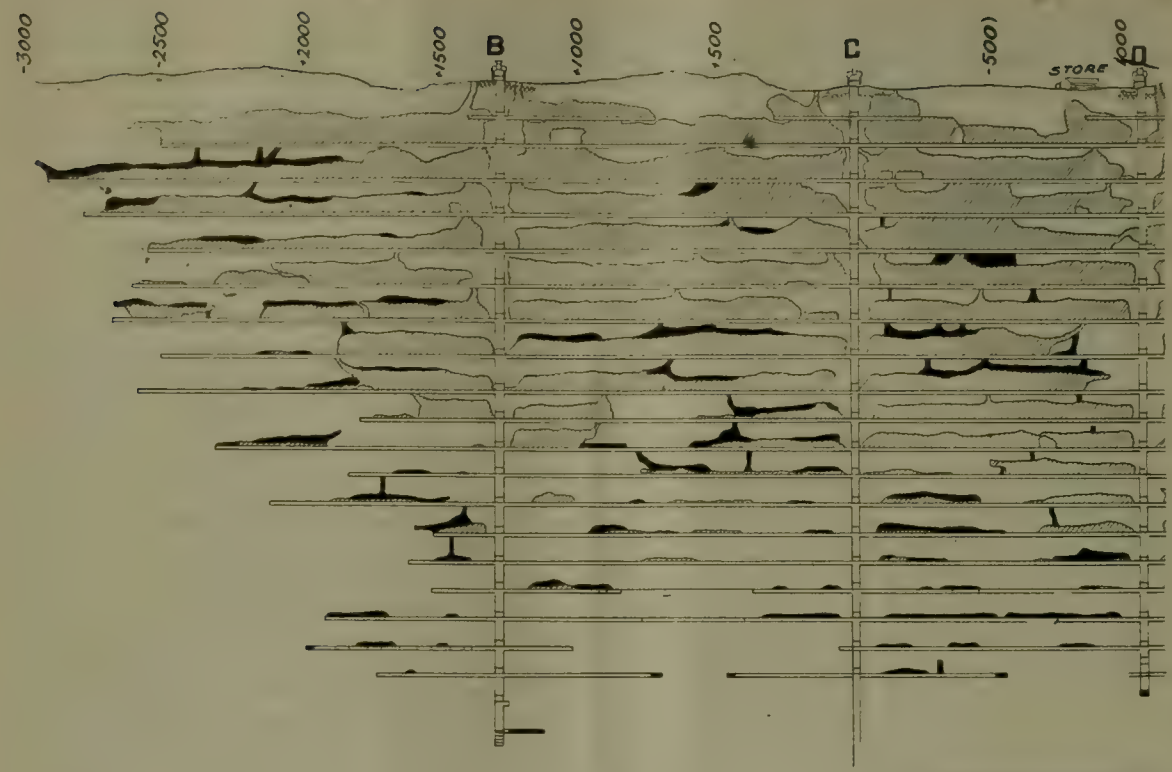
development for mining practice to take is to seek some readjustment so that hand tramming can be replaced by mechanical haulage as completely as possible. Mining costs must be steadily reduced, and as the day's pay per man is likely to advance and certain not to decrease, tramming represents an item in the mining cost which cannot be decreased except by increasing the tons hauled per day per man, and this cannot easily be done except by such changes in conditions as might better be directed toward eliminating hand tramming. Wherever employed, hand tramming is a prolific source of accidents—the men get their feet beneath the wheels, their hands in the doors, and their bodies between the cars or between a car and a post. Accidents are almost unavoidable when men have to work around a heavy moving object in semi-darkness, and the best remedy is to take the men away and handle the work mechanically. Another drawback to hand tramming is the fact that it adds to the working force of the mine a considerable number of employees of the least desirable type. The work is hard, unpleasant, and comparatively uninteresting, and, except in the case of beginners who expect to advance to higher positions, it only appeals to men who are too unskillful and ignorant successfully to perform more agreeable work. Such men are the natural prey of labor agitators and those who foment industrial unrest, and to this their arduous work is a contributory cause. Hard work tends to make men dissatisfied, and a tired man does not think clearly, as is reflected in the common expression 'too tired to think.' For all these reasons mechanical haulage will doubtless be substituted for hand tramming wherever possible as soon as practicable.

Large Amount of Ground Kept Open

Another characteristic of the mining methods employed in this district is the large amount of ground which is kept open. In the Calumet & Hecla there are over 70 miles of drifts and workings, and James MacNaughton has estimated that in normal times work is under way in over 80% of these openings. The reasons for this have already been made clear. The ore shades off gradually from a copper content high enough to yield a working profit, and as lowered working costs and higher recovery reduce the minimum profitable content, material left behind in the old workings is constantly being transformed into profitable ore, and drifts are therefore kept open as long as possible, to allow access to such material, instead of allowing them to cave as soon as stoping is completed. In addition the system of beginning stoping next the shaft and working outward makes it necessary to keep the drift open till stoping is completed at its farther end, and this may be a very long time if the farther stopes are low grade. Both these features are illustrated in the accompanying plan of the workings of a typical mine. The shaded areas are the old stopes and the cross-hatched areas are those worked in 1913. It will at once be noticed that work was going on throughout nearly the whole mine area. It is perfectly possible to take the view that there is no real profit on the ore recovered from old workings, the apparent operating profit having been already eaten up by the cost of keeping these workings open. This gives ample opportunity for argument, for I do not know of any data which would definitely prove or disprove this view. It is, however, evident that the profits on ore thus recovered are at least decreased. It must not be overlooked, though, that this method of working has a speculative side which also tends to justify it. There must have been many periods in the past quarter century when there was good ground for believing that copper might advance to a much higher figure than the one then prevailing, and in that case the low-grade ore in the old stopes would not only yield a good profit, but would enable a rapid increase in the tonnage mined to be made without waiting for development work. Thus between 1904 and 1907, Lake copper advanced from 13 to 21c. per pound and then declined to 15c. in 1908. A mine which could increase its output without waiting for development work would reap the benefit of the increasing price, while a mine which pushed development work on the strength of rising prices would be likely to be caught on the drop with blocked-out stopes that could no longer be worked at a profit. It is quite probable that this factor has been of importance in causing the retention of the system of stoping outward from the shafts. The thoughtful reader will already have been struck with the idea that the present large scale mining which has grown out of the early day small scale mining has all along been hampered by the persistence of the small scale ideas and meth-



FLOW SHEET
COPPER RANGE CONSOLIDATED COPPER CO'S.
ROCK HOUSES.
PINESDALE MICH. - 1912.



LONGITUDINAL SECTION OF

ods of the early miners. This is both natural and to a considerable degree inevitable; the managements of the various companies are working away from its influence as rapidly as possible.

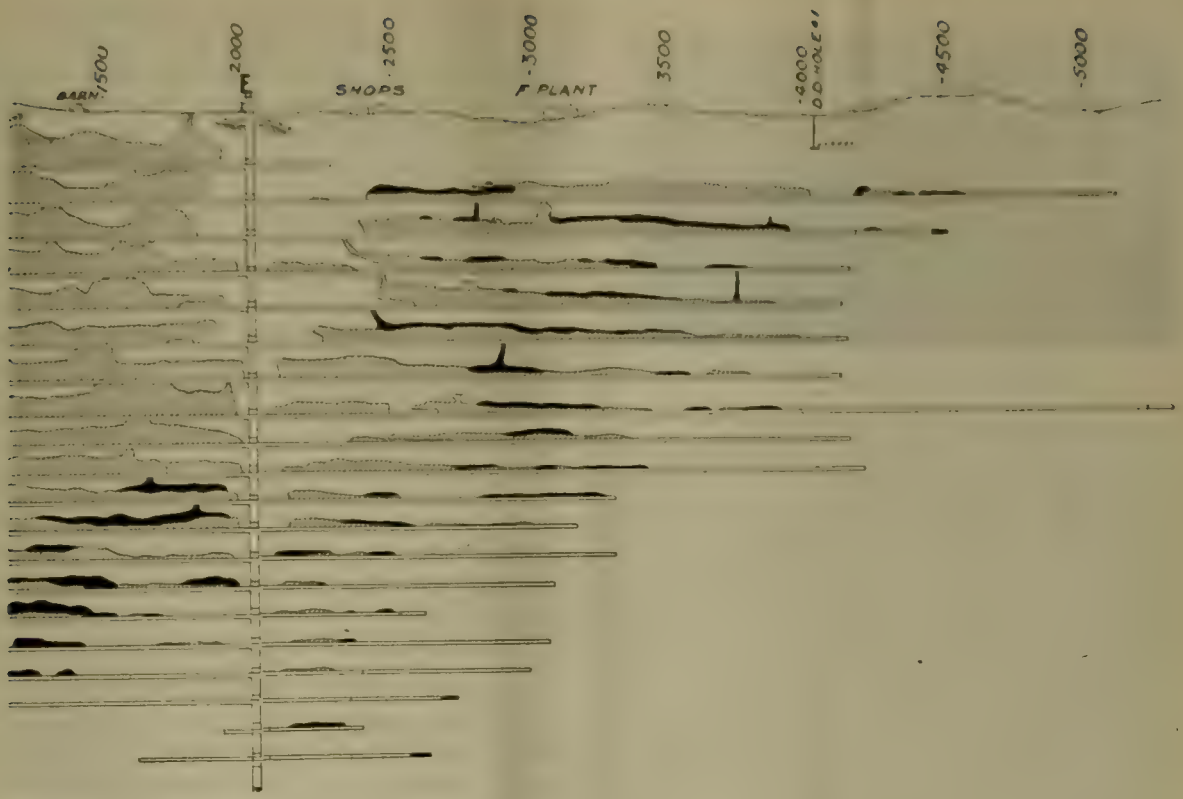
One-Man Drills

Drilling and breaking the ore in these mines has been the source of much interest, since the cost of doing this work has been so successfully reduced in the past few years, while the means adopted to secure this desirable end figured largely in the causes alleged for calling the strike in 1913. Until recently it was the custom in the mines of the district to use an ordinary Rand drill, weighing about 300 lb., and drilling a comparatively large hole, in stoping operations. As the post, base, and other accessories weigh about 300 lb. more, it was necessary for the two men constituting a drill crew to haul a weight of 600 lb. up to the face of the stopes (inclined 35° or more), and a large part of the energy expended and time worked by these men was devoted to the useless handling of heavy weights.

Charles L. Lawton, manager of the Quincy mine (who was largely responsible for the introduction of light drills for stoping in the Cripple Creek district) has always maintained that the use of large deep holes in breaking ground is unprofitable, since less mechanical work is required to cut a small hole, while the use of strong dynamite permits a small hole to be charged with the same explosive force per foot of hole as a larger hole with weaker dynamite. If a hole is started small it cannot be drilled deep, as the finished hole will then be too small, but as it is not customary to use very deep holes underground, for a variety of reasons, this does not materially affect the use of the smaller drill. By using a small drill it is possible to strike a greater number of blows per second, and the force of the blow is nearly as great as with a heavier weight of striking parts. It is evident that this is a more economical way to use the compressed air, since a large number of light sharp blows are obviously more effective in chipping away the rock than fewer heavy blows, which tend to spend their force largely in 'stunning' the rock. Mr. Lawton secured the co-operation of the Ingersoll-Rand Co., with the result that there was developed and put into use in this district the type of light or 'one-man' drill now so widely known. This type of drill weighs less than one-half as much as the old style reciprocating piston drill and can therefore be handled by one man, though it is standard practice to work drills in pairs and the men aid each other in setting up the drills. The light drill cuts more rapidly, less time is lost in setting it up and moving it, and only one man is employed per drill instead of two.

Wages Earned: One-Man v. Two-Man Machines

The economy thus effected has many ramifications As the drill does not reciprocate in the hole, its edges do not wear down so fast and a single drill will serve to drill a greater depth of hole before needing to be re-



CHAMPION MINE WORKINGS.

placed. It is therefore not necessary to sharpen so many drills, which makes less labor in the blacksmith shop, and less labor is required in taking dull drills out of the mine, and carrying sharp ones in. The light drill, for the reasons already mentioned, is capable of drilling considerably faster than the heavy drills, and according to the testimony of James MacNaughton, the average footage drilled during a shift with the big drills is 32 to 38 ft., and with the light drills 40 to 48 ft. In order to predispose the miner toward the use of the better drill the wage scale has been adjusted so that miners using the light drill earn 15 to 18% more than miners using the big drills. The following data are taken from the testimony of James MacNaughton:

CALUMET & HECLA, YEAR ENDED DECEMBER 31, 1912

	No. of shifts.	Labor cost.	Supply cost.	Average wage.
One-man drill	54,758	$ 193,936	$ 94,058	$3.34
Two-man drill	350,012	1,024,802	291,526	2.83

In the Calumet & Hecla subsidiaries, from January 1 to June 30, 1913, the average wage per shift for the one-man drill was $3.54 and for the two-man drill $3.10. The tremendous saving in labor cost of breaking the ore is well indicated by the table above. In round figures it may be said that the use of this drill has reduced the cost of breaking the rock in the stopes to one-third of what it formerly was; say to 15c. per ton as compared to 45c. per ton, in spite of the fact that the companies have made an increase of 15 to 18% in the wage scale of the men operating the light drills. Further reductions in the cost of drilling and breaking ore in the stopes can doubtless be made by intensive study, but they will necessarily be comparatively slight, and a further reduction comparable to that made by the use of the new type of drill can scarcely be hoped for. It is interesting to note in passing that some part of the saving made by the use of these drills is due to the simultaneous introduction of 'efficiency' methods and motion study. Thus it was found that the habit of the miners of throwing down dull steel into a heap with sharpened steel led to a considerable loss of time in changing bits through the miner rummaging through the heap in the endeavor to find the bit next required. By keeping the sharp bits separate from the dull ones and standing them up in order from short to long, it was found possible to considerably increase the footage drilled per shift. A force of young technical graduates provided with stop watches have been employed to study drilling as well as general underground work, in the Calumet & Hecla properties, and as a result of their suggestions many economies have been effected. The importance of this line of work on the general future of the district is so evident as to need no comment.

CAR-LOADING SYSTEMS

Another field for progress in which less advance has yet been made is the elimination of manual labor in the loading of cars with ore. In his book on the mines of

CENTENNIAL No. 1 AND 2 SHAFTS.

this district, familiarity with which by the reader I have assumed. T. A. Rickard has described the methods in use ten years ago, which have not since been materially changed. The irregular topography of the foot-wall in these deposits has already been emphasized, and it is evident that it renders necessary a certain amount of shoveling in the stopes. A great amount of study has been devoted to the possibility of getting the ore broken at the stope faces into the cars, running on tracks in the main level, by purely mechanical means. Little success has yet been attained, but a moment's reflection on the astonishing changes which have been brought about in mining practice during the past 25 years effectually serves to prevent entertaining the belief that this problem cannot be solved. As elsewhere discussed, the proper line of progress for practice in the district seems to lie along the substitution of a small number of men, at higher wages, for large numbers of lower-grade men at less wages, and this department of underground work is one of those in which the opportunities for elimination are greatest.

Filling Worked-Out Stopes

What may be considered as the greatest problem of all is the support of the excavations made in mining. The method followed by the Calumet & Hecla in its conglomerate lode workings was the use of timber, and it has already been indicated how the cost of this method is a burden which the low-grade mines, the type of future practice, cannot hope to assume. In a preceding article I have pointed out that the typical rocks of the district are a series of volcanic flows, essentially homogeneous in character and usually of considerable thickness. The rock layers overlying the ore deposits are therefore relatively strong as compared to the usual overburden in coal mining practice. The overlying rocks above a coal seam often contain strong layers of sandstone or limestone, but these are usually intercallated with layers of shale or other material of comparatively little coherence. When subsidence takes place, a few strong layers are involved, but the maximum of fracturing, and consequent expansion to fill the open space left by removal of the coal, takes place in the less coherent beds, so that the process is a gradual one which exhibits little violence. Even under these conditions the problem is a serious one, and the United States Bureau of Mines is devoting a considerable portion of its energies to its solution. The strength of the overlying rocks in the Lake Superior district is such that large stoped areas can be left with comparatively little support for long periods of time. In the Atlantic mine, in which for many years the mining costs were the lowest of any in the district, advantage was taken of this to permit mining out the full thickness of the lode, up to within 12 or 15 ft. of the level above, using stulls to protect the working level. For twenty years the mine was cheaply and successfully worked, but in 1904 the overlying rocks began to subside with such violence as to produce miniature earthquakes, and the air in the stopes was driven out with the violence of a coal mine explosion, wrecking the shafts, and within two years the mine was lost, although some 6,000,000 tons of ore still remained unmined. A somewhat similar though much less serious state of affairs now exists in the Quincy mine, which has been worked with unusual skill, and it is abundantly evident that the stoping out of large areas, providing only sufficient support to hold up the roof for a comparatively few years, is not a method which can be safely followed.

Caving and Other Methods Possible

One of two methods might be used to overcome this difficulty. The mines might be worked by caving methods, bringing down the roof into contact with the foot-wall as fast as the ore is removed; or the stopes may be filled. Caving methods have been considered, but present much difficulty. As already noted, the usual practice in the district is to work outward to the boundaries of the property, and the reasons for this have been indicated. In working by caving methods it is usually necessary to begin at the boundaries and work back, therefore the general plan of mining operations would require to be altered. The vital difficulty, however, is the strength of the overlying rocks and the fact that the moderate dip of the strata makes it necessary to set in motion greater and greater thickness of strong rock as the workings extend in depth. In ordinary caving work the overburden is, by careful work, brought into what may be called a fluid state, and it then follows down as the workings proceed in depth without causing any trouble. But in caving the overburden on these deposits it will not follow down on the stope with any degree of freedom, as the dip is not steep enough, and an attempt to cave great thicknesses of strong overburden would lead to the same condition of affairs as that described above. In the district around the Painesdale, where the dip of the lode is steep, caving could seemingly be employed, but for the district as a whole it seems impracticable.

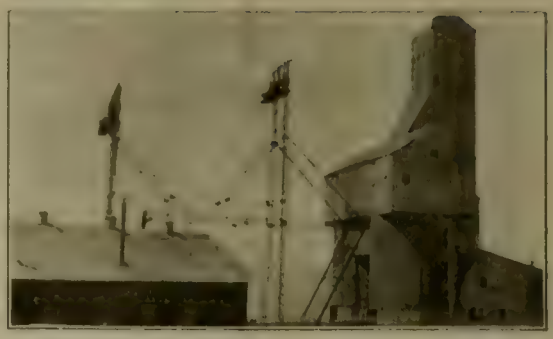
There remains, then, the falling of the stopes. This is also a difficult problem. No dependence can be placed on waste rock sorted out underground, for the amount of waste is in any case too small for this purpose, and the preceding discussion has, I hope, served to indicate my belief that the destiny of this district lies in large scale.

low cost work and the elimination, so far as possible, of human labor. Material must be brought into the stopes for this purpose. This cannot be derived by breaking it elsewhere underground, as the net result of such a method would be similar to 'robbing Peter to pay Paul,' and it is, in addition, expensive. The material must be brought from the surface. This involves three difficulties: the procuring of the material, the conveying of it underground, and its distribution in the stopes. The surface of the ground about these mines is in most cases nearly level, or gently rolling, and to secure material nearby would involve digging a hole which would introduce a problem of its own, especially as the surface is of considerable value for its present purposes. A promising start along the most logical line has been made by F. W. Denton, manager of the Copper Range properties, who has begun to use the sand from stamp-mills for filling. While the mills are at some distance from the mines it is cheaper to haul back the ore cars (which have to return anyway) loaded with sand than to attempt to secure filling nearby. A simple elevator attached to the tailing launder raises the tailing to a bin, from which it can be drawn into the cars at but a small total cost. At the mine a series of winzes near the working shafts have been constructed just beneath the railway track which serves the ore-bins. The car of sand is brought above this hopper, its content discharged, and it then moves on to receive its load of ore.

Sand-Filling Difficulties

Difficulties that will at once suggest themselves to any mining engineer do not fail to appear, but not exactly in the order of importance that might be supposed. There is but little trouble from the moisture in the sand, as the method by which the cars are filled insures that only the coarser material is discharged into the cars, and by the time it has reached the mine the sand has pretty well dried out. There is some chance, of course, that in winter time freezing may take place before the water drains away, and it will be interesting to see the results of experience during the coming winter. In order to transport the sand to the stopes and distribute it therein, the ingenious method of forcing it through pipes with compressed air has been adopted; a 2-in. pipe has been found more satisfactory for this purpose than a larger

BALTIC No. 2 SHAFT.



HANCOCK No. 2 SHAFT.

one. No trouble is experienced from the little moisture remaining in the sand, but it exhibits a tendency to pack in the pipes where its movement is interrupted. This has apparently been overcome by using 'booster' jets of air at intervals throughout the length of the pipe, and by enclosing the sand-hopper at the level in an air-tight box. The use of the sand is here supplementary to filling with waste rock, as described in 'The Copper Mines of Lake Superior.' The management of the Copper Range properties has always been progressive and will doubtless continue the study of the filling problem until a thoroughly satisfactory method is developed.

It has been suggested that the sluicing of loose material into the workings through boreholes, as devised in Pennsylvania many years ago and more recently extensively applied in Germany and South Africa, could be utilized. It scarcely seems practicable, however, as none of the mines have supplies of loose material available for the purpose, and if tailing is brought back from the stamp-mills, as described above, there is no advantage in introducing with it into the mines large quantities of water which would have to be pumped out again, besides making the workings unpleasantly wet. It must not be overlooked that the great depth of these mines greatly complicates the problem of filling them, and the tremendous extent of the workings is also an important factor. I can do no more here than state the problem; someone writing a decade later will doubtless be able to describe the way in which it was solved.

One more factor must be mentioned. The next article in this series will describe how the accumulated tailing from former milling operations has been converted into a considerable asset by the improvements in metallurgical methods devised by C. H. Benedict. Tailing used for mine filling is placed beyond recovery, and except in those cases where its copper content has already been reduced to below the hope of any further profit the copper thus lost is a charge against the cost of filling.

There are many other features of Lake Superior mining practice which are of interest, but it would unduly prolong my discussion to refer to them all in detail. Those mentioned are the ones which seem to me of most significance, and I will therefore conclude with some tables of comparative data (for which I am indebted to

the courtesy of E. N. Skinner*), which will serve to illustrate the points which I have attempted to set forth above.

CALUMET & HECLA, 1905 TO 1910

Production:	1905.	1906.	1907.	1908.	1909.	1910.
Daily output of ore, tons	5445	7475	8325	8025	8670	9175
Yield per ton, conglom., lb.	51.77	46.96	41.90	39.68	35.03	32.25
Yield per ton, amyg., lb.	22.00	19.51	19.00	18.45	17.06	15.85
Costs:						
Mining and milling, cents per lb. copper	6.62	7.64	7.05	7.65	7.33	6.55
Smelting and selling, cents per lb. copper	1.10	1.10	1.10	1.10	1.10	1.10
Construction and expansion	0.45	1.05	9.82	5.04	0.12	0.35
Total costs	8.17	9.79	17.97	13.79	8.55	8.00
Profit:						
Average price copper, cents	14.09	17.24	22.15	17.18	13.59	13.33
Profit per lb. copper, cents	5.92	7.45	4.16	3.39	5.04	5.33
Profit per ton ore	$2.99	$3.64	$1.33	$1.07	$1.52	$1.34

The data given above are not strictly comparable, as the methods of bookkeeping vary greatly, but are of much interest, nevertheless.

OPERATING DATA, CALUMET & HECLA SUBSIDIARY COMPANIES

	Ahmeek.	Allouez.	Isle Royale.	Osceola.	Superior.	Tamarack.
Yield per ton, pounds	24.0	17.29	13.2	15.4	22.87	18.3
Cost per ton stamped:						
Mining, transport, stamping, and taxes	$1.77	$1.69	$2.12	$1.60	$2.358	$2.81
Construction	1.09	0.03	0.13	0.12	0.089	....
Smelting, freight, selling	0.33	0.33	0.203	0.18	0.462	0.23
Total cost	$3.19	$2.05	$2.453*	$1.90	$2.909	$3.04
Output, pounds	9,220,874	4,091,129	4,158,548	11,325,010	2,992,765	4,168,743

*Includes $0.013 for exploration and equipment.

OPERATING DATA, 1913

	Baltic.	Centen'l.	Champion.	Lake.	Mohawk.	Mass.	Quincy.	Tri-mtn.	Victoria.	Wolverine.
Yield per ton, lb. copper	23.21	18.87	28.64	25.91	15.76	15.39	15.11	21.78	9.3	21.49
Cost per ton stamped:										
Mining and develop't	$1.64	$2.18	$1.62	$2.52	$1.01	$1.35	$1.605	$1.63	$1.44	$0.995
Surface	....	....	....	....	0.08	0.30	....	....	....	0.05
Stamp-mill	0.27	....	0.28	....	0.29	0.35	....	0.27	....	0.40
Freight	0.14	....	0.14	....	0.12	0.175	....	0.13	....	....
Office and general	0.35	....	0.47	....	0.13	0.028	....	0.42	....	0.17
Insurance	....	....	....	....	....	0.028	....	....	....	....
Taxes	0.15	....	0.30	0.22	....	0.06	0.099	0.10	....	....
Smelting and selling	0.24	0.26	0.29	0.32	....	0.145	0.189	0.24	0.17	....
General eastern	....	....	....	....	....	0.084	....	....	....	....
Total cost	$2.79	$2.44	$3.10	$3.06	*$1.63	$2.52	†$1.893	$2.79	$1.61	*$1.615
Total output, pounds	7,736,124	1,612,262	12,080,594	1,300,562	5,778,235	2,045,006	12,184,128	4,990,938	1,224,911	8,350,312

*Does not include smelting, freight, etc.

†Includes $0.21 for construction and $0.173 strike expense; total, 1912, $1.83.

The Mekeel Tunnel

By CHARLES S. SHAUNESSY

†The Mekeel tunnel is one of the short-grade tunnels of the Catskill aqueduct, being a part of the work for an additional water supply for the city of New York. It is situated in the highlands on the Hudson.

The dimensions of all grade tunnels of this delivery conduit were the same, being designed to carry over 500,000,000 gal. per day, or doubling the present supply of Greater New York.

The tunnel is 1003 ft. long and 13 ft. 4 in. by 17 ft. in cross-section, and was driven entirely from the north portal. The rock for about one-quarter way was gneiss, disintegrated in places, but not sufficient to require timbering except at the portal, where some shoring was done. The direction of the tunnel was approximately at right angles to the predominating planes, thus favoring a good breakage. The remainder of the rock was gray granite, very fine grained, high in quartz, and interspersed with joint planes and mud seams in various directions. Running through it at intervals were bands from one to four feet wide of pegmatite, an intrusive rock of very coarse grain and exceedingly good drilling. The tunnel was exceptionally dry, and water had to be brought in for the drilling operations, although after driving, small quantities appeared in the roof.

The general method of driving was with a top heading about 10 ft. high, representing the upper half of the tunnel section, the lower half or bench approximating a rectangle. Three Murphy drills, size 3½ by 7½ in., were set up on two 7-ft. columns in the heading, and on the bench two tripods were used of the same size and type. Special efforts were made to keep close to the minimum line and maintain the required clearances in the heading, thus avoiding the most expensive part of the trimming. Drilling in the gneiss gave little trouble, and some good records were made. The highest rate per drill per day was 86 ft. when conditions were good. For the entire tunnel the daily rate per drill was 30 ft. The contract price was $3.27 per yard.

*'Mining Costs of the World,' now in course of publication.

†Abstract from *The Tech. Monthly and Harvard Eng. Jour.*

Organization at the Treadwell Cyanide Plant

Co-operation between officials and men, and among the latter themselves, is highly desirable in any industry, as it tends toward a better feeling and subsequent efficiency. Employees often work mechanically, doing what is required above reproach, yet knowing little or nothing of the results of their operations. This is in some respects not fair to the worker, who gets into a groove and only thinks of finishing his shift. In smelters, stamp-mills, cyanide plants, and large concentrators, no harm results from giving out information to the men, so that they see defects in the machines under their care, or in their own supervision. The accompanying chart, furnished by W. P. Lass, is a new style of organization flow-sheet posted in the Alaska Treadwell cyanide plant at Juneau, showing the relationship of the whole staff, or the order of precedence of each person. The table shows the detailed method of reporting the daily operations of this plant, and is a copy of one placed on the wall and filled in each day by the cyanide plant accountant. Data which may be of interest to the men are available for study. The chart has done much to stimulate the interest and co-operation of the men. There are no secrets held by the Treadwell company, and employees share in the knowledge of what is being done.

The Company manages what is known as the Treadwell Club, which continues to be very popular with the employees, and is considered an important adjunct to the plant. A boarding-house is also maintained, which, although very desirable for the Company, is run at a small loss each year, but this is more than made good by the extra satisfaction given employees. Those who board there are charged $25 per month for meals, and $2 per month is added when they occupy a room in the Company's lodging house. Wages in the surface plants

are as follows: amalgamators, $120; feeders, $100; and vanner men, $95 to $130 per month. Machinists and helpers in machine-shop, $3 to $7; blacksmiths, $5 to $6; tool sharpeners, $4.50; and blacksmith's helpers, $3 per day. In 1913 there were 719 men employed on the property, who averaged $3.51 per day.

Date		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	General Average
Average Report.																																	
Tons of Concentrate put in bin.		91.23	93.34	96.80	93.44	92.85	100.44	96.50	99.45	94.20	90.78	91.36	93.48	89.95	83.15	90.05	93.90	89.50	89.53	93.03	85.57	89.90	86.00	91.29	94.12	93.11	99.25	94.46	92.87	93.43	86.73		92.63
Aver Value per ton Concentr.	$	6.535	7.07	6.86	7.004	5.866	5.283	5.657	7.686	7.535	7.265	7.156	7.30	7.087	5.481	6.025	7.234	6.557	5.638	6.734	5.404	5.438	5.710	5.504	5.677	6.245	5.838	7.660	6.572	6.006	6.174		$ 6.537
" " " "Sand Tailing	$	1.13	1.13	1.24	1.35	1.65	1.45	1.45	1.35	1.24	1.65	1.40	1.45	1.65	1.65	1.50	1.85	1.24	1.36	1.45	1.45	1.03	1.13	1.13	1.13	1.35	1.39	1.45	1.45	1.46	1.78		$ 1.40
" " " "of Solution in-	$	0.03	0.04	0.03	0.03	0.03	0.03	0.02	0.05	0.04	0.04	0.04	0.03	0.04	0.04	0.02	0.01	0.01	0.02	0.03	0.03	0.04	0.02	0.01	0.01	0.01	0.01	0.03	0.01	0.01	0.04		$ 0.03
Total Tailing " " "Sand & Solution	$	1.25	1.29	1.36	1.67	1.77	1.57	1.53	1.55	1.44	1.63	1.65	1.60	1.85	1.85	1.60	1.90	1.34	1.55	1.75	3.85	1.43	1.21	1.17	1.17	1.39	1.43	1.67	1.50	1.89	1.79		$ 1.55
Ratio of moisture to dry Tailing		4-1	4-1	4-1	4-1	4-1	4-1	4-1	4-1	4-1	7-1	5-1	5-1	5-1	5-1	5-1	5-1	10-1	10-1	10-1	10-1	10-1	4-1	4-1	4-1	4-1	4-1	4-1	4-1	4-1	4-1		5-1
Composite Solution Tails	$	0.08	0.13	0.16	0.08	0.14	0.14	0.09	0.24	0.12	0.04	0.06	0.10	0.04	0.04	0.04	0.07	0.08	0.22	0.16	0.18	0.04	0.06	0.10	0.34	0.18	0.14	0.28	0.15	0.04	0.06		$ 0.12
Morning Shift																																	
Precipitate Head Solution per Ton	Gold $	7.44	7.80	6.00	7.52	6.92	6.04	6.88	6.96	7.80	7.28	7.80	7.20	9.12	7.84	6.88	7.24	6.40	5.88	6.36	6.78	5.00	5.20	5.60	5.84	5.88	6.52	7.88	8.16	8.16	6.92		$ 6.84
	Cyanide.	1.96	1.80	1.90	1.92	2.00	1.90	2.00	1.96	1.96	1.98	1.88	1.88	1.98	1.98	1.96	2.04	2.00	1.92	1.98	2.00	2.00	1.88	1.96	1.92	1.94	1.92	1.84	2.00	1.94	1.96		1.90
	Lime.	1.64	1.42	1.84	1.84	1.60	1.74	1.52	1.68	1.50	1.72	1.56	1.48	1.42	1.60	1.50	1.80	1.70	1.86	1.80	1.74	1.70	1.78	1.80	1.82	1.78	1.70	1.62	1.72	1.64	1.82		1.64
Precipitate Tail Solution per Ton	Gold $	0.08	0.20	0.14	0.06	0.16	0.10	0.10	0.15	0.10	0.03	0.05	0.08	0.04	0.05	0.03	0.06	0.07	0.10	0.15	0.14	0.08	0.05	0.10	0.36	0.20	0.15	0.60	0.20	0.04	0.04		$ 0.13
	Cyanide.	2.00	2.00	2.00	2.04	2.04	2.08	2.08	2.02	2.02	2.06	2.04	2.10	2.08	2.20	2.08	2.12	2.10	2.06	2.14	2.08	1.90	1.84	1.96	1.96	2.02	2.00	2.00	2.12	2.14	2.02		2.03
	Lime.	1.52	1.64	1.62	1.78	1.64	1.62	1.86	1.80	1.54	1.78	1.60	1.58	1.48	1.44	1.48	1.60	1.66	1.60	1.64	1.82	1.68	1.03	1.82	1.78	1.86	1.78	1.84	1.68	1.80	1.66		1.64
Sand Tail per Ton	Gold $	1.02	1.04	1.24	1.45	1.86	1.65	1.65	1.24	1.24	1.24	1.45	1.24	1.65	1.65	1.86	1.85	1.84	1.45	1.25	1.45	1.03	1.24	1.13	1.24	1.13	1.24	1.45	1.24	1.65	1.85		$ 1.40
Solution Tail	Gold. $	0.02	0.04	0.03	0.03	0.03	0.03	0.03	0.04	0.05	0.07	0.05	0.04	0.04	0.04	0.01	0.01	0.01	0.01	0.02	0.36	0.03	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.05		$ 0.04
Tube	Number of Hours Tube Mill Running	8	8	8	8	8	8	8	8	7 55/60	8	7 55/60	5 45/60	8	7 55/60	8	8	8	7 55/60	8	8	7 55/60	8	6 55/60	8	7 55/60	8	8	7 55/60	8	8		7 45/60
Pachuca	Tons of Concentrate Received on Pachuca Floor	32	31	33	33	35	33	33	32	31	31	33	33	32	27	33	34	33	32	29	32	37	31	34	34	34	34	36	33	34	31		33
	Tons of Concentrate Discharged from Pachucas	75	33	69	37	70	33	70	70	Nil.	71	65	35	62	65	68	32	32	61	33	34	64	67	61	32	37	37	62	68	35	39		50
Dry Tons of Tailing Filtered.	In Kelly Press.	30	51	66	60	70	49	49	45	12	57	53	54	51	57	43	60	51	56	45	49	36	55	50	47	48	51	40	40	57	51		49
	In Treadwell "																																
Tons of Solution Decanted from Tank	Treatment No 1.	14	50	35	33	22	40	27	20	28	36	29	30	3	28	29	32	33	26	34	24	28	32	27	25	33	22	28	28	28	32		28
	" " 2.	19		18	29	27	17	4	24	23	24	31	30	21	27	27	22	30	33	4	18	29	26	33	11	29	15	37	26	19	31		22
	" " 3.	42	36	44	18	27	31	25	20	25	38	35	38	32	24	33	6	49	8	43	13	19	12	65	16	10	10	13	28	Nil.	44		29
	" Special																																
Tons of Solution	Clarified.	196	264	205	264	160	209	240	288	160	292	294	206	248	172	186	173	204	201	260	180	270	275	294	266	262	258	265	272	225	279		226
	Added to Tanks.	28	28	58	83	55	82	57	57	83	57	86	87	28	55	56	61	118	30	57	86	59	88	87	81	87	142	110	84	83	57		71
Tons of Solution Precipitated.		196	264	205	264	160	209	240	288	160	292	294	206	248	172	186	173	204	201	260	180	270	275	294	266	262	258	265	272	225	279		226

Latent Possibilities Among California Mineral Resources

By E. S. BOALICH

Much has been said and written in recent years regarding conservation and development of the natural resources of the United States. It has long been recognized that the possibilities along many lines, notably as regards minor mineral products, are far in advance of development. This means from a commercial viewpoint that the people of the United States are buying foreign materials and sending money out of the country for products which exist here, but have so far been inadequately exploited. California is probably the leading state in the Union in regard to extent and variety of her mineral resources. All the world knows of California's gold, and more recently of its petroleum. Few, however, realize the actual variety of the mineral deposits to be found here which have potential commercial value.

A combination of circumstances has occurred, the result of which, if taken advantage of, should go far toward strengthening the position of the mineral industry in California, and incidentally that of the entire Pacific coast and tributary western states. The beneficial results of the Panama canal need no enlargement. California now has water transportation to the eastern centres with the attending low freight rates. In addition, however, the European war bids fair to spur on the normal and expected advance in many hitherto dormant lines, either immediately or in the near future, in ways undreamed of only a few weeks ago.

Five items have been selected from among several of those which (1) have been imported to a large extent in the past; (2) have a small, if any production in California or the country at large; (3) occur in California and, subject to ordinary mining conditions, should be commercial possibilities under present circumstances. The consumption of these particular substances in the United States reached a total value of about $7,500,000 during 1913. Of that amount only $200,000 worth was produced in this country.

Seven million dollars worth of antimony, asbestos, chromite (chromic iron ore), magnesite, and magnesium will be needed in domestic industries during the next twelvemonth. These are but examples. The annual imports of potash, nitrates, arsenic, bismuth, mica, mineral paints, pyrite, and abrasives amount to many millions of dollars in value. Of the five items in question, foreign sources have been partly or wholly cut off. Figures for output and imports for 1913, except as noted, are given in the following column.[1]

Mineral.	U. S. production.	Imports.
Antimony	No ores mined.	$1,053,530
*Asbestos	$ 87,959	1,819,871
Chromite	2,854	625,740
Magnesite	77,056	1,812,759
Manganese ore	40,480	2,029,680
Totals	$208,349	$7,341,580

*1912.

To assist in promoting development, the distribution of these minerals in California will be briefly mentioned. Only the more important locations can be listed and, as prospecting for these minerals has not been active, the list is doubtless far from complete.

Antimony.—No commercial production in the United States in 1913; value of imports, $1,053,530; principal use, as an alloy with lead; price (of metal), November 1914, 15½ to 18½c. per pound; occurrence in California: Colusa county, stibnite found with cinnabar in Manzanita mine; Kern county, has been mined in San Emidio cañon, near Havilah; Napa county, at Manhattan mine; Riverside county, found near Corona; San Benito county, at Stayton mine.

Asbestos.—Value of the United States production, 1913, $87,959; value of imports, $1,819,871; uses, many and well known; price, roughly from $20 to $200 per ton; occurrence in California: Amador county, various prospects; Butte county, has been mined to small extent; Calaveras and Nevada counties, various prospects; Placer county, has been mined near Auburn; Plumas county, various prospects; Riverside county, has been mined in San Jacinto mountains and elsewhere; Shasta county, has been mined near Simms station; Siskiyou and Trinity counties, various prospects.

Chromite.—Value of the United States production, 1913, $2854; value of imports, $625,740; uses, in alloys, pigments, dyes, for refractory purposes, in chemistry, etc., price, roughly $8 to $10 per ton; occurrence in California: Alameda county, has been mined southeast of Livermore; Amador county, occurs near Jackson; Calaveras county, has been mined near Valley Springs, Campo Seco, and elsewhere; Del Norte county, occurs in Rattle Snake mountains, at French Hill, and Low Divide mines; El Dorado county, prospects; Fresno county, has been mined near Sentinel; Glenn county, Black Diamond mine near Newville; Lake county, east of Middleton; Los Angeles county, near Lang station; Marin county, west of San Rafael; Mendocino county, in hills west of Russian River valley; Monterey county, prospects; Napa county, east of St. Helena; Nevada county, near Nevada City, Washington, and Coyote Diggings; Placer county, has been mined near Iowa Hill and elsewhere; Plumas county, near Meadow Valley; San Benito, San Luis Obispo, and Santa Barbara counties, various prospects; Santa Clara county, near San Jose; Shasta county, has

[1]For further information, see the publications of the U. S. Geological Survey, especially 'Mineral Resources of the United States' for various years, and *Bull.* 585, 'Useful Minerals of the United States.' Also the publications of the California State Mining Bureau, *Bull.* 38, 'Structural and Industrial Materials of California,' and *Bull.* 68, 'Mineral Production for 1913.'

been mined on Shotgun creek, Sierra county, near Downieville, Siskiyou county, mined at Chromite station and Dunsmuir; Solano county, prospects; Sonoma county, has been mined near Cloverdale; Tehama county, has been mined on Elder creek, Trinity county, near Hayfork on Trinity river; Tulare county, near Portersville and elsewhere, Tuolumne county, southwest of Sonora.

Magnesite.—Value of the United States production, 1913, $77,056; value of imports, $1,812,759; uses, as refractory substance, in paper manufacturing, making CO_2, manufacturing of oxychloride cements, miscellaneous applications—crude, calcined, and refined; price, variable; for crude ore, which is but little marketed, about $8; for calcined product, roughly from $15 to $25 and up; occurrence in California: many deposits of problematical value occur in the Coast Range from Mendocino to Los Angeles counties; a few in foothills of the Sierra Nevadas, usually as veins in serpentine; Fresno county, mined at Kings river, east of Sangor; Kern county, east of Mojave; Napa county, has been mined in Chiles and Pope valleys; Placer county, has been mined at Iowa Hill and elsewhere; Riverside county, mined near Winchester; San Benito county, on Larious creek; Santa Clara county, has been mined near Livermore; Sonoma county, has been mined near Cloverdale; Tulare county, mined at Tule River, east of Portersville; also at Harker's place, northeast of Portersville.

Manganese ore.—Value of the United States production, 1913, $40,480; value of imports, $2,029,680; uses, alloy with iron, etc., many chemical uses, as a dye and coloring material, medicinal; price, roughly from $10 to $50 per ton, depending upon quality of the ore and use for which it is intended; occurrence in California: Alameda county, has been mined on Cedar mountain, east of Livermore; Calaveras county, northeast of San Andreas; Colusa county, St. John mountain; Marin county, west of Sausalito; Placer county, near Colfax; Plumas county, southwest of Meadow Valley; Riverside county, in Maria mountains, northeastern part of county; San Luis Obispo county, west of town of San Luis Obispo, Tuolumne county, two miles north of Sonora, also 'bog manganese,' near Columbia.

A Weir in Burma

That engineering is much the same the world over is well evidenced by the accompanying illustration. This shows a weir built in Burma, near Rangoon, for the purpose of determining stream flow preliminary to the installation of a Pelton-Doble water-wheel. The instrument man is a native engineer, in the employ of a placer mining company composed largely of Indian capitalists. The weir is built of teakwood, cut on the ground. Teak, freshly cut, has a pungent odor, and exudes an acrid sap, both of which are very repellant to ants, mosquitoes, and other insects, which property renders it doubly suitable for reconnaissance structures. Its construction would be a credit to any engineer. The end contractions are carefully made, and the dimensions of the notch are correctly proportioned to the stream bed. As a touch of Eastern mysticism, 'find the rodman.'

A WEIR IN TYPICAL JUNGLE COUNTRY.

German Iron and Steel Industry

According to a cablegram from the American consulate-general at Berlin, dated January 8, figures just made public by the German Union of the Iron and Steel Industry give the November 1914 production of steel at 900,026 metric tons, against 900,201 tons in October. The total output of steel for the first 11 months of that year was 4,023,713 tons. The pig iron production of Germany was 788,956 tons in November, as compared with 792,822 tons in the preceding month; that for the first 11 months of 1914, 13,535,666 tons, contrasted with 17,697,922 tons in the corresponding period of 1913. Trade journals report the Solingen industry in steel goods and cutlery quiet, because of the falling off in exports to the United States.

The Pato and Nechi Placer Properties, Colombia

By W. A. PRICHARD

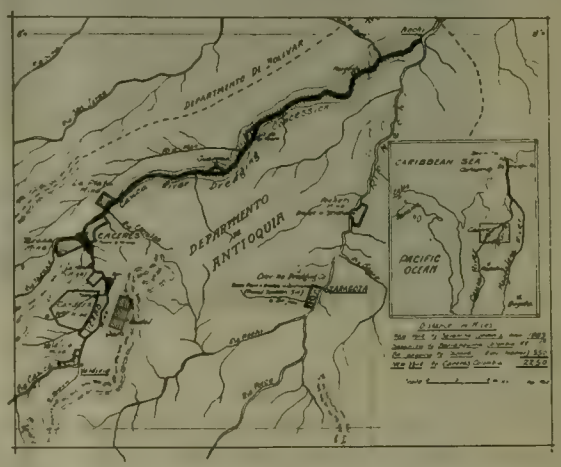
These properties are situated on the Nechi river in the department of Antioquia, Colombia, Central America. As a result of 12 months' examination of the Pato area, during which time 291 Empire hand-drill prospect holes and six shafts were sunk, the prospected areas undredged at October 1, 1914, are estimated at 528¾ acres with an average depth of 26.3 ft., and an average recovery value of 31.6c. per cu. yd. This area is calculated to contain 22,419,490 cu. yd., with a gross value of $7,092,100. The field operating cost of dredging on the basis of one dredge at Pato and one at Nechi, after 12 months from October 1, 1914, and two at Pato after 18 months from that date, is $1,744,462, leaving an estimated net return of $5,347,638. In calculating the present dredging area of Pato, I have used the results of 89 holes drilled under my supervision, 38 drilled under C. H. Munro, six drilled by A. P. Rogers, and one drilled by E. B. Kimball.

The average yield of the gravel handled from the time the dredge reached the prospected area up to the present, has been more than double the estimated average value of the dredging area.

In the drilling of this ground the drill-holes were not sufficiently close together to more than indicate that the gravel was profitable. In this part of the property there was only about one drill-hole to each 10 acres. The richest gravel formed a strip which was 500 ft. wide, and was only penetrated by two or three holes. That the dredge struck the richest ground first was due to the lay of the land, there being no other approach to the prospected area from the river at the time the boat was erected. Higher than average yields are expected to continue until in the spring of 1915, when lower average yields may be expected.

Outside of the prospected areas small extensions can be expected beyond the outlined boundaries. Between the estimated area and the Nechi river there is a fair amount of low ground that will probably prove profitable, as indicated by the results of the dredge which, although not reaching bedrock, returned from 15 to 33c. per yard for a considerable stretch in its hurried progress from the point of its construction to the tested area. There are a few acres of this ground along the river too deep for the Pato dredge, for which the Nechi dredge could be utilized after exhaustion of the Nechi ground. The future dredging prospects of Pato, therefore, outside of the tested areas, while indefinite, are by no means negligible. Aside from these exceptions, no important asset has been discovered.

The gold-bearing gravel benches have at one time covered several square miles of the Pato property, but these are now very much cut up and depleted by ancient workings. Only detached areas of the poorest gravel have been left. California hill, with an area of 13¾ acres, and an average depth of 45½ ft., is the largest and richest of these deposits. Eight drill-holes and two shafts sunk on this area give it a total of 1,008,200 cu. yd. with an average value of 19.7c. per cu. yd., making a gross value of $198,970. To work this deposit, it would be necessary to pump the water from the Nechi river, necessitating a mile of pipe-line, electric-driven pumps, and hydraulicking equipment. I understand that on a hydraulic property being operated higher up the river, it requires 17-cent ground to pay operating expenses, although that property has a water supply under gravity head. It is obvious on this basis that the margin of profit, if any, to be obtained from California hill is small. However, as there appears to be a small hydraulicking deposit on the Nechi property, the Pato



MAP SHOWING SITUATION OF PROPERTIES DESCRIBED.

management may later on have an opportunity to obtain figures from local operations that would justify the equipment of California hill and the working of it as a small side issue. At the present time, California hill is used for the camp, and is occupied by about $25,000 worth of buildings.

The yardage capacity of the Pato dredge varies with the amount of clay in the material handled, and the depth and character of the gravel. During July and August, 1914, the yardage was 128,488 and 139,547, respectively, working under fairly normal conditions. These were the first months of operation with the dredge pond water in a condition of positive control by means of a dam across Pato creek, completed in July 1914. Prior to this time the dredge depended on the elements, resulting in muddy pond water during the rainy periods, and a total stoppage in the dry periods. The muddy water caused enormous wear on pumps, etc.,

*Report to the Oroville Dredging Co., Ltd., of London, December 24, 1914.

with heavy losses of running time and heavy cost for renewals and repairs. The high average operating cost of 17.71c. per yard for the 11 months from October 1, 1913, to August 31, 1914, was due chiefly to this cause. For July and August the cost was 10.25 and 11.52c., respectively, including some extraordinary expenses. A pumping plant is being installed to aid in dredging the higher ground. It appears from recent operations that the average dredge capacity is over 125,000 cu. yd., but to be conservative I have estimated the operating cost on the basis of an average of 100,000 cu. yd. per month.

With one dredge bearing all of the overhead expense of management, power, etc., the field operating costs should never exceed 11c. per yard exclusive of bullion realization. After the Nechi dredge begins operating, bearing its proportion of the overhead expenses, the costs for Pato should not exceed 8c. per yard, exclusive of bullion expense. With two dredges on Pato and one on Nechi the cost for Pato should be about 7½c. per yard inclusive of bullion realization, which amounts to about 0.7c. per yard on a yield of 32c., or 1½c. on a yield of 70c. per yard.

It would require 20 years, more or less, for the present dredge to exhaust the estimated area of dredging ground on the Pato property. It is not likely that the dredge will last that long, even without taking into account the probable additional ground. Aside from this, I believe that a direct saving of 1½c. per yard to Pato and 1c. to Nechi could be made by distributing the fixed expenses over three dredges instead of two. An advantage can be gained by adding a dredge at this particular time, in that the construction could follow on the Nechi dredge. This would make a considerable saving in being able to continue the employment of the skilled mechanics now on the ground, who were taken out at considerable expense, and in the use of the building arrangements, etc., prepared at considerable expense for the erection of the Nechi dredge. I therefore recommend the addition of another dredge to the Pato property as soon as possible. The new dredge should be of the same capacity as the present Pato dredge, with interchangeable parts.

The Pato and Nechi properties lie in an oval basin surrounded by crystalline rocks. This basin has been cut through by the Nechi river, which separates the two properties. Within this basin are flat tables of gravel deposits whose edges form terraces. The bedrock of each of these gravel benches is clay, either red or blue according to exposure, in which are included beds of peat or brown coal. Each of these gravel benches is a reconcentration of the bench above it, and represents a former stationary level of the river. California hill is a remnant of the upper bench. Below this was a lower bench whose bedrock stood above water-level. These two benches have been nearly removed by erosion and ancient workings. The third bench, partly submerged, forms the greater portion of the higher dredging ground. The fourth bench is that being dredged now and is nearly submerged. The fifth bench, wholly submerged and covered with recent river sand, is the dredging area of the Nechi and some of the Pato not thoroughly prospected. Below this on the Nechi River bank we know from Mr. Rogers' drill-hole No. 1 that there is still a sixth layer of gold-bearing gravel between the depths of 66 and 74 ft. We know nothing yet about what occurs below this. The outer and higher bench gravel is on the clay which lies directly upon the rim rock, but toward the centre of the basin, where we encounter the lower layers of gravel, nothing is known of the ground under the clay which we assume for dredging purposes to be bedrock. In this connection I would recommend that the management dig into the bedrock from time to time with the dredge, on the chance that the supposed bedrock may be in places on an intermediate thin seam of clay. Since each successive gravel bench, as we go downward, is richer, it is possible that deep drilling may disclose ground rich enough for successful drift mining. I do not, however, attach much importance to this possibility.

The gold is of fairly uniform sized thin flakes. It is easily saved by amalgamation. There is but very little black sand, of which the most valuable portion is caught by the dredge, and saved for further treatment.

The Pato property is equipped with its own hydroelectric power plant, one 8½-cu. ft. dredge, an ice plant, and a complete repair shop. The power plant contains three 600-hp. Pelton-Francis turbines under a head of 87 ft., which drive three separate electrical generators of 300-kw. capacity each.

The Pato boat is an all-steel, close-connected, 8½-cu. ft. bucket dredge. Aside from an obvious mistake in design of the hull, which has caused it to sink twice, the dredge has proved very satisfactory. The mistake in the hull is being remedied by the addition of pontoons.

Regarding the climate, the days are disagreeably hot and steamy, the temperature ranging between 70 and 90°F. It rarely rains in the daytime. The nights and early mornings are cool and pleasant, except for parasitic and insect pests of many descriptions. During nine months of the year it rains nearly every night, and at times as much as 9½ inches in a few hours.

The Nechi property, which will be operated by the Pato company's managerial staff and supplied with power by that Company, has been prospected by 41 drill-holes, the first of which were sunk under the direction of the Pato management, while the last few holes were drilled under my supervision.

The dredgeable area as prospected to date is estimated to be 89¼ acres of an average depth of 47.6 ft. and an average value of 71.86c. per cubic yard, which should produce 6,855,900 cu. yd. of a gross value of $4,926,600. The field operating costs of dredging on the basis of one dredge operating on Pato six months, and two dredges on Pato after that period, is estimated at $554.472, leaving an estimated net return of $4,372,128.

In estimating the drill-hole results on the Nechi property, it was not possible to obtain corroborative results

as in the case of Pato, so we used a theoretical drill factor of 238 ft. of hole to the cubic yard, giving a lower value. If the Pato factor were used, the average value would be considerably higher, and I confidently expect the Nechi dredge to produce more than the estimated value. A gold fineness of 860, determined by assay, was used in the calculations of drill results.

To the south of the estimated ground there is a swampy area that has not been sufficiently drilled to determine its value. The few holes that were drilled as shown on the map indicate the probable existence of a few acres of dredgeable ground.

Up to the time of purchase of this property by the Company, the native owner was working the bench gravel deposit upon it in a small way. Sufficient drilling has not been done to determine the extent or value of this deposit. It has the appearance of being of sufficient size and value for profitable working by hydraulic methods. I recommend that the mine staff investigate this deposit at a favorable time.

The buckets of the Nechi dredge are of 7½-cu. ft. capacity. The Nechi dredging ground, however, contains less clay than Pato, and, being deeper, the buckets will average fuller than on the Pato dredge. The Nechi dredge should, therefore, handle as much or more yardage than the Pato dredge. To be on the conservative side, I am estimating the costs on a basis of 100,000 cu. yd. per month. The Nechi dredging area is agricultural land with very few trees. The cost of clearing should, therefore, not exceed $100 per acre. Pond water will be obtained by connection with the Nechi river, thus the cost for pumping pond water will not enter into the Nechi costs. I have estimated that the Nechi field operating cost will average not over 9c. per cu. yd. for the period during which only one dredge is working on Pato, and 8c. thereafter with two dredges operating on Pato. These figures include 2c. per yard for bullion expense.

An all-steel hull, close-connected, 7½-cu. ft. bucket dredge was ordered in England from Fraser & Chalmers. The hull arrived in Colombia in November and is now being put together at the Pato machine-shops. The machinery for this dredge has been delayed by the war, but will shortly leave England for Colombia. This dredge is designed to dig to a depth of 55 ft. below water-level and to handle a 10-ft. bank. It is impossible to say when this dredge will be in operation.

MINERS' SAFETY LAMPS have nearly all been imported from Europe, but, according to James W. Paul of the U. S. Bureau of Mines, numbers are being manufactured in this country, equal to those of foreign origin. This is the result of a policy of the Bureau. Glass chimneys for collieries in England were obtained from Germany, but orders are now received in the United States for these for use in England.

THE New York Assay Office handled $60,616,438 in 1914, compared with $34,283,992 in 1913. The increase was due to large gold exports early in the year.

Burro Mountain Porphyry Copper Developments

By FARIS V. BUSH

The copper production of New Mexico is gradually being increased by development of 'porphyry' mines, the latest being the entrance of Phelps, Dodge & Co.'s subsidiary, the Burro Mountain Copper Co., at Tyrone and Leopold, in Grant county. Although the Company has held property in the district for many years, active operations were not commenced until about a year ago, when the driving of the 7000-ft. Niagara haulage tunnel connecting Tyrone and Leopold demonstrated that the syndicate was getting ready for business. Later a railroad was constructed by the El Paso & Southwestern railroad (controlled by Phelps, Dodge & Co.) from Whitewater, New Mexico, on the Santa Fe, west 16 miles, necessitating extensive grading in order to enter the mountains. Following this, an experimental mill and power plant were erected, grading was done for a 100-ton mill several miles east of Tyrone, and active general development in the mines undertaken. The Burro Mountain district is considered as one of the highest grade 'porphyry' copper regions in the United States, the average ore being said to assay 3% and above. Other large companies in the field besides Phelps, Dodge & Co. are the Azure Mining Co., Savannah Copper Co., Mangus Development Co., Big Burros Copper Co., and Woodward Mining Co. There is also a large amount of territory, held by individual owners.

Copper was known to exist in the Burro mountains as early as 1871, but no locations were made, nor were any attempts made to mine it; silver and gold being the only metals to which the prospector turned his attention. Had it not been for the most favorable surface indications, the district would not have been prospected as early as it was. In 1879 the St. Louis mine was discovered by James Bullard, John Swisshelm, and J. W. Fleming, and shipments of surface ores were made to Denver. These gentlemen negotiated a sale with Paschal R. Smith and Frank Marshal, who organized the Val Verde Copper Co. and erected a 50-ton reverberatory furnace in Dead Man's gulch. On account of the high cost of production and a low recovery, they were forced to suspend operations. Later a 500-ft. shaft was sunk on the St. Louis claim, and a large body of sulphide ore was found. During one year 102,534 lb. of copper was shipped from the works. Assays showed the ingots to contain 95% copper, as per returns from the ore-purchasing agency of Pope, Call & Co., of Baltimore. The Val Verde Copper Co. merged with the Southwestern Copper Co., and all operations were suspended on account of marauding Indians. During this time other discoveries were made in the district, among which was the Samson mine, found by George Sublett and Robert Thomson. Theodore Carter got the Leopold brothers of Chicago interested in the St. Louis mine and other properties, in 1901, and organized the Burro

Mountain Copper Co. A 500-ton mill was built at Leopold and treated the ore. The Company made money and was taken over by Phelps, Dodge & Co. in 1904. North and east of the Leopold operations, the Tyrone Development Co. was formed by claim-holders, and this was taken over by the Chemung Copper Co., about 1906. This Company carried on extensive development work, sinking shafts, driving drifts, cross-cutting, and blocking out orebodies. Much of the success of the region can be attributed to this work. The Phelps-Dodge syndicate merged the Chemung property with that previously controlled, bought out a large number of individual claim-holders, and in 1913 commenced the work preliminary to producing.

The ores are essentially the result of secondary concentration of lean sulphides originally formed in an intrusive monzonite mass. Surface indications are ex-

EXPERIMENTAL PLANT AT BURRO MOUNTAIN MINE.

ceedingly favorable for prospecting. The rock in general is exposed, silicified rock with iron and copper stains being found in many places and indicate fracture zones with a northeast-southwest trend. The orebodies in general have a length in a northeast-southwest direction and their shorter diameters lie northwest-southeast. Some dimensions of the bodies are given as follows: 650 by 600 ft.; 450 by 200 ft.; 400 by 260 ft. Development has not proved the thickness of these bodies, all of which contain commercially valuable ore. The only statement given out by the Burro Mountain Copper Co. management was that enough ore had been blocked out to warrant the erection of a 100-ton concentrator.

In order fully to determine the process to be adopted, a 50-ton experimental ore-testing plant was erected near the portal of the Niagara haulage tunnel and the dumps of No. 1 and 2 shafts. This mill has been running since April 1914, but to date the most economic method of separation has not been solved. Two different methods of separation by oil flotation have been tried, but it is declared that to date neither has produced the desired quality of concentrate, and changes of the oily reagents and agitation are still under way. Doubtless flotation will finally be embodied in the flow-sheet of the 1000-ton plant, as the ore is well adapted to it. However, the most economic method may only be found after extensive testing. The Burro Mountain test mill is being closely watched by those interested in mining and milling of chalcocite ores.

The ore-dressing process now being followed in the plant is as follows: From mine to 10 by 20 jaw-crusher, to coarse rolls, and then to dry-ore bin. From here the ore is sized to $\frac{1}{4}$ in. through a trommel, the oversize going to fine rolls and back to the trommel, the undersize going to fine-ore bin. The ore is then classified, the sized ore going to Wilfley table No. 1, coarse to Hardinge conical mill, slime to slime thickener, and thence to flotation unit. The discharge from Hardinge mill goes to classifier No. 2; from here all under 80 mesh goes to the flotation unit, all over is re-ground until it reaches 80 mesh, and then goes to flotation. When the flotation process is not used the ore goes from the Hardinge mill to classifier No. 2, the coarse goes over Wilfley table No. 2, the slime to a spitz classifier; the sand goes over Wilfley table No. 2, and slime to a slime thickener, and then to a vanner. The flow-sheet is being changed from time to time as experiments show it to be desirable. The re-grinding especially is being closely studied. A. Sandburg, of Bisbee, is chief metallurgist, and Henry Stanley is mill superintendent.

Underground development was stopped by the Company at the beginning of the European war, and only enough men are employed in the mines now to keep the test mill supplied with ore from sundry places throughout the property. In future operations the caving system in one of its forms will be used. Practically all ore will be hoisted, both at Tyrone and Leopold, this adding to mining costs. According to the 1913 report of Phelps, Dodge & Co., a body of low-grade sulphide ore averaging 2.35% Cu was opened by drifts in the main haulage tunnel. This ore can be mined at a comparatively low cost.

Three miles east of Tyrone, grading for the large mill has been completed and a town-site laid out. A force of some 30 or 40 men will be engaged all winter in the erection of a machine-shop, carpenter-shop, and crushing building at the millsite, but work on the concentrator proper will not begin until the flow-sheet is settled. A central power plant has been erected at the portal of the 7000-ft. tunnel and near the No. 1 and 2 shafts. It will supply electric power for the operation of mines, mill, and for transportation to mill. The equipment consists of two 1250-hp. (sea-level) Carels type Diesel engines capable of developing 1000 hp. each. Each engine is direct connected to an 815-kva., G. E., 60-cycle, 3-phase alternator. For water supply, mine water is pumped from the No. 2 and No. 3 shafts. It is now being run through several miles of precipitation flumes containing scrap iron. The water is highly charged with copper sulphate, and a high-grade precipitate is sent to the Douglas smelter for treatment. If a larger

water supply is needed, wells at the head of the Mangas 'draw' may be the source of supply. Several churn-drills are at work prospecting new ground owned by the Burro Mountain Copper Co. All construction work and operations in general are under the supervision of E. M. Sawyer.

While the Burro Mountain Copper Co. is the largest operating company in the district, there remains much property of merit, developed and undeveloped, in the mineralized zone, that would warrant investigation. Climatic conditions are such that work may be carried on the year round, the average temperature being about 55°F. Labor is plentiful, the average wages (Mexican) being $2 per day. Transportation costs, which have retarded progress in the Burro mountains, have been lessened owing to the entrance of the El Paso & Southwestern railroad. The cost of copper per pound should not exceed 9c. where development has revealed commercially valuable ore.

Gold Mining in Eastern Asia

Gold is widely distributed over eastern Asia, but the most important deposits are in Siberia and northern China, where in the Lena and Amur basins rich alluvial deposits occur. Those to the north of the Amur are worked by Russians; on the south side the Chinese wash the gravel by methods that are crude but effective. Of recent years the Chinese miners have begun to adopt foreign equipment to some extent, and the illustration at the left of the group picture shows a Chinese miner using a Russian wooden gold pan in Siberia. The Chinese are extremely skillful with the pan, and but little gold remains in ground which they have worked over. Some form of pan is everywhere employed, and the next illustration shows the 'dooling' (pan) and the 'patchule' (hoe) as used in Indo-China. These are the implements of the Malay in gold and tin mining, and, together with bamboo baskets, carrying-poles, and the china pump, constitute practically all the machinery used in the winning of gold and tin in tropical Asia. The prevalence of gold washing in the Amur basin of Siberia may easily give rise to an exaggerated idea as to the importance of these deposits. Generally speaking, except where the use of foreign machinery will permit the working of ground now inaccessible, such as gravel below water-level, or with immensely thick overburden, there is little additional profit to be gained by its use, since the low cost of labor reduces the cost of working by such crude methods to a point where it can scarcely be improved upon. The cost of bringing in foreign equipment is high, and the gradual introduction of native-made equipment following foreign designs seems to be the natural line of progress. The picture to the right of the centre shows Chinese tributers washing ground near an outcrop of quartz veins in Siberia. Note the locked Russian washing machine; also, in the upper left-hand corner, a Russian wooden gold pan such as is shown in the illustration to the left. The top of the machine has a punched screen; only the fine stuff goes through, and the gravel is washed on the screen as shown. The inside of the machine consists of staggered inclined riffles. It does not make as good saving as the rocker. The peculiar shape of the Russian pan does not seem to offer any advantage over the normal conical pan. The Russians who have worked in Alaska have brought back to Asia many of the methods which the Alaska miners have developed, and the picture at the right shows American pattern sluice-boxes, erected in Siberia by a Russian with experience in Alaska. Chinese laborers do the rough work even on the Russian side of the Amur. For these photographs we are indebted to F. L. Cole, who has had extensive experience in China, Siberia, and the Philippine Islands.

THE Dominion Iron & Steel Co., Canada, output last year was as follows: iron ore, 350,000 tons; limestone, 295,000 tons; pig iron, 181,000 tons; steel ingots, 237,500 tons; rails, 120,000 tons; blooms and billets for sale, 23,500 tons; wire rods, 37,700 tons; wire and wire products, 26,000 tons; and steel bars, 15,000 tons.

COPPER CONCENTRATE produced by the Elmore vacuum plant at the Sulitjelma mine, Norway, amounted to 1422 tons in November.

METHODS USED BY CHINESE IN WASHING GOLD-BEARING GRAVEL.

The Rand's Largest Central Power-Station

By V. PICKLES

*The Rosherville plant of the Rand Mines Power Supply Co., Ltd., has a total capacity of about 84,000 kw. It is both an electric generating and an air-compressing station. There are five boiler-houses with eight boilers in each, and a turbine-room 75 by 450 ft. The plant is on Rosherville lake, the largest sheet of water on the Rand, this being the reason for its situation.

Coal Handling.—Coal is delivered along sidings to five outside storage bunkers, one opposite each boiler-house. Underneath the bunker floors are the conveyors, which are fed by rotary fillers through chutes built in the concrete floor of the bunkers. These conveyors are of the Babcock & Wilcox gravity bucket type, and they deliver the coal from the outside to the overhead inside bunkers, whence it is delivered through mild steel plate chutes into the stoker hoppers. Each conveyor is capable of handling 40 tons per hour. Blake-Dennison weighing machines are installed in each conveyor tunnel, which automatically weigh the contents of every four buckets as they pass over the machines. The total reading is taken, and a daily check thus kept on the operation of the station.

Boiler Plant.—The general arrangement of the boiler-houses consists of a basement 10 ft. high, in which the ashes are dealt with. Ash bunkers are provided under each boiler, capable of storing approximately six tons. The ashes are removed in trucks and attached to the haulage gear leading to the ash dump. On the next floor are the boilers themselves, and each boiler unit is of the Babcock & Wilcox marine type, fitted with chain-grate stokers, and each having its own superheater and economizer integral with it. The boilers are arranged in two rows in each house, with a common firing floor. The boilers of the first four houses have a rated capacity of 32,000 lb. of steam per hour, and are capable of evaporating 40,000 lb. of water under favorable conditions. The heating surface of these boilers is 5520 sq. ft.; of the superheater, 1720 sq. ft.; and of the economizer, 2200 sq. ft. In No. 5 boiler-house, which is the most recent addition to the plant, the boilers are slightly larger. The heating surface of the boiler is 5920 sq. ft., of the superheater 2247 sq. ft., and of the economizer 3050 sq. ft. The normal output is 33,000 lb. of steam per hour. The Prat system of induced draft is employed. This system is one found more on the Continent than in England or America. At Rosherville, adjacent boiler units are connected to a common stack, the conical shape of which is probably well known to most of the people on the Rand. Air from an electrically driven fan is forced through the conical part of the stack and thereby produces a suction in the flues and consequent draft through the furnace. The fans for double units are driven by 125-hp., 3-phase, squirrel-cage motors, while those for the single units, that is, the two outside rows of boilers in No. 1 and 5 houses, are driven by a 75-hp. motor. The draft is regulated by means of a damper of torpedo shape moving up and down in the conical end of the blast pipe, and so regulating the volume of air discharged from the fan. The draft can be varied from ½ to 2 in. of water in the uptake. The superheaters and economizers are of the Babcock & Wilcox well known type and need no explanation.

Steam Pipes.—Steam is delivered from each boiler unit to a main open steam-pipe ring in each house. The open ends of this ring are connected by vertical pipes to the main steam header running the whole length of the station. Isolating and section valves are, of course, suitably placed, the main sectionalizing valves being electrically operated. At the bottom of each vertical header steam separators are placed, and the whole range is efficiently drained by steam traps. The main header is anchored at several points along its length, and expansion is taken care of by means of swivel expansion joints, a type not usually found in English practice, but which are fairly well known on the Continent.

Boiler Feed System.—The boiler feed pumps are turbine driven. They are nine in number, and are installed in the turbine-room basement. Each pump is capable of dealing with 280,000 lb. of water per hour, against a working pressure of 225 lb. per sq. in. The turbines are of the simple impulse type with one stage, and are designed for working at 225 lb. of steam at a temperature of 350°C. Regulation is obtained by means of a throttle valve operated by the delivery pressure, and the speed is therefore automatically regulated according to the demand on the pump. The suction of each pump is connected to a feed tank placed inside the boiler-house above the firing floor, and on the delivery side are connected to a breeches pipe, so that they can deliver into either the common or independent feed range. The exhaust steam from the turbines of these pumps is carried to the feed tanks and is exhausted through nozzles directly into the tank, and thus give up practically all the heat of the steam, and the water is also recovered.

Water Purifying Plant.—Water from Rosherville lake is used for 'make-up,' and most of the waters in the reservoirs along the 'reef' consist largely of mine water, and is in consequence quite unsuitable for boiler use without treatment. The treatment is carried out by means of an Archbutt-Deeley softening plant with a capacity of about 8000 gal. per hour. This type of softener appears to be suitable for the treatment of the hard water in the lake. The Archbutt-Deeley plant is hand operated and of the non-filtering type. Chemicals are added, and the water is then allowed to settle

*Abstract of general description for the South African Inst. of Elec. Engineers.

until all the precipitated substances caused by the addition of the chemicals have subsided. The clear water is drawn off from the top by means of a floating discharge pipe into a large reservoir, from which the make-up pumps draw the water.

Turbo-Generators.—Five turbo-generators are installed, each of 12,000-kva. capacity, 50 cycles, and normal voltage of 5000. The turbine is designed for a working pressure of 225 lb. and a steam temperature of 350° C., and consists of the Curtis stage and 12 expansion stages of the Rateau type. The main supply to the turbine enters the nozzle box, which contains 14 nozzles. Four of these are always open, and the remaining 10 are controlled by hand-regulated valves, these being opened or closed according to the load on the turbine. Speed regulation is taken care of by a throttle governor and an emergency trip is provided which cuts off the steam supply at 10% overspeed. Exhaust steam from the condenser auxiliary turbine is delivered to the main turbine at a point between the Curtis and Rateau stages. The generators are bar wound, having one bar per slot. The complete generating unit consists of the generator and the transformer, but provision is made for connecting the transformer for stepping up either to 20,000 or 40,000 volts, as may be desired. Protection of the generating unit embraces both the generator and transformer with intermediate connections. Inverse time-limit overload relays are installed. In the event of a fault developing inside the protection, the unit is immediately isolated by means of the Merz-Price protective gear, and simultaneously the excitation is cut down to almost zero to prevent the fault extending. The neutral point of each generator is earthed through a low resistance. The generator rotors are of the non-salient type, and are 5 ft. 4 in. diameter. They therefore have a peripheral speed of about 278 ft. per second. Ventilation is obtained by means of fans carried at each end of the rotor, the air being drawn from outside through the air filter. Each set contains its own direct-driven exciter, and a standby supply is also provided from a motor-generator and a battery.

Compressors.—The station contains nine steam-driven rotary air-compressors, six of 3000 and three of 7000-kw. capacity, or about 40,000 kw. in all, run at a speed of 3000 r.p.m. These take in air at atmospheric pressure and deliver it into the pipe-line at a pressure of 110 to 120 lb. per sq. in. gage pressure, according to the demand on the system. The smaller sets consist of two stages with an inter-cooler between, and deliver 22,000 cu. ft. of free air per minute with an outlet pressure of nine atmospheres (132.3 lb.) absolute. The larger sets are in three stages separated by two inter-coolers, and deliver 44,000 cu. ft. of air per minute. The stages and the internal diaphragms are water jacketed, with the result that the air is delivered into the pipe-line at a temperature below 100°C., and is cooled during transmission to atmospheric temperature. Each stage contains eight impeller wheels forming the rotor, the air passing through these wheels in series. Between each pair of impellers the air passes through passages in the stator that forms the diffuser when the velocity of the moving air is changed into pressure. The low-pressure end of the larger sets is double ended, the air being taken in at each end, and is discharged from a common duct at the centre. This arrangement automatically balances the end thrust of this stage, but the other stages have to be balanced by special means. The stages are separated from each other by labyrinth glands on the shaft and at the circumference of the impellers, and little leakage takes place between them. The clearance between the grooves and notches of these labyrinths is small, so that any want of balance in the machine would rapidly cause heating of these glands. An automatic non-return valve is provided on the discharge pipe of each machine, and directly the pressure falls below that of the pipe-line the compressor automatically discharges to atmosphere. The low-pressure stage of the steam turbines of the large compressors is also a double-ended device, so as to secure ample area for the steam without unduly lengthening the blades. The condensing plant is similar to that of the turbo-generators, already described.

Switch Gear.—The switch gear is contained in a switch-house at the south end of the building, with cubicles on the outside of the building containing the step-up transformers between the generators and busbars. This building has four floors. The top floor contains the lightning arrester gear and the outgoing lines are fed from this floor. The third floor contains the busbars, both 40,000 and 20,000 volts, and the second floor is the switch floor. The lower floor contains the cableways, etc. The busbars are in duplicate, selecter knife switches being used for connecting to either one set or other of the bars. The 40,000 and 20,000-volt systems are connected together through a coupling transformer of 10,000-kva. capacity. The switches themselves are three single-phase coupled switches, and are operated from the control board. This control board is placed at the south end and overlooks the whole of the engine-room. A large signaling board is placed in such a position that it can be seen at any point of the engine-room, and from which instructions can be signaled to the drivers of either the turbo-generators or compressors.

POTASH SALTS imported into the United States in December were as follows:

	Quantity.		Value.	
Classes.	1913.	1914.	1913.	1914.
Carbonate, pounds	2,350,853	1,362,138	$75,990	$56,169
Cyanide, pounds	213,177	11,200	28,271	2,118
Hydrate, pounds	1,303,359	1,630,468	50,494	65,465
Nitrate, pounds	560,000	.....	19,448	.....
Muriate, tons	28,619	8,313	932,599	311,011
Sulphate, tons	6,459	2,204	271,585	101,542
Other salts, pounds	695,373	503,349	63,957	52,167

CONSTRUCTION of the Trans-Australian railroad, 1060 miles, by the Commonwealth government, continues. On December 19 there was 308 miles of track laid and 2070 men employed.

DISCUSSION

Readers of the MINING PRESS *are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.*

Dissolution of Silver and Gold in Thickeners

The Editor:

Sir—I beg leave to correct one statement in Mr. Menier's letter on Oliver filters at the Commonwealth mill, Pearce, Arizona. He states that the dissolution of metals from the pulp during its passage through the four 40 by 12-ft. Dorr thickeners is *nil*.

I will explain that the slime-pulp, after treatment in the nine Pachuca agitators, is diluted with barren solution 3 to 1, thickened 1.5 to 1, and transferred by 4-in. air-lifts through the four thickeners in series before the final caking to 28% moisture. The thickeners are arranged for counter-current replacement. The four filters are 11.5 by 16 feet.

No further extraction is gained during filtration, but the following assays for the month of September 1914 show an average extraction of 0.33 oz. silver:

September	Agitator tailing, oz.	Oliver tailing, oz.	Silver dissolved, oz.
1	1.73	1.44	0.29
2	1.68	1.50	0.18
3	1.84	1.60	0.24
4	2.14	1.66	0.48
5	1.90	1.74	0.16
6	1.96	1.58	0.38
7	1.82	1.62	0.20
8	1.85	1.71	0.14
9	2.12	1.74	0.38
10	1.72	1.56	0.16
11	2.05	1.71	0.34
12	2.12	1.72	0.40
13	2.07	1.73	0.34
14	2.06	1.76	0.30
15	1.62	1.56	0.06
16	1.48	1.35	0.13
17	1.48	1.30	0.18
18	1.64	1.22	0.42
19	1.62	1.44	0.18
20	1.84	1.48	0.36
21	1.82	1.46	0.36
22	1.96	1.52	0.44
23	2.06	1.62	0.44
24	2.18	1.62	0.56
25	2.72	1.90	0.82
26	2.25	1.88	0.37
27	2.30	1.80	0.50
28	2.38	1.72	0.66
29	2.00	1.90	0.10
30	2.34	2.00	0.34
Average	1.958	1.628	0.33

FREDERICK A. VOORHEES.

Pearce, Arizona, January 14.

Who Will Engineer the Engineers?

The Editor:

Sir—Among the many interesting subjects covered in the 'Discussion' columns there is one which to me and to others, perhaps, has seemed to be neglected. It is with this idea in mind that I am tempted to precipitate a discussion of the question as to just why members of a body which has always been given the title of a profession should find themselves in the position in which the majority of them are today.

As a freshman in a reputable college of mining engineering, some twelve years back, I was given to understand that immediately after graduation I could expect to put in some years at hard labor, learning the practical side of mining, and serving what, in anything like a trade, would be called my apprenticeship. After a term of years I was led to believe that my diligence and industry, as in all the fairy tales, would be rewarded by a life whose requirements would vary between being the guide, philosopher, and friend of the trusting capitalist and the free-and-easy associate of the wily burro and his friend, the prospector—in other words, a sort of elastic nature, who could be all things to all men—who would be as needful of a dress suit in his wardrobe as a pair of overalls. In fact, I rather expected to be wearing these garments on alternate days, with all the associations that their possession implies.

Fond illusions! The dress suit is now moth-eaten, but the overalls have been replaced many times. In fact, if the war had not interfered, the price of cotton might, in time, have made even these humble garments beyond the average E.M.'s means. Whatever may be the cause of the downward trend in engineering salaries, the fact remains that the average member of the engineering force of any of our larger mines, in a position of some trust and no little responsibility, averages rather less in his monthly pay-check than the ordinary ten-day miner who has to be guarded on every turn to keep him from 'high-grading' the profits away from the mine.

In saying this, the intention is far from that of striking a personal note. My own case has perhaps been rather more fortunate than that of many of my fellows, in that I have at least had the satisfaction of having held a few good positions, while they lasted, and in having the more or less immediate prospect of holding more. This has perhaps been on account of not being married, and being able to handle examinations in the more remote parts of the world. But the average mining engineer who marries and does not give up his pro-

fession usually ties a millstone around his neck. This is a strong statement, but true, and explains why some eighty per cent of my own class in college have given up mining, and among them have been men of exceptional capacity. They could see the cold fact with clear vision—that the years of their youth would be wasted on the petty details of a subordinate position which they dare not give up on account of the responsibility of a family—and when they grew older, or the mine played out, they would be turned adrift. Would they not have been foolish to stay with their profession? Some few, however, have stayed, and as the years go by the story will be told.

Why is it, then, that a profession, and surely it is entitled to the name, that demands more of self-reliance, more of ingenuity and individuality, as well as more of dogged hard application and work, than any other that one can name, commands no more respect at the hands of the mining interests of this country? Let us examine some of the causes.

First, the law of supply and demand. For the last eight years, at least, mining has been on the wane. Capital has been timid of investment, and many of the older mines have curtailed their operations and their staffs. Mexico has driven out many experienced engineers. On the other hand, our technical schools have been grinding out graduates with marvelous energy. These are often in competition with older men, and sometimes make good over them. With this there is no quarrel, as no one seeks to interfere with the principle of the survival of the fittest. But, on the other hand, is it not the fact that the very necessity of training inexperienced men holds down the initial salaries, and thereby lowers the status of the experienced efficient man who is forced by circumstances to seek a new job?

It seems to me, and I find that my opinion is concurred in by many others of my fellows, that some sort of an organized effort to change the general situation would be effectual. Personally, I am able to speak from the standpoint of the operator, the superintendent, the engineer, and the 'mucker.' I know that in keeping down costs, I have at times taken advantage of the surplusage of engineering talent. Nevertheless, I did it with a protest against the conditions which forced me to do it, and I have often pondered, in my own mind, as to whether the situation could not be alleviated, to some degree at least.

There can be no question in the minds of any that an efficient man in a position of responsibility often has chances to save many times his monthly pay check—at least in a mine of any size. There can equally be no question that among the horde of engineers, now fortunately diminishing, that is being turned out of technical schools every year, by graduation and other more expeditious methods, there are many men who fortuitously attain to positions which they are not fitted either by training or experience to hold, and which, if they do hold them, are caused to suffer from inexperience for some months, if not years. If a man has a pleasant personality and a disposition to make good, there are few superintendents or managers who will not overlook all but the most glaring errors. The cost of these errors is usually charged up to the general salary account—in other words, the engineering staff as a whole in that and other mines, pays for the experience which the novice, or the man who is trying to make a bluff stick, is getting in competition with them.

This being the case, and I think many operators and managers, as well as engineers who have been long in the field, will agree with me that it is, does it not seem as if, by means of the college engineering associations or some more general bureau, a register of engineers could be started whereby the individual record of each engineer at actual work in the engineering field could be kept for reference? This record should be entirely independent of the college record, except along general lines of training, for many who graduated by accident know full well that there were better and abler men who failed of getting their diplomas.

The idea would be, in general, to have some definite and responsible bureau to whom managers, operators, and superintendents in need of competent engineers could apply and be sure of getting a man whose experience and training, as well as personal record, exactly fitted him for the work in view. Having once established such a bureau, I should go one step farther. It should be the duty of the secretary, or whatever else he might be called, to safeguard the interests of the engineer as well as the employer, and send no man out to a position of responsibility unless he were paid what he was worth. While this might seem arbitrary, and to savor of the walking delegate, I think that the satisfaction of being sure of getting a thoroughly competent man, who would not require more than two or three days' education in his new duties, would be worth much more, financially and mentally, to the average manager and operator, than the difference in salary.

An association of this sort could be financed with only a trifling expenditure on the part of each engineer registered. Of course, many difficulties would be encountered, in the way of disgruntled inefficients. These would soon automatically eliminate themselves, and the engineering field would be the clearer and better for it. The responsibility of passing on the qualifications of a man should be left to the superintendent himself, after a study of the records of several candidates submitted.

Personally, I think the details of such a plan are not impossible of working out. Not having the time to do so, and not flattering myself with the possession of omniscience, I should like to see the idea thoroughly discussed, and other better ideas brought forth; and if thereby I shall have started something which will trend toward the general betterment of the present ridiculously low average of engineering salaries, and at the same time toward raising the standard of general efficiency, a great good will be effected.

A. ENGINEER.

San Francisco, January 20.

CONCENTRATES

Readers of the MINING PRESS *are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.*

THE St. John del Rey mine, Brazil, has a vertical depth of 5711 ft., and is the deepest metal mine in the world.

STICHTITE, named after Robert Sticht, of the Mount Lyell mine, Tasmania, and previously known as 'kammerite,' is a carbonate-hydrate of magnesium, chrome, and iron.

"A HUNDRED DOLLARS IS SPENT on the prevention of accidents in the anthracite coal regions of Pennsylvania," said a prominent operator recently, "for every dollar that is spent on their cure."

GOOD GRANITE should stand a crushing strain of at least 20,000 lb. per sq. in.; some granites will stand 40,000 lb. This may be compared to common red brick, which will crush at about 3000 lb. pressure.

THE FILING OF AFFIDAVITS as to annual labor on mining claims only constitutes *prima facie* evidence that the work has been done, and may be rebutted by competent testimony as to the actual facts. If no work has been done in a tunnel for three years, all rights under the tunnel-site location have lapsed, and if no assessment work has been done on the claims tapped by the tunnel, they as well as the tunnel site are open to location.

THE CALORIFIC VALUE of a fuel is the total quantity of heat developed by the complete combustion of the unit weight of fuel. In the metric system of measurement, which is generally used by chemists and physicists, the heat units are the 'gram calorie' and the 'kilogram calorie.' The gram calorie, or small calorie (cal.) is the amount of heat required to raise the temperature of 1 gm. of water 1°C. at 15°C., and the kilogram calorie, or large calorie (Cal.) is the amount of heat required to raise the temperature of 1 kg. of water 1°C. at 15°C. In the English system, which is generally used by engineers, the heat unit is the 'British thermal unit,' or B.t.u. The British thermal unit is the quantity of heat required to raise the temperature of 1 lb. of water 1°F. at 60°F. Calorific values given in calories per gram may be converted into British thermal units per pound by multiplying by 1.8, the ratio between the centigrade and Fahrenheit degree. The factor for converting grams to pounds does not enter into consideration, as the heat developed by combustion of a unit weight of fuel is always measured by the rise in temperature that it produces in an equal weight of water.

A MINER holds by location two claims with no vein outcropping, and a tunnel site, on which no work has been done. A good deal of rich 'float' quartz is scattered over the area. Will the tunnel site hold all 'blind' veins that it cuts, even though they extend into another property but do not outcrop there? How much work must be done on a tunnel site to hold the same? And would this work act as assessment work on the claims that the tunnel site is located on? Work must be done in the tunnel with reasonable diligence, in order to protect the claim to blind lodes cut by the same. Cessation for six months will cause the claim to lapse. A person cannot acquire title through a tunnel location to blind lodes in valid mining claims owned by others, and can not get an extralateral right on blind lodes in his claims until he is in a position to prove the existence, course, and extent of the apex in such claims. Assessment work, as the term is ordinarily used, is not required for a tunnel site; but of course work done in the tunnel for the development of claims located over it could be counted as assessment work on such claims. What is required for the validation of a tunnel location is continuous development work in the tunnel, without cessation for a greater period than six months.

COST OF CYANIDE TREATMENT is liable to vary within wide limits and is influenced by a number of factors. Cyanide and alkali consumption will depend on the character and cleanness of the ore being treated; and other chemicals, such as lead acetate or bromo-cyanide, may be found necessary to aid extraction. The proportion and distribution of base metal present will also affect the cost of treatment, involving in some cases the expense of concentration and in others the additional cost of shipping the concentrate produced. Roasting may be imperative as a preliminary to cyanide treatment. The output from the crushing and regrinding machinery is limited by the hardness and toughness of the ore; and the treatment cost per ton is influenced by the judgment shown in the selection of proved units for every department. Certain items of cost are only slightly affected by a variation in the amount of ore handled, so that the cost per ton will materially decrease with higher tonnages. The installation of labor-saving devices and smooth-running machinery will insure lower costs both for running and repairs; and the presence of favorable local conditions may result in good profits where losses might otherwise result. Difficult transportation and high freight costs make considerable differences in profit estimations, but sometimes this is counterbalanced by cheap power. Pebbles for tube-milling may cost anywhere up to $60 per ton, or may be made locally for a tenth of this amount. Royalties on various patents are paid in some localities and evaded in others.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

ROCHESTER, NEVADA

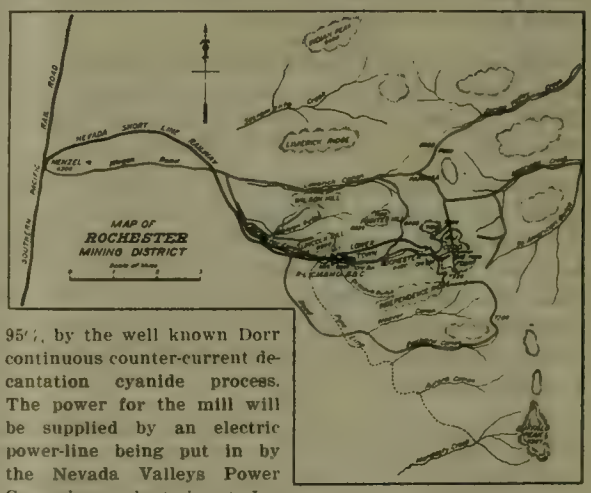
HISTORY AND PROSPECTS OF THIS NEW DISTRICT.—THE RAILWAY, SMALL MILL, AND NEW MILL.—NENZEL HILL MINES.—LIMERICK RIDGE, WILSON AND LINCOLN HILLS.—GOLD-SILVER ORES OF INDEPENDENCE RIDGE.

Rochester begins to look like a real mining camp with its large bodies of ore blocked out, a railroad right into town, one small mill turning out bullion, and a large custom mill almost ready to start, besides other mills proposed for the near future. The district is a little over two years old, and has quite a remarkable record as far as mining is concerned, in that it has been practically self-supporting. During its first year ore shipments amounted to an aggregate of over $500,000. It was not high grade, but the short haul to the railroad made it possible to ship $25 ore at a profit, this being the average value of the 550 cars of ore shipped during 1913. This close proximity of the railroad was in many ways a serious detriment to the mining end of the camp. It enabled the rabble and the hobo to get into the place. It resulted in a great townsite boom, wherein much money was lost that could have been spent in development to the betterment of the district, and to the personal profit of these people, who, as it was, lost their money and went away from Rochester with anything but good words for the place. Gambling was 'wide open' and the 'suckers' were cleaned. More saloons were opened than would supply the wants of the two or three largest cities of the state. Business houses of all sorts were so numerous that they could not help but fail. All these losses were entirely independent of mining, but they assisted in building up a fake boom which eventually reacted against the mining industry. But during all this time the legitimate prospector, and particularly the lessee, were quietly extracting ore and shipping it, and using the profits from one shipment to open more ore. As soon as a custom mill seemed to be assured, many of the lessees quit work to wait for the mill, while others stopped their shipments but kept on developing ore, with the result that today there is enough ore blocked out in the different mines to keep the new mill running at full capacity for over two years. And as this ore runs from $10 to $25 per ton, there will be a good profit realized from these reserves.

The Nevada Short Line railway, better known as the Codd road, is completed from Nenzel, formerly Oreana, on the 'Espee' (Southern Pacific) to the Lower Town. The road from the mill to the upper part of the district has been surveyed, and construction will be started as soon as the frost is out of the ground. In the meantime the ore will be hauled from the ore-bin at the end of the tramway to the new mill by teams. The mill is nearly finished, and is expected to be running about February 7. The railroad has just started a new gasoline motor passenger car. This car was built at Reno, and its trial runs have been satisfactory. The car seats 12 passengers and carries a little baggage, express, and mail. It makes the run from Nenzel to Rochester in about 30 minutes, climbing from 4200 to 5800 ft. elevation. The car makes two trips per day, meeting both trains on the main line.

The small mill is a two-stamp Joshua Hendy amalgamation plant, owned by the Lincoln Hill Mining & Milling Co. It is situated in Rochester cañon, just below the mouth of Octopus gulch. The power is obtained from a gasoline engine, which also runs an electric generator. The water is pumped from a well in the bottom of the creek bed, from which a drift was driven on bedrock across the whole channel to develop all the water possible. This Company owns two claims on the north slope of Lincoln hill, from which it is mining gold ore, some of which runs as high as $300 per ton. A few lots of ore for lessees on Lincoln and Wilson hills have been crushed, the last lot being from the Gotham claim on Wilson hill, owned by U. W. Harwood, and which returned $67 per ton.

The new mill being built near the lower part of Rochester cañon is about opposite Octopus gulch. This mill is guaranteed to treat 100 tons per day, and to make an extraction of



95%, by the well known Dorr continuous counter-current decantation cyanide process. The power for the mill will be supplied by an electric power-line being put in by the Nevada Valleys Power Co., whose plant is at Lahontan. The water for the mill is brought by gravity from a small stream about six miles southeast.

Nenzel hill has had the most development work done. Here are three leasing companies working on adjoining blocks of ground. They are all opened to the same level, which is about 500 ft. deep on the dip of the vein. Large quantities of ore have been shipped from these leases, and a good tonnage of milling ore is blocked out in them, waiting for the mill to start. A new adit has been driven at about the middle of the properties as a working exit for them all. A surface gravity tramway is being constructed from this about 1000 ft. long to ore-bins at what will probably be the terminus of the railroad.

Silver was the predominant metal in the ore on Nenzel hill near the surface, while on the lower level there is quite an increase in the gold content.

About two miles to the south of Nenzel hill is the Packard portion of the district, from which the richest silver ore has been shipped, and in the past three months production was $45,000.

Limerick ridge, Wilson hill, and Lincoln hill have two systems of veins; those running nearly east and west are being prospected more thoroughly at the present time, containing almost free gold ore. The cross-veins run about southwest and contain considerable silver, but so little work has been done that not much is known of these veins. H. C.

Potter has recently taken a lease on part of the Nonpareil claim where both systems of veins are found and purposes to drive an adit to open the veins at their intersections. His ground is situated on the north slope of Lincoln hill, pretty well down near Golden gulch, where he will have good backs. Some fine specimens of free gold in white quartz have come from this part of Lincoln hill. In the upper part of Limerick canon there are several miners working placer claims in bedrock drifts, 30 or 40 ft. below the surface. Some of the gravel is worked in dry-washers, while the balance is taken about a mile down the cañon to a spring and washed.

Just across Octopus gulch, on the southern extension of the Buck & Charley vein, the Rochester-Lincoln Consolidated Mines Co. is opening a vein in two adits. Some ore has been shipped from the upper one, and the lower is showing ore in two places.

Just to the east of the latter property are the Octopus claims, on which considerable work has been done. Nothing has been shipped from this property, but ore of good milling value is being opened.

Independence ridge shows the ore to contain about equal amounts of gold and silver. The Buck & Charley mine has been the most developed, and is one of the promising mines of the camp. Six men are working it under lease, and have shipped considerable ore, sending out about two carloads per month; but now that the railroad has laid a spur track to their ore-bin, they expect to increase their shipments to five cars. The ore averages about $40, although some of their shipments have run up to nearly $100 per ton. This is the first mine in the district to be connected direct with the railroad.

WASHINGTON, D. C.

Leasing Bill Amendment.—Radium Production.—Mining Legislation.

A matter of importance in mining legislation in Congress is the action by the committee on public lands of the Senate in so amending the so-called leasing bill in the conservation program as to exclude from its operation coal and potash lands. The committee decided to amend the bill in a minor manner. In other respects it is as it came from the House, and that bill will still, in its leasing provisions, apply to oil, gas, and phosphate lands. It is the plan to report separate leasing bills for the coal and potash lands, which may be introduced at this or the next session of Congress. Such is the report of the committee, and it is declared that by modifying the leasing bill in this manner a great deal of opposition to the bill has been removed, so that the bill in the Senate has less opposition than any of the conservation measures. The prospects of passing the bill are known to be small, in view of the filibuster in the Senate against the ship purchase bill which has so far blocked all legislation. Even should the filibuster be raised soon, it is thought all other legislation would be prevented enactment, except the supply bills and other minor measures to which there is no opposition in Congress.

The House has had under its immediate inspection some of the radium which has been produced from Colorado fields, the total amounting to $10,000 in value, and being shown in the House by Martin D. Foster, from Illinois, chairman of the House mining committee, to demonstrate what this country could do in radium mining, and especially the Bureau of Mines, which treated the ore by processes of its own at Denver, and at such a reduction in cost that radium heretofore available at $120,000 per gram ought to be salable at $40,000. The Bureau is to make public its processes at a later date. The radium was the property of Howard E. Kelly, of the Johns Hopkins hospital at Baltimore, Maryland, and of James Douglas, who operates a large cancer institution in the city of New York. These gentlemen supplied the radium from lands owned by them in the West, and it was treated by the chemists of the Bureau at Denver. The cost was defrayed by the United States government out of the annual appropriation of $100,000 for experiments in the treatment of ores. After the gentlemen named shall have obtained seven grams of radium, the radium fields they own are to become the property of the United States, and it is believed that enough radium will be acquired by the government to equal in value the $100,000 appropriated for experimental purposes. The presentation of the radium in Washington was attended by a banquet at which many felicitations were expressed. Mr. Kelly and Mr. Douglas declared their faith anew in the therapeutic value of radium, saying that what cancer cures have failed from the application of radium were not due to the use of radium, but to the fact that the cases were such that there was not enough radium on hand to effect the cure. Of course, radium legislation is being held up among others in Congress, and for reasons apart from the filibuster.

All other mining legislation broached in Congress also remains in a dead-still position. It is hard to prophesy what will happen in the remaining month of the short session of Congress, but of course, if there is to be an extra session, many of the things the mining people are asking for may receive attention, providing they do not involve any large sum of money, as the government is short of funds, revenue being far below the expenditure, and so it is loath to undertake anything new carrying an appropriation.

DEADWOOD, SOUTH DAKOTA

Snowfall.—Homestake Company's Activities.—Oro Hondo, Echo, Golden Reward, and Hidden Treasure Mines.

A fall of 16 to 20 in. of snow, as measured at various points in Lawrence county, on January 17 and 18, makes the record for the present winter. Having been favored with an especially fine season to date, operators were well prepared for the storm, and no distress has been reported among them. The Wasp No. 2 company stopped work in the open-cut workings, from which the entire mill supply is drawn, and will not resume for some weeks. This action follows the usual custom at this property, namely, to suspend during the severest of the winter. Other properties are running full time.

At the Panama-Pacific Exposition the Homestake Mining Co. will make a highly instructive and interesting exhibit in the Palace of Mines and Metallurgy. It will include a reproduction of a portion of the mine, showing stopes, shafts, and methods of mining. There will also be a complete selection of rocks and ore and wall materials from vairous parts of the great property. Another feature will be a collection of photographs, interior and exterior, of surface plants, and a great number of underground views. The exhibit will be the most complete ever arranged by the Company, and will be carefully installed so that all conditions at the property may be readily understood. The various items entering into the exhibit have been shipped to San Francisco, and A. J. M. Ross, of Lead, of the engineering force of the Company, has left for that point to install the exhibit and remain with it during the Exposition. ——Under the laws of the state of South Dakota, the inheritance tax on the estate of T. J. Grier, late manager of the Homestake company, was $3398, on an estate appraised at $243,000. The tax was recently paid to the probate court of Lawrence county.——During 1914 the Homestake company's employees' aid fund disbursed in benefits the following sums: death, $12,400; injury, $9054; sickness, $10,606; and one suicide, $200. Receipts during the year were from employees, $28,017; from the Company, $12,000; interest, $952. Cash on hand December 31, 1913, was $30,035, and at the end of 1914 the balance was $38,543. The fund is supported by the men and the Company. Each employee gives $1 per month, and the Company provides $1000 per month. Benefits range from $1000 for accidental death or total disability through accident, to $1

per day for sickness or injury causing loss of work. In this connection it might be mentioned that the Company provides free medical service for all employees and their families, this service including medicines and hospital care if necessary. A large new hospital is to be built during the present year, to cost about $25,000.——Construction work on the new headframe at the B. & M. shaft of the Homestake is proceeding at a good rate, and the great steel structure will soon be completed. The engine room has been enclosed and the work of setting up the Nordberg hoist is well under way. At the electric plant, near the Amicus mill, machinery is being erected, the building being complete. The boiler plant, which will furnish steam to operate the two above-mentioned installations, is making good progress. Nearly all brickwork is done, and the roof will soon be finished.

With the completion of a station now being cut at the 1400-ft. level in the Oro Hondo shaft, the auxiliary hoisting engine will be removed from the 1000-ft. level to the new station, and sinking resumed. A small amount of water is being encountered below 1000 ft., and this is easily handled by sinking pumps. From the dam on the latter level, water is hoisted to the surface in the skips operated by the main hoist. Considerable water is handled from this point, as on this level are nearly 3000 ft. of lateral workings.

Shaft sinking has commenced at the Echo property, in the Maitland district, starting from the surface. The equipment includes a 22-hp. Vulcan single-drum hoist, driven by electric motor; an 8 by 8-in. Bury single-stage belt-driven compressor, operated by electric motor; two Western air-hammer sinking-drills; a Shaw drill-sharpener; and a swing cut-off saw in the timber-framing shed. Everything about the plant is running smoothly, and good progress may be anticipated in sinking the several hundred feet the Company proposes to do.

With the addition of 60 stamps to the Golden Reward mill, at Deadwood, the plant will be practically doubled in capacity. The stamps being used are those purchased at the old Hidden Fortune mill, which the Company took over last summer. Treatment of the Company's 'blue' ores, by roasting and fine grinding prior to cyaniding, is yielding good results, and the Company hopes to make the present one of its banner years in point of gold production.

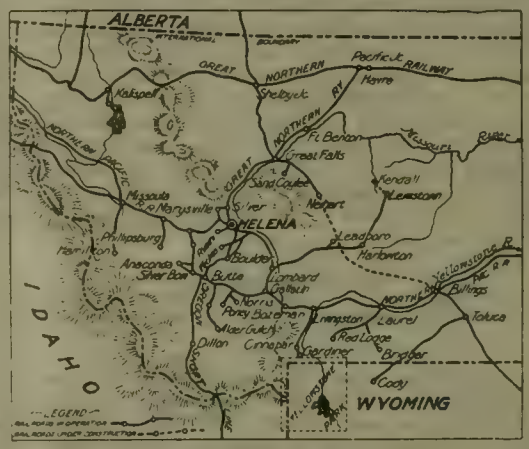
Shaft sinking is under way at the Hidden Treasure property in upper Deadwood gulch, and the shaft, which was 210 ft. deep when unwatered, is rapidly being deepened with the aid of air-drills. The formation is phonolite and porphyry, cut by numerous lenses of ore carrying a large amount of fluorite. S. R. Thompson, of Deadwood, is superintendent.

HELENA, MONTANA

HISTORY OF THE HELENA DISTRICT.—WORK OF THE HELENA MINING BUREAU.—DISTRICTS AND MINES.

Ever since 1893 the mining industry in the Helena mining region has been in a quiescent state. Up to that time Helena was one of the best known mining centres in the West, and work was progressing rapidly and satisfactorily in the adjacent mining districts of Rimini, Unionville, Lump Gulch, Marysville, Corbin, Wickes, Montana City, and others. Various causes contributed to the closing of a large number of these mines, and owing to local financial difficulties many of them were not reopened for several years. In the meantime the miners and prospectors of the region went elsewhere. After their departure, prospecting in the hills and valleys was continued in a desultory manner, and several efforts, more or less successful, to secure the enlistment of capital, were made without any continued specific results being obtained. The latest movement in this direction is in the hands of the Helena Mining Bureau, Inc., which was organized and incorporated through the Helena Commercial Club for the purpose of conducting a campaign for the revival of the mining industry for a minimum period of three years. The Bureau was incorporated for $100,000 at a par value of $5 per share, the minimum subscription received being for thirty-six shares, payable one share per month.

The working plan proposed and adopted was to take over a property within a radius of 10 miles of Helena, and to develop it; if it showed promise, to turn it over to a larger aggregation of capital at a reasonable advance over its cost to the Bureau. Two hundred and eighty-two individuals of the business and professional classes subscribed for the stock, giving the Bureau a monthly income of $1500. Forty-nine properties were offered to the Bureau and carefully examined by responsible mining engineers. Two of these were leased and bonded, and work started immediately. One property consists of three claims known as the Wayside group, situated in the Scratch Gravel hills, six miles from Helena; the other, known as the Hawkeye mine, is within the city limits. The Bureau equipped both properties with machinery good for 500 ft. depth. The work is conducted under the supervision of a board of seven directors chosen from the responsible



MAP OF MONTANA.

business men of the city, who give their time and work free of cost to the Bureau. The results so far obtained in both properties are very gratifying to all concerned, tending to increase the confidence of local people in their mining resources.

Outside of the 10-mile district, the Bureau receives listings of various properties in which investment can be made, and which are all open to full examination by mining men. *Bulletin* 527 of the U. S. Geological Survey gives a full description of what is known as the Helena mining region. The data for this bulletin were compiled under the direction of Walter Harvey Weed. On the invitation of the Bureau, Mr. Weed came to Helena and made a detailed examination of the country within the 10-mile radius, and conclusions summed up in his report are to the effect that the Helena area presents great opportunities worthy of investigation and development by large capital.

The work of the Bureau has had a most remarkable influence in this district. Owners of properties lying idle for some years have resumed work. Prospectors have been active and in the whole district there have been more men working than for many years past. In addition, outside mining men are coming in, making purchases and preparations for developing them. In the Bald Butte and Marysville districts the older mines are being reopened, and new organizations perfected. The Shannon, Cruse, Bald Butte, and Piegan-Gloster are working and planning for larger development. The famous old Drumlummon and St. Louis properties, after a stormy career in the courts, running over some 22 years, are

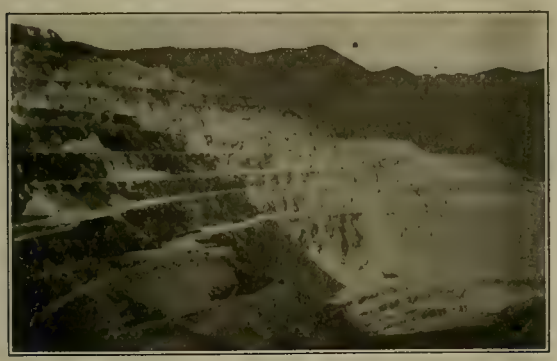
approaching a point where responsible parties will take hold of them.

In the Rimini district, James Breen has installed the first unit of a 500-ton stamp-mill for working the great porphyry dike. The Valley Forge, which opened good ore last fall, is working continuously. The Lee Mountain and other large properties there will be working steadily by spring.——In the Unionville district there is also great activity, a number of Butte men having secured ground with a splendid past record and with which they are entirely satisfied. The old Whitlatch Union and the Spring Hill properties, both of which are acknowledged to be of excellent promise, will be actively worked within the next few months by ample capital.——Several discoveries have been made in the Montana City and Jackson Creek districts, on which work is being actively conducted.——The Franklin mine, in the Scratch Gravel hills, four miles from Helena, owned by the estate of Thomas Cruse, the original locator of the Drumlummon, has been shipping a high grade of steel galena for the past year, and still continues to do so. The mine is also shipping high-grade free-milling gold ore from a cross lead on the same property.—— The York Mining Co., at York, north of the Missouri river, took over the old Little Dandy property last year. The Company installed a large mill and the results reported are very gratifying.

NEW YORK

Dividends Paid by Mining Companies.—Railways and Rivers of Alaska.—Utah Copper Mill Improvements.

Total dividends paid by 120 mining companies in the United States during 1914 amounted to $96,820,912, according to compilations made by one of the brokerage houses. This does not include some of the largest copper companies, and the same



SOME OF THE UTAH COPPER CO.'S WORKINGS.

authority states that if these companies were included, the total would exceed the dividend disbursements of all the railways in the United States for the same period. The average yield to stockholders was 18%, not including any profit due to increase in the selling price of the stock.

Both the Copper River & Northwestern and the Alaska Northern railroads have been offered for sale to the United States government, which is now authorized to own and operate railroads in the territory. The Copper River road with its terminus at Cordova, cost $25,000,000 for its 196 miles of line. The Company has $50,000,000 stock. The Alaska Northern has issued only $5,000,000 of the $30,000,000 of stock and bonds authorized. The government has provided $35,000,000 to be expended for its railroad. Franklin K. Lane has stated that surveys have been made for other lines up the Copper and Susitna River valleys, respectively, which would obviate the necessity of buying either line. The Coast and Geodetic Survey has discovered a channel through the delta of the Kuskokwim river and the shipping lines from Seattle have announced sailings to the Kuskokwim at the opening of navigation in the spring. The Kuskokwim is, next to the Yukon, the largest river of Alaska, but although it is 9 miles wide at its mouth and navigable for 600 miles inland, the flats and bars of its delta have until now effectively barred the entrance of steamers. The opening of a channel will aid greatly in the development of this part of Alaska, which has been held back by its inaccessibility.

As a result of the introduction of the flotation process at the mills of the Utah Copper Co. the Magna will be increased from 12 to 18, and the Arthur from 9 to 12 units. This will increase the capacity of these plants from their present 20,000 to 30,000 tons per day. For the agitators to be used, an ingenious mechanical improvement has been made, in that instead of being driven by belts, the propellers are placed on the extension of the shaft of a suspended 10-hp. motor. It has been computed that the cost of the copper recovered by flotation will be 4½c. per pound. This, of course, does not include a proportionate part of the preceding work done on the ore; but merely represents the cost of saving copper which would otherwise be lost in the tailing. The increase in the output resulting from the greater saving will bring the total production of the Utah Copper up to 200,000,000 lb. annually. Some time ago the Utah metallurgists made an ingenious improvement by re-concentrating the concentrate from the concentrate; equivalent to a reduction of $1 per ton in smelting charges.

A seat on the Stock Exchange was transferred for $40,000 on January 28. This is $2000 above the last sale.

TORONTO, ONTARIO

Power Shortage at Cobalt Resulting in Curtailment of Operations.—La Rose, Nipissing, Temiskaming, Crown Reserve, and Tough-Oakes Mines.

The output of the Cobalt silver mines will be considerably curtailed during the next three months or more on account of the shortage of power. Owing to the light rainfall last year, the Northern Ontario Light & Power Co. finds that it is unable to deliver the power required for operating the mines at capacity. Arrangements have consequently been effected under which every mill is to be closed down for one week in every four. Under normal conditions, the Company has a capacity of 17,000 hp., but with the present low water the greatest available volume of power is 10,200 hp., of which the mills alone require 5000 hp. The decrease went into effect on January 25, causing the laying off of about 300 men. Some of the mining companies will shut down for three weeks at a time, so as to have only one stoppage, and others will close for a week every month. Mining operations will in many cases be continued with power from auxiliary steam plants.

The quarterly report of the La Rose Consolidated ended December 31, 1914, shows a reduction of the total surplus, which amounts to $1,214,400, compared with $1,396,619 for the previous quarter.——The financial statement of the Nipissing, as of January 2, shows a surplus of $1,396,778, of which $437,524 was cash.——The recent discovery on the Temiskaming is proving to be of considerable importance. The vein which came in from the Beaver on the 530-ft. level has been followed 40 ft., and is still good in the face, and 5 in. wide, forming one of the longest ore-shoots so far found on the property. It has yielded 9 tons of ore.——The annual report of the Crown Reserve will show a decrease in production of about 250,000 oz.——The power-plant of the Meteor mine, which adjoins the McKinley-Darragh, was completely destroyed by fire on January 15.——At the Tough-Oakes, the mill is nearly ready for operation, all that remains to be done being the adjustment of some parts of the machinery. The first treatment of ore is expected in March. There is about 7000 tons of ore on the dump. Active underground work has been resumed, and 13 faces can supply ore.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press.

ALASKA

Cordova

A shipment of 250 tons of copper ore from the Mother Lode mine left Cordova by the *Mariposa* on January 16. The total to date is 391 tons, averaging $160 per ton. Another lot will be sent out in February, and the superintendent, J. J. Godfrey, expects to ship about 1500 tons this winter. A Leschen aerial tram carries ore to McCarthy Creek flats, and there is a sled haul of 14 miles to the railway. The property was fully equipped last summer. There are 40 men employed.

Fairbanks

Quartz miners at Fairbanks are busy. The Rhoads-Hall company employs 24 men, and the mill crushes 17 to 20 tons

RHOADS-HALL MINE AND MILL, FAIRBANKS.

per day. Crites and Feldman are extracting good ore. C. E. Hellig is preparing his mill for custom work. The Chatham mill recently crushed 100 tons for McNeil. The Newsboy company hopes to develop ore in its 100-ft. drift.

Iditarod

Gold valued at about $250,000, the property of the Yukon Gold Co., was hauled from Iditarod to Tanana by J. M. Haley and partner with a dog-team on December 29. The gold was delivered to the stage for shipment to Chitina and the 'outside.' Mails to Iditarod are going in from Seward. Mining is quiet in the lower river areas, but miners are optimistic.

Juneau

The federal mining inspector, Sumner S. Smith, will probably ask the territorial legislature to amend the mine inspection law passed at Juneau two years ago, giving him full power to enforce the regulations. The law states that the territorial inspector shall work under the direction of the federal mining inspector, but it fails to give the latter jurisdiction in seeing that the law is upheld. Mr. Smith has started classes of instruction in pulmotors and helmets at Treadwell.

In the application of the Matanuska Coal Mining & Development Co. for title to 1290 acres of coal land in the Matanuska district, the land department at Juneau has refused to grant it. The government stated that the locators did not make preparations for mining coal, which the Company admitted, but claimed that work done three years ago entitled them to the title under the Alaska Coal Land act of 1904.

In the Sheep Creek power suit of the Alaska Gastineau and Alaska Treadwell companies, the latter has been upheld by the Supreme Court at Washington, D. C.——The new 2500-hp. turbine at Treadwell was 'cut in' on January 19. While testing the machine, T. Rattray, of the General Electric Co., and other attendants, were severely burned by an oil switch accidentally exploding.

The Alaska Treadwell mills crushed 61,341 tons of ore in December, yielding a total of $127,714. Operating expenses totaled $85,017, and construction $62,443, leaving a loss of $21,024. The stock of broken ore in stopes was decreased by 32,137 tons.——The Mexican mine produced 19,040 tons of ore yielding $42,814. Including construction expenditure, there was a loss of $5984.——The United mill recovered $94,188 from 39,261 tons. Construction cost $28,494, but the profit was $12,744.

ARIZONA

There was heavy rain and snow in the central and southern portions of the state at the end of January, resulting in floods almost as disastrous as those of a month ago. Streets at Phoenix and at Globe, Miami, Glendale, Tucson, Bisbee, Tempe, Buckeye, and Arlington were under several feet of water on the 30th. Ranchers in the lowlands were forced to flee for their lives. The Salt river overflowed, the flood attaining a volume greater than the highest point known. The Santa Cruz, Gila, and Rillito rivers also filled their valleys. Globe and Miami were isolated for several hours.

Cochise County

On February 1 the Copper Queen and Calumet & Arizona companies will start a profit-sharing system, or sliding scale of wages with their employees at Douglas. This will be based on the price of copper.

Gila County

The annual report of the Old Dominion Co. of Maine for 1914 shows that dividends received from the Old Dominion Copper Mining & Smelting Co. at Globe totaled $860,409. The increase in value of shares held was $582,573, making $1,415,008 available, of which $1,173,412 was paid in dividends. The surplus at the end of 1914 was $433,064.

Mohave County

At 300 ft. in the United Eastern mine, east of the Tom Reed, the vein has been opened 16 ft., assaying $30 per ton. Sinking is to be continued to 500 ft. depth.——Good ore is still being opened at 300 ft. in the Gold Ore, at Gold Road.——It is reported that the Golconda zinc mine, 16 miles north of Kingman, is to be sold to an influential syndicate operating in Arizona.

CALIFORNIA

Amador County

The Argonaut at Jackson has paid a quarterly dividend of 30c. per share, or $60,000. N. S. Kelsey is superintendent.——A rich stringer has been cut in the Amador Queen, south of Jackson.——A 5c. dividend has been paid by the South Eureka company. There are about 300 men employed at present.——At Amador City the Keystone company has installed a motor-driven hoist, and the 40-stamp mill will soon be in full operation. Development down to 1400 ft. is encouraging. C. R. Downs is manager.

Butte County

According to James H. Leggett of Oroville, eucalyptus trees planted in the old dredge tailing nine years ago are now being used for telephone poles, fence posts, and other work. It is not necessary to level the rock piles. The young trees are

planted in the fall. His results with grapes grown on this material are well known, while figs peaches and apricots have done well. The theory of the success of fruit grown on dredge tailing is that the warmth of the rocks accumulated by day is slowly given off during the night, also the roots can spread with ease.

A good deal of coarse gold nuggets from 4½ to 37½ oz., from the Santa Claus claim, has recently been recovered from Squirrel creek, which joins the Feather river near Spring Garden tunnel. The gold is found on bedrock. E. A. Ludwick and others from Nevada have purchased the Gabbert quartz claims and are installing a hoist and compressor, and will prospect for the source of this gold.

Calaveras County

At the Royal property at Hudson, the 300-ft. level has been explored for 300 ft. south, showing 6 to 20 ft. of quartz, and 10,000 tons is broken ready to hoist. The manager, F. W. Page, states that tracks with loaded cars, as left years ago, are in good condition, walls standing well, and ore-bins are filled with ore ready to draw, also in good order.

Eldorado County

According to the *El Dorado Republican*, 'Promotion Edition,' gold mining in this county is less active than for 25 years. With few exceptions, only prospecting and development is being done in the quartz areas. However, this is not considered discouraging when the conditions are understood. Not much is being done between Placerville and Nashville. The Guildford Gold Mining Co. is working its mine by adits, and has 15 stamps crushing ore, in charge of A. Baring-Gould, two miles north of the former town. Sluicing has given place to drift mining at the Georgia Slide deposits near Georgetown. Limestone deposits are actively worked.

The old Springfield mine, which produced a large amount of gold down to 1600 ft., is to be unwatered and reopened by J. A. Finch, well known in Spokane. He is assisted by Enol McBoyle, who has been examining the property for some time.

Nevada County

(Special Correspondence.)—The Union Hill mine at Grass Valley has completed sinking the three-compartment shaft to the 800-ft. level. A station has been cut and driving is now in progress, the objective point being an ore-shoot that was developed through a winze sunk to a depth of 50 ft. below the 600-ft. level a year ago. This supplied ore for the operation of the mill from a stope 100 ft. long. This shoot is 125 ft. southeast of the shaft on the 600-ft. level, and has a slight dip to the southeast.

Grass Valley, February 1.

A new three-stage 500-gal. per min. Byron Jackson centrifugal pump is now working in the Golden Center mine. Development is quite satisfactory.

The North Star company has purchased the Muller and Walling claims, between the Nevada City and Spanish mines. This gives the company holdings of nearly two miles in length.

Shasta County

The agreement made with the Mad Ox Mining Co. by the owners of the Mad Ox claims at Stella for $12,000 has been extended, payments to be deferred to July 15, 1915, and May 15, 1916. The Company will pay 15% royalty on ore milled, the royalty to be applied to the purchase price.——Near Gas Point 1160 acres of placer ground has been located by San Francisco men, who already have about 1200 acres between this place and Igo.

Sierra County

The old Dead River mine is being reopened by Eastern people, in charge of R. E. Holmes.——An air-compressor and machine-drills are being installed at the Gold Bluff mine near Downieville. Salt Lake City people are interested.——A ventilating fan is now running at the Ruby mine.——At the Monarch Consolidated, known as the Lee, 20 stamps are working. D. McGonigal is in charge.

Trinity County

There is plenty of water in this county for hydraulicking, and the Trinity Consolidated, Testy, Lagrange, and others are busily sluicing.

Yuba County

Title to the Jefferson mine at Browns Valley is in dispute, and F. W. Johnson's claim to it is contested by B. Durris and others, a temporary injunction has been obtained against the latter from doing assessment work, both having been complying with the law.

COLORADO

Gilpin County

The Carr Mines Co. has completed its new mill. It consists of a crusher, Challenge feeders, ten 750-lb. stamps working at 53 drops per minute, amalgamating plates, two Gilt Edge tables, and No. 6 Willfley concentrators. The plant is motor-driven and crushes 30 tons per day. This type of stamp was installed to prevent sliming, and aid amalgamation.——The Fifty Gold Mines Co. of Black Hawk intends to remodel its mill, and erect a sampling plant for custom ores.——Regular shipments of gold-silver-copper ore are being made from the Pittsburgh mine in lower Russell gulch.

Lake County (Leadville)

Another serious fire, the fourth in the district in a few months, occurred on January 24, when the Big Five Operating Co.'s Big Four mine plant was destroyed, with a loss of about $20,000. The local opinion is that there is an incendiary in the district. The Colorado Power Co. has a contract to supply an electric hoist and compressor for the property.——Motors are being installed at the Penrose shaft of the Down Town Pumping Association.——The Canterbury hill and Prospect mountain tunnel scheme is gaining interest, and enough money will be raised locally.

High-graders put in several holes in the 700-ft. level of the Connor's lease of the Little Jonny mine, blasted out gold ore, and stole to the amount of $5000 one night last week.

Summit County

The annual meeting of the Rico-Wellington Mining Co. was held at Provo, Utah, on January 28. Jesse Knight is president, and J. C. Jensen, manager. The latter reports the mine in good shape for increased shipments of copper ore.

Net earnings of the Tonopah Placers Co. for the quarter ended November 30, 1914, totaled $101,982.

Teller County (Cripple Creek)

Another and lower drainage tunnel for this district is suggested by C. C. Hamlin, of Colorado Springs, the manager for the Granite company.——Official returns of ore from the Creson shoot show that 88 tons averaged 206 oz. gold per ton, and 76 tons, 105 oz., the total being worth $520,000.——Lessees are working down to No. 10 level in the Blue Bird.——Buildings and machinery are being erected by the Hondo company on Battle mountain.——Three cars of $15 ore have been marketed from the Cripple Creek company's Kohnyno vein in the Fortuna shaft at Victor.

IDAHO

Blaine County

A recent shipment of 42 tons of ore from 500 ft. in the Wilbert mine, 25 miles north of Arco, in the Dane district, averaged 56.85% lead and 21.4 oz. silver. This ore is sent direct to the smelter without concentration.

Clearwater County

The Pierce district placer claims are to be the scene of considerable work. The 100 acres of ground formerly owned by the American Placer Mining Co., on Orofino creek, are to be dredged by John M. Porter. Estimates give 25c. per yard.

The Hare company is operating a boat of 2000-yd. capacity per day. Another one is to be constructed for W. J. Harris about four miles from Pierce. A sawmill has been erected to cut 100,000 ft. of lumber for this dredge.

SHOSHONE COUNTY (COEUR D'ALENE)

A 100-ton mill is to be built for the H. E. M. Mining Co., operating three miles northwest of Wallace. During 1914 development consisted of 2479 ft., and expenses totaled $22,127. The sum of $20,000 will be raised for the plant. An adit is in 2276 ft., and a vein has been opened for 250 ft. Ben L. Collins, of Spokane, is secretary.——The annual meeting of the Mexico-Coeur d'Alene Mines Co., operating 12 miles from Thompson Falls, Montana, and eight miles from the Hercules mine at Burke, Idaho, was held in Spokane recently. The superintendent, John Burnham, stated that 17 ft. of milling ore has been opened in the lower adit. Shareholders decided to install a compressor plant and other equipment to be operated with electric power.——Some rich ore is being opened in the winze below the lowest level of the Caledonia at Wardner.

Dividend No. 209, amounting to $81,750, was paid by the Bunker Hill & Sullivan company on February 4. The total to date is $15,873,750.——The Tamarack & Custer Mining Co. held its annual meeting at Wallace on January 29. The present surplus is $100,000. Concentrate shipments amount to 1500 tons per month. Jerome J. Day is general manager.——It is probable that the Interstate-Callahan company will enlarge its present mill, instead of erecting a new one.——When the new electric pump is installed in the Hypotheek, sinking will be resumed to 1100 ft.——The Tuscumbia mine has been leased for 2½ years to G. Ehrenberg and A. Nelson. Ore will probably be treated at the Idora mill.——The Montana Power Co. will be ready to supply current on Beaver creek by April 1.

MICHIGAN

BARAGA COUNTY

(Special Correspondence.)—The discovery of vanadium ore was reported 27 miles east and north of L'Anse in November 1914, and the ground has been examined for the Michigan Geological Survey by W. E. Hopper. Owing to snow, only local geological conditions could be studied, but several of the statements of George W. McGhee in the *Mining and Engineering World* of December 12, 1914, concerning this property are incorrect, no carnotite being present, and the presence of vanadium ore being doubtful.

Houghton, January 24.

HOUGHTON COUNTY (THE COPPER COUNTRY)

In recent issues of *The Daily Mining Gazette* of Houghton are two interesting articles, namely, 'Recollections of Silver Islet,' by Samuel Brady, and 'Copper Mining in the Early Days,' subject for extracts from books printed for the Centennial of 1876.

The former describes the work done on the island since the discovery of silver there in 1868, by Gerald Brown, a Canadian government surveyor. The island, or rock, was only 40 by 60 ft. and only 3 ft. above the surface of Lake Superior. In rough weather it was swept by the waters, which destroyed the work in progress. The vein yielded considerable silver, ore averaging from $20,000 to $26,000 per ton in 1871-2, the metal then being $1.28 per ounce. During the second, third, and fourth years of the Company's work, dividends totaled $360,000. In March 1884 the shaft was down to 1160 ft., and a winze 70 ft. deeper, but shortage of fuel allowed the water to gain on the operators, resulting in a permanent shut-down.

In the second article, the history of the Copper Country is given. The Jesuit missionaries reported the existence of native copper in 1659 to 1666. An Englishman, Alexander Henry, made the first attempt at mining in 1771, near the forks of the Ontonagon river, where was a large mass of metal. In 1841, Douglas Houghton, state geologist of Michigan, made the first examination of the district. He was drowned on October 13, 1845, near Eagle river. Numbers of mines were started in 1850, using crude methods of extraction. The Cliff mine produced 22,374,588 lb. from 1853 to 1860. The Minesota was the important property of the Ontonagon area for 15 years, and was remarkable for its mass copper. In 1859 it employed 718 men, and yielded 1626 tons of metal worth $515,786. Freight to Boston was then $11 per ton, against $20 the previous year. Copper exports in 1860 totaled 8543.4 tons, an increase of 2000 tons over 1859. The following is a list of the mines in the district in the year 1860: Central Clark, Connecticut, Copper Falls, Eagle River, North American, Northwest, Phoenix, Pittsburgh & Boston (Cliff), C. C. Douglass, Isle Royale, Franklin, Hancock, Huron, Mesnard, Pewabic, Portage, Quincy, Adventure, Astec, Bohemian, Hamilton, Mass, Minesota, National, Nebraska, Norwich, Ogima, Ridge, Rockland Superior, and the Toltec. The Minesota is the most important of any of the mines mentioned in the district.

At the Isle Royale new mill, three sections of the steel frame are up, and equipment is being received for installation. No. 1 shaft of the mine is to be reopened, and will produce 'rock' at No. 11 level. Large shipments are being made to the Allouez-Centennial mill, in spite of stormy weather.

MISSOURI

JASPER COUNTY

The Weaver mill, near Carl Junction, was destroyed by fire during the third week of January. The mine has been closed for some time.——One man was killed and another injured by a fall of ground in the Llewellyn area, northeast of Joplin, on January 26.

MONTANA

With the first biennial report of the Department of Labor and Industry of this state for the year 1913-14, W. J. Swindlehurst, commissioner, appears the report of the inspector of quartz mines, W. B. Orem. He states that the mining industry is one of the most important of the country, supplying 65% of the freight traffic of the railroads. His report covers accidents, sanitation, ventilation, shafts and cages, electric power, explosives, a synopsis of the state's mining laws, mineral output, and the important mines of the counties. Silverbow county is covered by the deputy mine inspector, D. J. McGrath. There are also reports by the coal mine inspector, John Sanderson, and the boiler inspector, Percy L. Brown.

NEVADA

ESMERALDA COUNTY

Final returns of the Goldfield Consolidated for December are as follows: ore treated, 29,851 tons; net realization, $195,-119; costs, $5.67 per ton; and development, 2528 ft. at $5.66 per foot. In the Combination mine the 292-Z sill at 230 ft. produced 111 tons of $127.60 ore. Lessees mined 1166 tons worth $19,394, of which the Company received $10,584, less cost of transport and treatment.

In the Florence the incline rise is up 40 ft., but bad air has hindered progress. There is 9 ft. of $50 ore showing in the top.——A winze below 700 ft. in the Kewanas has cut the latite-shale contact at 840 ft. Four feet of low-grade quartz was cut between the two formations.

LANDER COUNTY

Stream tin was recently discovered at Battle Mountain, according to *Press Bulletin* 7 of the Mackay School of Mines.

NYE COUNTY

Six mines at Tonopah produced 10,997 tons of ore worth $223,906, during the week ended January 30.——The report of the Tonopah Mining Co. for the quarter ended November 30, 1914, shows that the value of ore treated was $588,138. Net earnings totaled $226,152, and sundry income $82,686, of which total $18,917 was spent in exploration and Moore Filter suit.

Dividend on October 21 was $250,000, and cash at the end of the quarter $88,691. Net assets are $1,698,769.

A fire-protection scheme is being installed at the Extension. Forty more leaves are being added to the filter to cope with the daily output of 270 tons.——Development in the Belmont continues excellent.——Ore is being sent from the Montana mine to the West End mill.

STOREY COUNTY

It has been decided to continue work on the lower levels of the Belcher mine on Gold Hill. The joint incline is being reopened in the fire area, and a temporary pumping plant is to be installed. The two pumps under water at 1500 and 1600 ft. will be recovered. Plans are now under way to consolidate the Belcher, Crown Point, and Yellow Jacket, adjoining companies, and this would result in economies and better mining results.

OREGON

BAKER COUNTY

(Special Correspondence.)—The Ben Harrison mine, near Greenhorn, which has ore blocked out estimated to be worth $900,000, and has heretofore been shipping the concentrate product of its 20-stamp mill to Tacoma, has decided, after careful tests, to install a cyanide plant to cost $65,000. Snow in the Greenhorn is now 42 in. deep, but a road is to be broken at once to the mine, and the new plant started as soon as possible. It is estimated that the saving effected will pay for the new plant in less than a year.

Greenhorn, January 26.

JOSEPHINE COUNTY

Mining men of Grants Pass discussed the appropriation for the state Bureau of Mines and Geology with the director, H. M. Parks, last week. The institution was declared of great value to the industry, and a biennial allowance of $50,000 is to be asked.

TENNESSEE

POLK COUNTY

The Tennessee Copper Co. is planning an extension to its acid plant. The Company's contract with the International

ACID PLANT OF TENNESSEE COPPER COMPANY.

Agricultural Corporation is still in force to supply acid. The improved copper market makes it possible to resume construction of other plants stopped early in August. A steel headframe has been erected at the McPherson shaft, a new furnace at the smelter, while machinery is to go to Copper Hill. The new hoist at Burra Burra and McPherson mines will double their capacity. About October 1, 1915, copper will be produced at the rate of 20,000,000 lb. per year, at a cost of perhaps 2c. per pound lower than at present. Ore reserves are estimated at 25 years' supply.

UTAH

JUAB COUNTY

Forty men, 32 lessees and eight on Company account, are working the Lower Mammoth, from 400 to 1800-ft. level. The Company is developing at 700 and 1000 ft. Some good zinc ore is coming from 1500 and 1800 ft.——The Eagle & Blue Bell is shipping a good deal of ore from 1700 ft.——The Dragon Consolidated is producing 200 tons per week. A new shoot of gold ore occurs at 600 ft.——Preparations are under way to resume work at the Mammoth.——There is a shortage of water for this part of the district.——Some fair gold ore is coming from 800 ft. in the Chief Consolidated.

SALT LAKE COUNTY

As part of the Magna mill of the Utah Copper Co. is under repair, several units of the Arthur plant were started last week. This will result in no increase of copper production.

Ore shipped by the Utah-Apex company in December amounted to 4157 tons of smelting material, 9172 tons for the mill, and 3093 tons of concentrate.——It is reported that ore has been cut in the Columbus Extension adit in the Alta-Big Cottonwood district.

WASHINGTON

FERRY COUNTY

(Special Correspondence.)—A further dispute has arisen at Republic. In this case the Lone Pine, Pearl, and Surprise mines, the Republic Mines Corporation (bankrupt), Republic Consolidated Mines Corporation, Western Union Mines Co., J. L. Harper, and A. J. Laughon are concerned. In brief, the last mentioned states that the Western Union company has failed to comply with an agreement made with him for the Republic Consolidated about the mines mentioned, therefore the Consolidated resumed possession of its properties. The Western Union company failed to meet its December payroll on January 25, 1915, and over 100 miners walked out. Liens have been filed on the assets of this concern, including ore, bullion, precipitates, and solutions in the San Poil mill, which plant is under option to the Western Union. All of its options have been forfeited. Mr. Harper is suing the Lone Pine-Surprise company for damages for alleged misrepresentation. A representative of the West Virginia people controlling the Western Union has gone East suddenly, and S. M. Croft, president of the Company, says he will meet the payroll and reorganize if necessary.

The affairs of the San Poil Consolidated mine and mill are under investigation, the Company being heavily in debt.—— The Ben Hur Leasing Co. has deferred its December pay-day, owing to the absence of a leading member of the Company.

Republic, January 30.

KITTITAS COUNTY

(Special Correspondence.)—The new year started with considerable activity in the Swauk district, in both placer and quartz mining.

The Cougar mine has started operations again, and considerable development will be done this winter, and as soon as the weather permits the 10-stamp mill will start crushing. George Marshall, of Vancouver, B. C., has charge of the property. Mr. Nettle, also of Vancouver, is now examining the mine. In the past, straight amalgamation has been used in the mill, and results have not been altogether satisfactory, and it is probable that the process will be changed.——C. B. Killson, owner of the Nellie quartz mine, has opened a 4½-ft. vein of fair ore in the shaft.——J. T. Sugars and J. F. Powers have taken a lease and bond on the Beckman placer claim. A drainage adit has been started from Williams creek, and 200 ft. has been completed. They expect to strike bedrock in about 100 ft. more. ——The Trilby gulch placer, owned by K. Enekel, has been leased by four miners who will start piping as soon as there is water. This placer has been a good producer and has been only partly worked.——What is of great interest to this district at present is the possibility of two large dredges being operated here in the near future. George T. Coffey, an Alaska mining man who came here last fall, has done a great deal of prospecting on Swauk creek, and with gasoline hoists and pumps he has pretty thoroughly prospected for about five miles.

This spring he will start the prospecting of Williams creek. He has taken a bond on about 35 claims here. If prospecting results are satisfactory, it is understood that two dredges will be built, one on Williams creek and the other on Swauk creek. Mr. Coffey will prospect Lions creek also, if he can secure the right-of-way up the gulch.

Liberty, January 7.

(Special Correspondence.)—Placer miners on Swank, Williams, Nelson, Lions, and other creeks in the Swank district are busy, and getting satisfactory results.

Liberty, January 27.

CANADA

Ontario

To lessen the unemployed problem at Timmins, the Hollinger company and town council have put men at work cutting cord-wood at $1.25 per cord. There is 320 acres of land nearby to be cut. The annual meeting of the Hollinger was held in Montreal on February 2.——At the Vipond, the Davidson vein has been opened 75 ft. on the 300-ft. level, and is from 4 to 6 ft. wide. The mill is treating 100 tons per day.——Development at 400 ft. in the Dome Lake continues satisfactory. A second clean-up at the mill produced $5000.——No. 4 shaft of the McIntyre mine is down to 600 ft.——The Crown Reserve company's profit in 1914 was $239,477, against $528,287 in 1913, and surplus after dividends $477,711.

MEXICO

Hidalgo

In cross-cutting south on the No. 16 level at a point 870 ft. east of San Guillermo shaft of the Santa Gertrudis, a vein has been cut 700 ft. south of the north vein. In the cross-cut the vein is 10 ft. wide, assaying 19 oz. silver and $1 gold per ton. Driving on this vein is in progress, and for the first 48 ft. assays 57 oz. silver and $4 gold per ton, the vein being wider than the drift.

Sonora

It is reported in Douglas, Arizona, that the Constitutionalists have raided El Tigre and commandeered considerable supplies.

AERIAL TRAMWAY OF SAN LUIS MINING CO., DURANGO.

The 'port' of Agua Prieta has been closed to the importation of food and merchandise for the south. This was ordered by the Carranzistas. Mining companies, including the Moctezuma and Tigre, will soon face a shortage if this is kept up.

PERSONAL

Gerald Brown is in New York.

Charles Janin was in New York last week.

H. Foster Bain has returned from New York.

Morton Webber sailed on the S. S. *Baltic* on January 27 for London.

T. A. Rickard returned to London on the S. S. *Lusitania* on January 30.

A. A. Boyd has been made superintendent of the Mt. Morgan mine, Queensland.

Scott Turner is in this country from Spitzbergen and has gone to Minnesota.

E. H. Leslie is at Columbus, Ohio, where he went to attend the funeral of his father, who died suddenly last week.

Charles T. Kruse has been appointed superintendent of the Jones & Laughlin mines on the Marquette and Menominee ranges.

Harry Huntington Miller has been appointed manager for the Cia. A. Minera Lo Increible, at its mines in El Callao district, Venezuela.

James Douglas, accompanied by W. H. Brophy, recently made his customary trip of inspection to the United Verde Extension in Arizona.

James F. McCarthy, president and manager of the Hecla Mining Co., at Wallace, Idaho, has been elected president of the Idaho Mining Association.

Herman A. Wagner is making an examination of the Crown King district, Yavapai county, Arizona, with a view to erecting a custom treatment plant.

George P. Vanier, chief chemist for the Pennsylvania Steel Co., at Steelton, Pennsylvania, has been awarded a certificate of merit by the Franklin Institute of Philadelphia, for his potash bulb for use in the determination, in industrial laboratories, of the total carbon in iron or steel.

The U. S. Civil Service Commission announces an open competitive examination for consulting mining engineer, to fill this position in the Bureau of Mines, for service in the field, at a salary ranging from $3000 to $3600, or at the rate of $10 per day when actually employed. The duties of this position will be to make examinations in different parts of the United States, including Alaska, concerning gravel gold mining operations, including dredge mining, hydraulic mining, and drift mining; and to prepare reports for the Bureau on this industry. As prerequisites for consideration for this position, the applicant must have had professional experience as mining engineer in connection with gold mining operations, extending over a period of not less than 10 years, of which not less than five years must have been given to professional work in connection with gravel gold mining operations. This professional work must have included operations in connection with dredge mining, hydraulic mining, and drift mining. Graduation with a degree in mining engineering, from a college or university of recognized standing, will be accepted in lieu of two years of the required professional experience. Applications must be in by March 2.

The San Francisco branch of the A. I. M. E. will meet at the new Clift hotel on Tuesday, February 9. C. E. Wells, metallurgist for the Selby Smoke Commission, will speak on the fume question.

The Michigan College of Mines has asked the state for $154,708 for maintenance and extraordinary expenses to cover the next two years.

The Northwest Mining Convention meets at Spokane on February 22-27.

THE MARKET PLACE

Weekly Summary of Prices of Shares and Metals

Metal Prices

San Francisco, February 4

Antimony	.18	18⅝
Electrolytic copper	15½	15¾
Pig lead	4.05	5.00
Quicksilver (flask)		$55.00
Spelter	8½	8⅝
Tin	.38	39½
Zinc dust, 100-kg. zinc-lined cases	.11	12½

On account of the rise in spelter, zinc dust is also moving upward. Fair supplies are now coming from Australia.

EASTERN METAL MARKET

(By wire from New York.)

New York, January 4.—Copper is quiet but firm, lead quiet, and spelter strong and excited, as domestic supplies are low and foreign demands heavy.

Metal quotes in the delayed telegram of the week ended January 28 were as follows: copper, 13.75, 13.87, 14.00, 14.00, 14.12, and 14.25c.; lead, 3.70c. every day, and spelter, 6.55, 6.75, 6.75, 6.87, 7.12, and 7.25c. per pound.

The past month's markets are discussed on the next page of this issue.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Jan. 28	14.25	Dec. 23	12.84
" 29	14.37	" 30	12.75
" 30	14.50	Jan. 6	12.92
" 31 Sunday		" 13	13.30
Feb. 1	14.63	" 20	13.53
" 2	14.63	" 27	14.00
" 3	14.63	Feb. 3	14.50

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	....
Feb.	14.46	....	Aug.	12.34	....
Mch.	14.11	....	Sept.	12.02	....
Apr.	14.19	....	Oct.	11.10	....
May	13.97	....	Nov.	11.75	....
June	13.60	....	Dec.	12.75	....

Prices in London are £63 to £63 10s. per ton. In December the Chino and Ray mines produced 2,827,891 and 3,126,536 lb. copper, respectively, both small decreases. Large exports have advanced prices.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds. New York delivery.

Date.		Average week ending	
Jan. 28	3.80	Dec. 23	3.80
" 29	3.80	" 30	3.80
" 30	3.80	Jan. 6	3.80
" 31 Sunday		" 13	3.70
Feb. 1	3.80	" 20	3.70
" 2	3.80	" 27	3.70
" 3	3.80	Feb. 3	3.80

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	....
Feb.	4.02	....	Aug.	3.86	....
Mch.	3.94	....	Sept.	3.82	....
Apr.	3.86	....	Oct.	3.60	....
May	3.90	....	Nov.	3.68	....
June	3.90	....	Dec.	3.80	....

On January 29 the American Smelting & Refining Co. advanced its price $2 per ton, making the New York quotation 3.80c. per pound for shipment from the West in 50-ton lots. London quotation was £18 13s.9d. per ton.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	....
Feb.	39.76	....	Aug.	30.20	....
Mch.	38.10	....	Sept.	33.10	....
Apr.	36.10	....	Oct.	30.40	....
May	33.29	....	Nov.	33.51	....
June	30.72	....	Dec.	33.60	....

The quotation for spot tin advanced to 37c. on January 29, following an excited market in London, where prices advanced £3 10s to £4 on the various positions. Prices today are 37.50c. per pound, New York, and £173 per ton, London.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.		Average week ending	
Jan. 28	48.75	Dec. 23	48.66
" 29	48.75	" 30	48.65
" 30	48.62	Jan. 6	48.65
" 31 Sunday		" 13	48.98
Feb. 1	48.62	" 20	48.98
" 2	48.37	" 27	48.77
" 3	48.00	Feb. 3	48.52

Monthly averages

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	....
Feb.	57.53	....	Aug.	54.35	....
Mch.	58.01	....	Sept.	53.75	....
Apr.	58.52	....	Oct.	51.12	....
May	58.21	....	Nov.	49.12	....
June	56.43	....	Dec.	49.27	....

The past week has shown a decided weakness in silver. Owing to shortage of power at Cobalt, Ontario, the yield there will be reduced perhaps 25% for some time. The Mogollon district, New Mexico, has had troubles, resulting in curtailment. Exports of metal from San Francisco to the Orient in January were worth $779,000, say 1,600,000 oz. The Tonopah Mining Co. had 546,386 oz. stored on November 30. The Nipissing shipped 241,145 oz. last week.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Jan. 7	51.50	Jan. 21	52.50
" 14	50.00	" 28	52.50
		Feb. 4	55.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	....	Aug.	80.00	....
Mar.	39.00	....	Sept.	76.25	....
Apr.	38.90	....	Oct.	53.00	....
May	39.00	....	Nov.	55.00	....
June	38.60	....	Dec.	53.10	....

The quicksilver market is strong, and will most likely show further increases. Spanish metal in London is quoted at £11 12s. 6d., or $55.80 per flask.

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
Jan. 28	7.25	Dec. 23	5.37
" 29	7.50	" 30	5.40
" 30	7.50	Jan. 6	5.50
" 31 Sunday		" 13	5.85
Feb. 1	7.75	" 20	6.13
" 2	7.75	" 27	6.88
" 3	7.75	Feb. 3	7.58

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	5.22	....	Aug.	4.45	....
Mch.	5.12	....	Sept.	5.16	....
Apr.	4.98	....	Oct.	4.75	....
May	4.91	....	Nov.	5.01	....
June	4.84	....	Dec.	5.40	....

Spelter became stronger on January 29, the price going to 7.70c., New York, and 7.60c., St. Louis. London quotation was £37 10s. per ton. Bids for ore at Joplin ranged from $58.50 to $65, the highest being $68 per ton.

ANTIMONY

This metal, like copper and spelter, was greatly affected by war influences in January. First of all, England placed an embargo on exports from that country. Russia bought up all the Chinese and Japanese antimony she could, and the Japanese bought back some of the contracts for future delivery they had entered. Domestic buying was almost nil in most of the month, though near its end some domestic consumers woke up and skirmished to find metal they could buy. Prices ranged during the month from 13 to 15c., and 16.50 to 20c. per pound for Cookson's, Hallett's, and other brands on the market.

New York Metal Review

Copper prices have advanced under the stimulus of an improved export demand and that from American makers of ammunition whose products are destined for the warring nations. Exports, however, are still far below normal, and the general domestic demand is anything but satisfactory. Lead was reduced in January because of the slow domestic demand and large production in 1914, which were not offset by exports, though these were good. Because of the heavy demand for brass-mill spelter, either directly or indirectly for export, its prices have soared and broken records. Tin had a quiet month, but the trend of prices was upward. In antimony there has been a large advance, following the action of foreign governments in taking all they could get, while England has placed an embargo on exportations from that country. In the metal-working industries generally, including iron and steel, the advances in both prices and activity of recent weeks are being held, but the gains are slow. The railroads are disappointingly backward in developing prospective purchases, though they are doing better. In the shipbuilding field the outlook is brightest, as enough vessels have been placed to make most of the Atlantic Coast shipyards busy, and more orders are pending. Two ships have been ordered from the Maryland Steel Co. by the Hawaiian-American line. The exportation of metal-working machinery continues on a large scale, one agency alone having placed orders for about 400 machine tools for export last week. Here and there manufacturers are rushed night and day, but the operations of many others are at low ebb.

COPPER

In January the price of electrolytic reached the 14c. level for the first time in seven months. The war, which at first caused the demoralization of prices, eventually sent them upward. The quotation became 14.12½c. cash, New York, on January 21, having advanced from 13.87½c. Lake reached 14c. on January 19. Throughout the month the domestic demand was quiet, and it was evident at all times that the brass and copper mills were not being called on even to a fair degree for commonplace products. With those used in the art of war, it was different. In the first few days of the month, electrolytic was nominal at 13c. cash, New York, but Lake was in strong demand at 13.50c. to 13.75c. Of the latter, the ammunition makers were taking large quantities. In the second week of the month the strength of the market in Europe began to exert more influence here, and by January 12 electrolytic was up to 13.62½c. Re-sale copper, which had been in evidence up to this time, was withdrawn. Lake was quoted on January 12 at 13.75c., with some brands commanding a premium. From the middle of the month it became more and more apparent that European sales were increasing, and prices went up with the demand. It was reported, for instance, and generally accepted, that Russia had bought 25,000,000 lb., later increasing the amount to 40,000,000 lb., all for shipment *via* Japan, where at least some was to be manufactured into ammunition. Government figures showed that the exports for the week ended January 23 amounted to 23,057,055 lb., against 7,836,759 lb. in the previous week. In the week ended January 9, the exports totaled 16,884,783 lb. Of the amount exported in the week ended January 23 (23,057,055 lb.), France took 14,927,323 lb., Italy 4,114,324 lb., and England 3,489,437 lb. In the eight weeks ended January 23, the total of exports was 93,936,426 lb. While these figures are encouraging, in view of existing conditions, it will be seen that exports are considerably under normal. The elimination of Germany as a customer is severely felt. Europe usually takes between 70,000,000 and 80,000,000 lb. of copper per month. In March 1914, when the record was broken, 89,562,166 lb. was exported. On January 26 Lake was quoted at 14.62½c. and electrolytic at 14.37½c., cash, New York.

High ocean freights, due to the scarcity of vessels, hampered foreign business, and materials needed by the allied nations were moved when other kinds of cargo lay on the steamship piers for days. One New York firm, nevertheless, did a good business in exporting copper locomotive fire-box plates to various European countries, which formerly had obtained them from Germany. The quotation for hot-rolled sheet copper was advanced ¼c. on January 16, to 18¾c.; on January 21, to 19c.; and on January 25, to 19½c. The announcement that the monthly statements of the Copper Producers' Association would be abandoned was a disappointment to many, though they hardly were surprised, as the producers have never been unanimous as to the wisdom of issuing the statements.

LEAD

Domestic consumers did not figure prominent in the lead market at any time in January, and such strength as was shown came from the export demand, which was fairly good. In 11 months of 1914 (not including December), 49,482 tons was sent out of the country. The New York quotation was 3.80c. until January 11, when the American Smelting & Refining Co. caused great surprise by reducing its price to 3.70c., a reduction of $2 per ton. The decline was attributed to the light domestic demand and to the figures of the U. S. Geological Survey, which showed that production had increased about 100,000 tons in 1914. The large production made the trade wonder that prices had kept up as well as they had. Toward the close of the month the buying for export was particularly good.

SPELTER

A continued export demand for spelter and heavy buying by brass mills engaged in the manufacture of war materials caused spelter to soar in January. The New York price was about 5.75c., January 5; 6.05c., January 12; 6.25c., January 19; and 7.50c. January 26 and 28. Brass-mill spelter brought more than its usual advance over prime Western; in fact, it was principally the brass-mill grades which were in large demand, and the higher prices of ordinary grades were largely sympathetic. Toward the end of the month the market was much upset; choice brands were scarce and commanding high premiums. Sales were made up to 13.50c. Both Russia and England took large quantities. Records were broken when the price exceeded 7c., and some makers of galvanized sheets withdrew their quotations on that product. The price of sheet zinc in carload lots at the mill was also withdrawn.

TIN

Trading in tin was quiet almost steadily throughout the month. In December, arrivals at Atlantic ports amounted to only 860 tons, deducting 240 tons exported to Russia. Of the December deliveries, 1900 tons, 400 tons arrived at Pacific ports. Despite the small arrivals, the market was but little affected, although the situation under other circumstances would have sent prices skyward. The total deliveries in 1914 were 41,700 tons, against 43,900 in 1913, a falling off of 2200 tons. January 1 there was in stock and on dock and landing, 1386 tons. The total world visible supply, December 31, 1914, was 13,396 tons, against 11,483 tons November 30, 1914, and 13,893 tons December 31, 1913. Price levels of the month may be broadly indicated as follows: January 5, 33.25c.; January 12, 33.35c.; January 19, 33.85c.; January 20, 34.12½c.; January 25, 35.65c.; January 28, 36c. On January 14 a representative of a London house endeavored to start business by offering 33c., but the concession offered made consumers timid and they stayed out of the market. Throughout the month buying was principally of small amounts for immediate shipment to satisfy urgent needs. In the last week of the month there was an unexplained rise in prices at London, the advance being £13 10s. between January 19 and 27. The belief was that a scarcity of the metal existed in London because of the difficulty in unloading vessels at that port.

Current Prices for Oils and Candles

(Corrected monthly by Standard Oil Co., California.)

All prices are f.o.b. San Francisco except where otherwise specified, and are subject to change without notice.

Granite Mining Candles	Per set, cents	Granite Mining Candles	Per set, cents
6s-12 oz.-40s	8¾	6s-14 oz.-20s	9½
6s-12 oz.-20s	9	6s-16 oz.-40s	10
6s-14 oz.-40s	9¼	6s-16 oz.-20s	10¼

Extra hard 1c. per set higher than the above.

The following prices are for oils (Calol) in wood barrels; cases (2-5 gal.) 3c. per gallon higher.

	Per gal., cents.		Per gal., cents.
Compressor oil	40	Light gas engine oil	28
Amber gas engine oil	40	Red compressor oil	26
Castor machine oil	20	Red engine oil	17
Dynamo and motor oil	24	Turbine oil	35
Engine oil	24	Turbine oil, heavy	35
Gas engine oil	26	Diesel engine oil	40
Heavy gas engine oil	45	Cylinder oil	37
Heavy red engine oil	19	High-pressure cylinder oil	50
Heavy red journal oil	21	Low-pressure cylinder oil	37
Ice machine oil	28	Valve oil	44

The following prices are for oils in iron barrels, cases (2-5 gal.) 7c. per gallon higher, except on Eocene, which is 8c. per gallon higher.

	Per gal., cents.		Per gal., cents.
Pearl oil	9	Engine distillate	7
Headlight oil	10	Aroturps	15
Eocene oil	11	V. M. and P. naphtha	10½
Red Crown gasoline	11½		

	Per bbl.
Star fuel oil, f.o.b. Richmond Refinery	$0 85

	Per ton.
Petrolastic cement X	$13.00
Petrolastic cement XX	12.00
Asphaltum	$5.50 to 12.50

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted, except as noted, f.o.b. San Francisco. Buying prices marked *.

	Min.	Max.
Antimony ore, 45 to 55%, per ton	$32.50	$42.50
Arsenic, white, refined, per lb.	0.05	0.06
Arsenic, red, refined, per lb.	0.12	0.15
Asbestos, chrysotile	100.00	350.00
Asbestos, amphibole	5.00	7.50
Asphaltum, refined, per ton	11.50	20.00
Barium chloride, commercial, per ton	50.00	60.00
Barium sulphate (barytes), prepared, per ton.	20.00	30.00
Bismuth ore, 15%, per ton	*250.00	upward
China clay, English, levigated, per ton	15.00	20.00
Chrome ore, according to quality, per ton	7.50	10.00
Cobalt metal, refined, f.o.b. London, per lb.	1.90	....
Coke, foundry, per 2240 lb.	12.00	15.00
Diamonds (according to size and quality):		
Borts, per carat	2.00	15.00
Carbons, per carat	55.00	80.00
Feldspar, per ton	5.00	25.00
Firebrick:		
Silica, per M.	50.00	55.00
Snowball, per M.	40.00	45.00
Flint pebbles for tube-mills, Danish, per 2240 lb	24.00	28.00
Fluorspar, per ton	10.00	15.00
Fuller's earth, according to quality, per ton	20.00	30.00
Gilsonite, per ton	35.00	40.00
Graphite:		
Amorphous, per lb.	0.01	0.02½
Crystalline, per lb.	0.04	0.13
Gypsum, per ton	5.00	7.50
Infusorial earth, per ton	10.00	15.00
Iridium	55.00	....
Magnesite, crude, per ton	5.00	7.50
Magnesite, dead calcined, per ton	20.00	25.00
Manganese ore, oxide, crude, per ton	10.00	15.00
Manganese, prepared, according to quality, per ton	30.00	70.00
Mica, according to size and quality, per lb.	$0.07	$1.00
Molybdenite 90% MoS_2 per ton	1000.00	1500.00
Monazite sand (5% thoria), per ton	150.00	200.00
Nickel metal, refined, per lb.	0.45	0.60
Ochre, extra strength, levigated, per 100 lb.	2.00	3.00
Osmiridium, per oz.	30.00	40.00
Platinum, native, crude, per oz.	30.00	45.00
Silex lining for tube-mills, per 2240 lb.	35.00	45.00
Sulphur, crude, per ton	25.00	40.00
Talc, prepared, according to quality, per ton.	20.00	50.00
Tin ore, 60%, per ton	425.00	450.00
Tungsten ore, 65%	400.00	425.00
Uranium ore, 10% min.	25.00 per unit	
Vanadium ore, 15% V_2O_5 per ton	150.00	180.00
Wolframite (see tungsten ore).		
Zinc ore, 50% up, per ton	*15.00	20.00

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Heimann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are f.o.b. San Francisco and subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66°, drums, per 100 lb.	$ 0.80	$ 1.10
Acid, sulphuric, com'l, 66°, carboy, per 100 lb.	1.25	2.00
Acid, sulphuric, C. P., 9-lb. bottle, bbl., per lb.	0.13	0.18
Acid, sulphuric, C. P., bulk, carboy, per lb.	0.09½	0.12
Acid, muriatic, com'l, carboy, per 100 lb.	1.60	3.00
Acid, muriatic, C. P., 6-lb. bottle, bbl., per lb.	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, per lb.	0.10½	0.15
Acid, nitric, com'l, carboy, per 100 lb.	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., per lb.	0.16	0.22
Acid, nitric, C. P., bulk, carboy, per lb*	0.12½	0.15
Argols, ground, bbl., per lb.	0.10	0.20
Borax, cryst. and conc., bags, per 100 lb.	3.00	4.35
Borax, powdered, bbl., per 100 lb.	3.38	4.50
Borax glass, gd. 30 mesh, cases, tin lined, per 100 lb.	10.50	14.00
Bone ash, 60 to 80 mesh, bbl., per 100 lb.	0.50	6.50
Bromine, 1-lb. bottle, per lb.	0.55	0.65
Clay, domestic fire, sack, per 100 lb.	1.50	2.00
Cyanide, 98 to 100%, 100-lb. case, per lb.	No quotes	
Cyanide, 98 to 100%, 200-lb. case, per lb.	"	"
Cyanide, 129%, 100-lb. case, per lb.	"	"
Cyanide, 129%, 200-lb. case, per lb.	"	"
Lead acetate, brown broken, casks, per 100 lb.	9.00	10.50
Lead acetate, white broken, casks, per 100 lb.	10.50	10.75
Lead acetate, brown broken, casks, per 100 lb.	9.00	10.50
Lead acetate, white, crystals, per 100 lb.	12.50	13.25
Lead, C. P., test., gran., per 100 lb.	13.00	15.00
Lead, C. P., sheet, per 100 lb.	15.00	18.00
Litharge, C. P., silver free, per 100 lb.	11.50	13.50
Litharge, com'l, per 100 lb.	8.00	9.50
Manganese ox., blk., dom. in bags, per ton.	20.00	25.00
Manganese ox., blk., Caucasian, in casks, per ton (85% MnO_2—¾% Fe)	65.00	120.00
Nitre, double ref'd., small cryst., bbl., per 100 lb.	9.00	11.00
Nitre, double ref'd., granular, bbl., per 100 lb.	8.50	10.50
Nitre, double ref'd., powdered, bbl., per 100 lb.	9.25	11.25
Potassium bicarbonate, cryst., per 100 lb.	14.00	16.00
Potassium carbonate, calcined, per 100 lb.	15.00	30.00
Potassium permanganate, drum, per lb.	0.14	0.20
Silica, powdered, bags, per lb.	0.03	0.05
Soda, carbonate (ash), bbl., per 100 lb.	1.45	1.75
Soda, bicarbonate, bbl., per 100 lb.	2.00	2.50
Soda, caustic, ground, 98%, bbl., per 100 lb.	2.75	3.25
Soda, caustic, solid, 98%, drums, per 100 lb.	2.50	2.75
Zinc shavings, 850 fine, bbl., per 100 lb.	12.00	14.00
Zinc sheet, No. 9—18 by 84, drum, per 100 lb.	No quotes	

*Extra charge for packing nitric acid for shipment to conform to regulations.

Roessler & Hasslacher quoted as follows on January 15:

Ammonia, anhydrous, in 50-lb. cylinders, per lb.	$0.27
Arsenic, white powdered, in 500-lb. bbl., per lb.	0.05
Cobalt oxide, black, in 10-lb. tins, per lb.	1.05
Cyanide, potassium, 38.4% cyanogen, per lb.	0.27
Cyanide, sodium, 51% cyanogen, per lb.	0.25
Sodium, metallic, in 1-lb. tins, per lb.	0.40
Zinc dust, in bbl. 1600 lb.	0.12

The chemical trade shows further settling to normal.

COMPANY REPORTS

GIANT MINES OF RHODESIA, LTD.

This Rhodesian company made a profit of £34,189 in the year ended June 30 1914. There was 123,320 tons of ore treated yielding £99,577. Costs totaled $2.45 per ton.

CONSOLIDATED GOLD FIELDS OF NEW ZEALAND, LTD.

The third quarterly report of this Company shows the following results:

	Wealth of Nations.	Blackwater	Progress.
Development, feet	686	719	1,230
Ore treated, tons	6,800	13,647	7,220
Yield per ton	$7.64	$8.79	$5.98
Cost per ton	$4.48	$5.28	$4.90
Operating profit	$22,500	$49,000	$8,600

The total working profit was $80,100, but shaft-sinking, development, prospecting, and experiments cost $57,600, leaving a net profit of $22,500. A dividend of 5% (24c. per share) was paid on the Blackwater company's shares.

ARAMAYO FRANCKE MINES, LTD.

This Company operates in the North and South Chichas provinces of Bolivia, and the report covers the last financial year. There was 43,366 tons of tin ore treated, yielding 3442 tons of *barilla*, or concentrate. The output in the previous year was 3694 tons. There was 58 tons of wolfram sold, compared with 281 tons; copper matte, 342 tons, a new source of revenue; and bismuth and rich silver-tin ore. Sales of all products, including 4218 tons of tin, realized £352,049. The net profit in Bolivia was £145,765, against £153,177 in the year ended May 31, 1913. Tin mining was suspended in August on account of the war, but as sea risks are considerably less, work has been resumed. From June to November 1914 the output was 1962 tons *barilla*, 384 tons silver-tin ore, 25 tons wolfram, 33.7 tons copper, and 18 tons increase of bismuth. Four dividends of 12c. per share or £59,684 were paid, and £30,000 debentures redeemed. Another dividend has since been paid and another declared, also payment of £30,000 debentures. The balance carried forward is £90,364.

MT. MORGAN GOLD MINING COMPANY, LTD.

The report of this well known Australian company covers the half-year ended November 29, 1914. During this period the total revenue was £502,382 of which £438,546 was spent in operating, development, and depreciation. The surplus was therefore £63,836, from which £50,000 was distributed as a dividend. Including the previous balance, that carried forward to the current year is £134,189. The various funds have a total value of £341,040, and net liquid assets £400,721.

The general manager, B. Magnus, reported as follows: It is hoped that new work to be done at the mine to equip it for the maximum output will be finished during the present term. Development totaled 2484 ft., and ore reserves consist of 1,127,000 tons of high and 1,849,000 tons of low-grade material. Ore mined down to 950 ft. consisted of 171,355 tons, against 131,135 tons in the previous half-year. The Many Peaks pyritic mine supplied 32,112 tons. The new blast-furnaces started in July and have reduced costs of treatment. Concentrate from the flotation plant gave some trouble, on account of its fineness. The smelter treated 179,939 tons of mixed ores, yielding 4594 tons of copper and 58,509 oz. gold. The concentrator treated 31,274 tons of 2.36% copper and $5.36 gold ore and has shown that it can handle 500 tons per day. This mill was described in the *Press* of December 26, 1914.

LENA GOLDFIELDS, LTD.

This Company controls one of the greatest placer properties in the world, and the report covers the year ended September 30 1914. The operating company in Siberia is the Lenskoie, of which the Lena Goldfields holds 60.62% of the shares. The Lenskoie company's profit was £207,973, from which £87,302 was paid in dividends at the rate of 7.50 rubles per share, the Lena company receiving £52,533. The latter had a cash balance of £340,408 at the end of its financial year.

The mine report is by the consulting engineer, C. W. Purington, well known in the United States. R. E. Smith is general manager. He states that in the four divisions of the property a total of 873,633 cu. yd. of gravel was washed, yielding 370,210 oz. gold valued at £1,381,993. Including purchased metal and gold in slag, the total was 399,111 oz. worth £1,489,881. The areas controlled by the Lenskoie have a recorded output of over £40,000,000 ($195,000,000). A higher recovery was made by adopting American methods, and an engineer from the United States is superintending other changes. The cost of operation and Petrograd expenses was $7.13 per yard, a reduction from the previous year. Three classes of reserves are 2,134,890 cu. yd., valued at £3,595,000; 1,949,500 cu. yd., valued at £2,781,000, and 56,000,000 cu. yd., worth £5,113,000, respectively. The latter can be worked by hydraulicking. The estimated profit in these reserves is £3,633,700. At the end of the year there were 7636 men employed.

An interesting comparison between working the Bodaibinsky area by drifting and sluicing is given, showing the following results: by drifting, 1,270,000 cu. yd. averaging $5.23 per yard, giving a loss of £307,000, converted by adoption of the hydraulic method treating 12,700,000 cu. yd. averaging 4.4c. per yard into a profit of £852,000. The reserves mentioned by no means exhaust the possibilities in this area for sluicing, and extensive areas of bench gravels bordering the Bodaibo valley can be worked in this way also, without elevation of tailing.

OROVILLE DREDGING COMPANY, LTD.
OROVILLE DREDGING, LTD.

It may be explained that the Oroville Dredging Co., Ltd., is the English concern which controls the American operating company, Oroville Dredging, Ltd., also the Pato and Nechi companies operating in Colombia, Central America.

The English company's report covers the term July 1, 1913, to September 30, 1914. The directors state that the American company resumed payment of dividends in February 1914, and distributed two of 12½c. per share. The English company received £31,929, and with previous balance was able to pay two 6d. dividends, absorbing £31,483. The American company's loan account has been reduced from £30,949 to £24,260. To December 8, the Pato dredge had recovered $67,538 from 474,428 cu. yd. from one area, and $848,114 from 1,400,340 cu. yd. in the tested area. W. A. Prichard's report was published in the *Press* of February 6. The Nechi Mines (Colombia), Ltd., was formed in February 1914 with a capital of £140,000, and a dredge is now under construction.

The general manager of the American company, W. P. Hammon, resigned during the term, and the report for the year ended July 31, 1914, is signed by Charles W. Gardner. In August 1913 all the separate dredging companies controlled were consolidated into the present Oroville Dredging, Ltd., excepting the Boston Machine Shop Co. Gold returns represent the work of three dredges, No. 4 and Exploration 2 and 3. At present, February 1915, only two boats are at work. The three mentioned excavated 2,897,557 cu. yd. of gravel yielding $251,599. Of this, $134,353 was profit. The sum of $64,146 was spent in administration in London and San Francisco, dismantling dredges, etc. The surplus at the end of the financial year was $389,307. Dredge operations will be dealt with in another issue of this journal. The Boston Machine Shop made a loss of $2611.

MINING DECISIONS

PAROL AGREEMENT TO MINE—REVOCABLE.

A verbal agreement between plaintiff and defendant that plaintiff should have the right to mine a certain area of coal in defendant's mine, cannot be enforced by plaintiff where defendant rescinded the same before any operations were commenced.

Christian v. Smith Coal Co. (Alabama), 66 Southern, 641. November 7, 1914.

MINING LEASE—ACQUIRED BY VERBAL PERMISSION

Where plaintiff has given defendants verbal permission to enter upon and mine her land for ore, and, relying on such permission and subsequent assurances, defendants had expended considerable labor and large sums of money in developing work, and had tendered to plaintiff 10% royalty on the first sale of ore, the transaction was construed as vesting in defendants a statutory mining right for a period of three years, under the laws of Missouri.

G. M. Mining Co. *v.* Hodge (Missouri), 170 Southwestern, 689. November 27, 1914.

OIL LEASE—FAILURE TO OPERATE

Where plaintiff's vendor executed to defendant an oil and gas lease in consideration of $1 and defendant's agreement to pay a royalty, with a stipulation that the lessee should begin prospecting on and developing the lands described in the lease or other lands within four miles of those so described, within a year from date, a failure to prospect or do any development work for more than 10 years constituted an abandonment of the lease, though defendant did begin operations on other lands within four miles of those leased within the time specified.

Mansfield Gas Co. *v.* Parkhill (Arkansas), 169 Southwestern, 957. October 5, 1914.

MINING LEASE—SURFACE RIGHTS

A mining lease granted the lessee the right to construct on the premises all facilities necessary to market the ore taken from the land, including railroads. Held that this did not confer upon him the right to construct or authorize the construction of a railroad for general traffic on the land in question, or for any purpose except in aid of the mining operations and the transportation of ore to market. The lessor retains the right to possession and ownership of the surface, except as to such portions as are needed to carry on the mining operations.

Howell *v.* Cuyuna Northern Railway Co. (Minnesota), 149 Northwestern, 942. December 11, 1914.

MINE OWNER NOT LIABLE FOR CONTRACTOR'S NEGLIGENCE

A mine owner employed an independent contractor to work the mine, agreeing to furnish certain enumerated appliances and apparatus, but the contractor to furnish the labor, assume all risks for accidents, and operate the mine in accordance with the best methods and mining laws and to the satisfaction of the owner and its engineer. Owing to the absence of a derailing switch at the mouth of the mine, an accident occurred resulting in death to one of the contractor's employees, whose administrator then sought to hold the mine owner liable. The derailing switch was not among the appliances required under the contract to be furnished by the owner. Held that the administrator of the estate of the employee who was killed could not recover against the mine owner.

Connors-Weyman Steel Co. *v.* Kilgore (Alabama), 66 Southern, 309. November 7, 1914.

RECENT PUBLICATIONS

RELIEF OF OUR PACIFIC COAST. By J. S. Diller. Reprint from *Science*, January 8, 1915. P. 10.

ANALES DE INGENIERIA. Organo de la Sociedad Colombiana de Ingenieros. P. 61. Bogota, 1914.

ERUPTIONS OF LASSEN PEAK, CALIFORNIA. By J. S. Diller. Reprint from *The Wasama*, December 1914. P. 6. Illustrated.

WATER AND VOLCANIC ACTIVITY. By Arthur L. Day and C. S. Shepherd. From the Smithsonian report for 1913. P. 31. Illustrated.

SPRING DEPOSITS AT SULPHUR SPRINGS, ARKANSAS. By C. E. Siebenthal, with microscopic examination by H. E. Merwin. Reprint from *Economic Geology*. P. 9.

REPORT of the Governor, J. F. A. Strong, of Alaska, to the Secretary of the Interior, for the fiscal year ended June 30, 1914. P. 109. Map. A résumé of this interesting report was published in the *Press* of January 30.

THE ELECTRIC ARC FURNACE AND THE DEVELOPMENT OF THE STEEL CASTING INDUSTRY. By Ivan Rennerfelt. P. 16. Ill. Free publication *Steel Castings*, issued by the Tropenas Converter Co., 50 Church street, New York, January 1915.

ANNUAL REPORT OF THE DEPARTMENT OF MINES AND INDUSTRIES OF THE UNION OF SOUTH AFRICA FOR THE YEAR ENDED DECEMBER 31, 1913. Pretoria, 1914. This report covers the Transvaal province, Cape of Good Hope, Orange Free State, and Natal.

METAL-MINE ACCIDENTS IN THE UNITED STATES IN 1913. Compiled by Albert H. Fay. *Technical Paper* 94. P. 73. U. S. Bureau of Mines, Washington, D. C., 1914. This bulletin should be in the hands of all mine operators, especially where the safety-first movement is studied.

PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES. Vol. I. No. 1. P. 58. Massachusetts Institute of Technology, Boston, January 1915. This is to be a monthly publication. The first number contains papers on mathematics, astronomy, chemistry, botany, genetics, physiology, ethnology, and anthropology.

ANNUAL REPORT OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION FOR THE YEAR ENDED JUNE 30, 1913. P. 804. Ill., index. Washington, D. C., 1914. This is an interesting and valuable report, compiled by the secretary, Charles D. Walcott. Included in the volume are 36 papers on subjects as varied as could be, from the earth's magnetism to fundamentals of housing reform. Numbers of illustrations make the work complete.

Department of Mines, Ottawa, Canada, 1914:

PRODUCTION OF IRON AND STEEL IN CANADA, 1913. By John McLeish. P. 44. The output of pig iron was 1,128,967 tons, and 1,168,993 tons of steel ingots and castings.

PRODUCTION OF CEMENT, LIME, CLAY PRODUCTS, STONE, AND OTHER STRUCTURAL MATERIALS IN CANADA, 1913. By John McLeish. P. 62. The total output was valued at $30,809,752, an increase of 7 per cent.

U. S. Geological Survey publications, Washington, D. C., 1914:

RESULTS OF SPIRIT LEVELING IN NEBRASKA, 1896 TO 1913. Work done in co-operation with the state from 1911 to 1913. P. 57. Ill., index.

SURFACE WATER SUPPLY OF THE UNITED STATES, 1912. Part X. The Great Basin. By F. F. Henshaw, E. A. Porter, and G. C. Stevens. *Water-Supply Paper* 330. P. 275. Ill., chart, index.

New Machines and Devices

Sectionalized Water-Wheel

In view of the many comments at the present time with reference to packing for export, it is interesting to observe how one American firm meets exceptional conditions. The accompanying illustration shows a shipment of a tangential water-wheel, made by the San Francisco shops of the Pelton Water Wheel Co., to the Estaca Mining Co. of Mexico. The wheel is a 100-hp. unit for direct connection to an air-compressor. It was necessary to sectionalize the entire shipment for mule-back transportation.

THE RUNNER ASSEMBLED.

The small halftone shows the Pelton-Doble runner assembled; the top one of the other halftone shows it taken down for packing; the bottom one shows the reverse curve needle nozzle assembled; the method of sectionalizing being plainly shown; and the middle one shows the entire equipment boxed and ready

ILLUSTRATING HOW TO PACK A SECTIONALIZED WATER-WHEEL.

for shipment. Each package is properly numbered; the gross and net weight in pounds and kilograms, the cubic capacity plainly marked, and the purchaser's private mark properly displayed. These illustrations are well worth the study of any firm interested in foreign trade, while purchasers of equipment can take this shipment as a model on which to base specifications. All parts are carefully marked to place before knocking down in order to facilitate reassembly after arrival at the mine.

Commercial Paragraphs

The Hardinge Conical Mill Co. has received an order to supply three of its largest size ball-mills for the Moose Mountain, Ltd., Sellwood, Ontario, Canada. Also sixty 10-ft. diameter mills for the Anaconda Copper Co., twenty of which are to be installed at once, the others to follow during the year.

Driggs-Seabury Ordnance Corporation, Sharon, Pennsylvania, has published a very attractive catalogue devoted to the Vulcan service truck. This truck is a heavy duty vehicle designed to meet the requirements of rugged usage, and is made in several sizes up to 7-ton capacity.

Sangamo Electric Co., Springfield, Illinois, has recently issued Bulletin No. 40, which is devoted to the alternating current watt-hour meters manufactured by this Company. The bulletin is fully illustrated and contains a large amount of data regarding the construction and operation of this type of meter.

Lehigh Car Wheel & Axle Works, Catasauqua, Pa., in catalogue 50 describes the 'Fuller Quality Products' as manufactured by this Company. This Company is one of the pioneers in the manufacture of chilled charcoal iron castings of every description, especially designed for service requiring great strength and durability.

Busch-Sulzer Bros.-Diesel Engine Co., St. Louis, Missouri, has recently published a bulletin containing the results of tests which were performed to determine the economy and efficiency of the Diesel engine under fluctuating and steady loads. These tests show a fuel consumption of a little over six gallons for 100 net brake horse-power hours.

The Asbestos Protected Metal Co., Pittsburgh, Pennsylvania, announces that on February 1, the general offices of the Company, including the executive, accounting, sales, and engineering staffs, will be moved from the Beaver Falls plant to the First National Bank building, Pittsburgh. The manufacturing operations of the Company will continue as heretofore at Beaver Falls, Pennsylvania, and at Waltham, Massachusetts.

The International High Speed Steel Co., of New York, has acquired a tract of nine acres of land at Franklin, near Rockaway, New Jersey, on which it will erect a large steel plant for the manufacture of 'Bulldog' brand of hollow and solid mining drill steel in all sections, shapes, and sizes; and also of high speed, tool, and automobile steels of every description. It is expected that the plant will be in operation by April and will, when completed, give employment to several hundred men.

Western Electric Co., New York, has recently devoted considerable attention to the perfection of the mine rescue telephone equipment. This equipment, which provides a reliable and flexible means of constant communication between a rescue crew in the mine and the directing force at the surface, has been developed in collaboration with the Federal Bureau of Mines. The final design is such that it will meet successfully all the conditions that may arise in mine rescue work. With the new equipment, it is possible for a rescue crew of from one to five men to be connected to the circuit at the same time. The throat transmitter does not interfere with the use of standard oxygen helmet, and a high grade of transmission is obtained even with all five sets in use and all the coils of wire cut in, making a total transmission line of 3300 feet.

Shaft Sinking at Kelvin, Arizona—By A. L. Flagg, page 250

MINING PRESS

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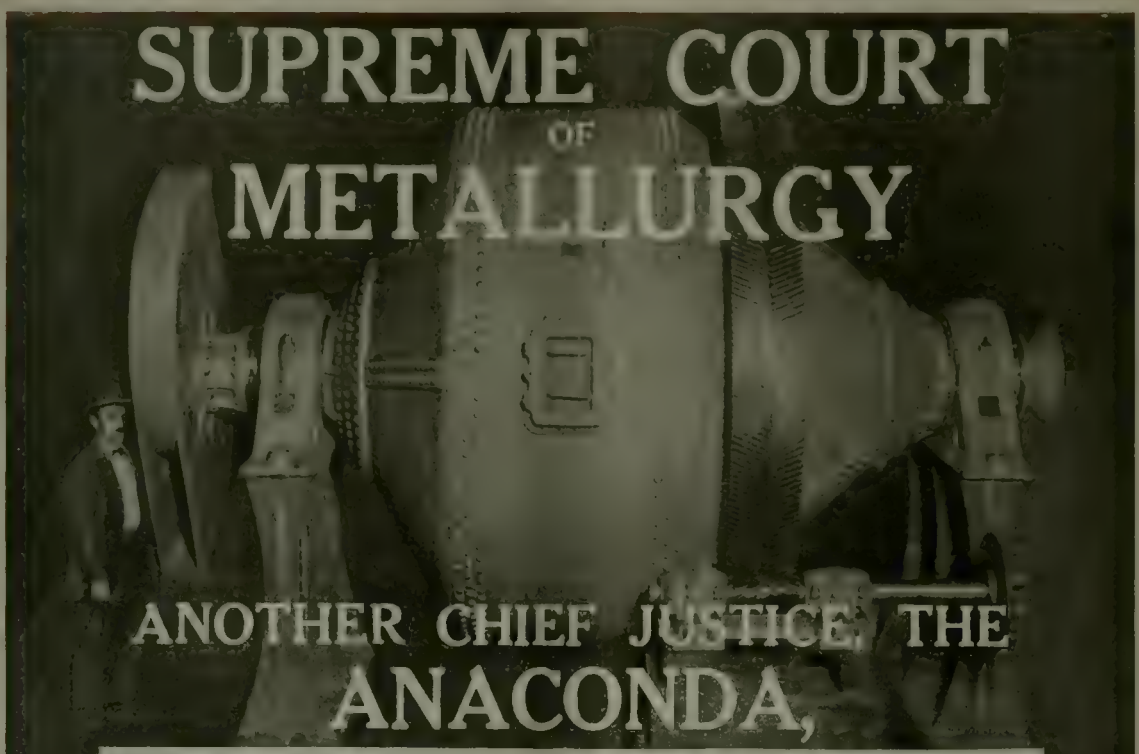
SAN FRANCISCO, FEBRUARY 13, 1915

Contents—Page 2
Buyers Directory—Page 26
Advertisers Index—Last Page

SUPREME COURT
OF
METALLURGY



ANOTHER CHIEF JUSTICE, THE
ANACONDA,

has rendered its decision after exhaustive trial and thorough investigation of all evidence.

Hardinge Mills 10 ft. in diameter are to be installed in its new fine grinding plant. A contract was signed January 19, 1915, covering 60 of these mills, 20 for immediate delivery.

HARDINGE CONICAL MILL CO.
50 Church Street, New York

W. G. SWART, CONSULTING ENGINEER
1218 Foster Bldg., Denver, Colorado

Sales Agents: Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colorado

Cable Address: Halharding, New York *London Office: Salisbury House*

MINING PRESS

Established May 21, 1860, as **The Scientific Press**; name changed October 20 of the same year to **Mining and Scientific Press**, shortened January 2, 1915, to **Mining Press**. Controlled by T. A. Rickard.

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VOL. 110 SAN FRANCISCO, FEBRUARY 13, 1915 No. 7

TABLE OF CONTENTS

EDITORIAL Page.

Notes 245
The Ship Purchase Bill 245
Canada and Canadian Nickel 246
Problems of Labor—II 247

ARTICLES

SHAFT-SINKING AT KELVIN, ARIZONA.

By A. L. Flagg 250

Interesting details covering methods and costs of sinking a three-compartment, 6 ft. 4-in. by 16-ft. shaft, which was sunk 220 ft. from a station itself 245 ft. from the surface, are given. The shaft was sunk using Sullivan piston drills, mounted on cross-bars and drilling cut holes 10 to 11 ft. deep, with back holes 7 to 8½ ft. Blasting was with Hercules gelatin powder, and 'delay action' fuses of the California Cap Co. There were only 6 misfires in a total of 795 holes fired. The total number of shifts was 218, of which 204 were consumed in actual sinking. The cost was $48.13 per foot.

ORE TREATMENT BY THE VANDERCOOK PROCESS.

By E. C. Morse 254

The Vandercook process is one of combined amalgamation and cyanidation. In applying it, numerous ingenious modifications of the usual types of classifiers, agitators, thickeners, and filters have been made, and a filter is employed in which no cake is built up. Mr. Morse describes the apparatus and gives results of a test on ore from the Hope mine in Washington.

NEW FILTERING PROCESS AT THE TREADWELL CYANIDE PLANT.

By W. P. Lass 256

Starting from the basis of a Kelly press, Mr. Lass tells how an improved type of filter has been built up which is now in use at Treadwell. It consists of a drum with internal leaves so arranged as to permit quick and easy filling, washing, and discharge by internal sluicing.

THE LADD MANGANESE MINE.

By Samuel H. Dolbear 258

A description of one of the older manganese mines near Livermore, California, which has recently been sold to the Western Manganese Co., which is to reopen it.

A SUBSTITUTE FOR DANISH PEBBLES 259

A note on the use of lava chips at the 'sand cement' plant of the U. S. Reclamation Service on the Boise project in Idaho. Under the particular conditions present, a marked saving was possible as a result of the substitution.

SPECIFIC-GRAVITY APPARATUS.

By J. M. Lillygren 260

Notes and sketches on a convenient form of apparatus for making specific gravity determinations with pulps. It is in use at the mill of the Aurora Con. Mines Co., Aurora, Nevada.

Page.

DREDGING COSTS AT OROVILLE 260

A detailed record of the three boats of Oroville Dredging, Ltd., for the year that ended July 31, 1914. The total cost was 4.04c. per cubic yard.

CONCENTRATION AT MOUNT MORGAN, QUEENSLAND 260

Detailed figures of results in the 500-ton concentrating plant of this Company, based upon returns for a half year.

DEPARTMENTS

DISCUSSION:

Amalgamation in Hardinge Mills.

By H. W. Hardinge 261

Mr. Hardinge contributes some interesting comment and early history.

Valuation of Dredging Ground.

By E. J. Vallentine 262

Mr. Vallentine suggests a system of spacing holes so as to make any hole equidistant from six others.

The Mine Mule. *By F. J. Martin* 263

Mr. Martin comes to the defense of one of the miner's assistants.

Smelting Copper Sulphide Ores.

By William Kemp 263

Mr. Kemp questions whether we have made as much progress as we like to think, and quotes figures from his note-book.

An Agitator from a Thickener.

By D. W. Minier 264

Mr. Minier tells how a Dorr thickener was made over into an agitator.

CONCENTRATES 265

MINING IN THE FAR NORTH.

Ruby District: Prospecting, Gravel Washing, and Gold Production. *By Emil Edward Hurja* 266

Another of Mr. Hurja's papers on the present condition of mining in the various Alaskan districts. Ruby is a young district, but one which is rapidly increasing its production.

REVIEW OF MINING: Special correspondence from London; New York; Washington, D. C.; Joplin, Missouri; Austin, Texas; Platteville, Wisconsin; Grants Pass, Oregon 268

THE MINING SUMMARY 272

PERSONAL 276

SCHOOLS AND SOCIETIES 276

THE MARKET PLACE:

Metal Prices 277

RECENT PATENTS 278

NEW MACHINES AND DEVICES:

Motor-Driven Mine Pump 279
The Marathon Mill 279
The Rise of Steel Pipe 279
Most Powerful Dipper Dredges in the World 279
The Denver Siren 280

COMMERCIAL PARAGRAPHS 280

EDITORIAL

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CALIFORNIA petroleum producers take little comfort in having broken all records for production in 1914, since production is still beyond consumption. A dividend record of over eleven million dollars, however, is not bad in a 'bad' year.

SHIPMENT of 4000 sacks of ore having an average value of $1000 per sack, from the Cresson mine at Cripple Creek, is reported in the local papers. Applying any probable 'factor of safety' to these figures, the Cresson find still remains one of the most remarkable in a district famous for high-grade ore.

PLANS for the meeting of the American Institute of Mining Engineers at New York, beginning on February 15, insure a good meeting. The annual dinner promises to be an unusually interesting event, while the announcement of the vote on the proposed changes in the constitution of the Institute is awaited with interest.

THE BUSINESS of the United States Steel Corporation in 1914 amounted to only $71,661,149, the smallest in the history of the concern. Even in 1908, after the financial crisis, the total was $91,847,710. The greatest year was in 1907, when the revenue was $160,964,674. In the course of one year net profits were cut virtually in half, and whereas in 1913, 11.17 per cent was earned for the $508,000,000 of common stock, in 1914 nothing was earned for the common and only 6½ per cent for the preferred stock. Consequently, after the payment of 3 per cent on the common stock, there was a deficit of $16,965,687. Never before was the Company unable to show its 7 per cent preferred stock dividend safely earned.

WASHINGTON advices are to the effect that the Administration bill for leasing the coal, oil, and phosphate lands, has been reported favorably to the Senate. It seems probable that the bill will become a law despite the opposition of able and influential senators who see nothing of good in a leasing system. We have already expressed our approval of the system and its application to these particular substances in which it is possible to make approximate measurements at least, of the quantities of mineral in the land leased. Indeed, we have no strong feeling of opposition to a general leasing system, but we recognize that the situation as to coal mining and gold mining, for example, differs greatly, and, whatever might be the theoretical benefits of any system, practically these would not be realized in the face of virtually unanimous opinion against it of those concerned. Since coal mining, petroleum production, and even phosphate mining, are now largely conducted upon leased land, extension of leasing to mines on public lands is not revolutionary. It has much to commend it, permits immediate development, and does not close the way to any later change that may prove desirable.

A COMPREHENSIVE study of gold-dredging has been undertaken by Mr. Charles Janin, acting for the United States Bureau of Mines. It is planned to cover all North American operations and to make a careful analysis of the possibilities and limitations of the process as a first step toward solution of the general problem of reviving placer mining. At the same time, Mr. J. M. Hill will make a comprehensive study of the placer deposits of the country for the United States Geological Survey, the work being closely correlated with the studies of methods undertaken by Mr. Janin. At least a year will be devoted to these investigations and the result is certain to be the most comprehensive and valuable reports upon placers and placer mining that have ever been made.

THE SHIP PURCHASE BILL

Opinion is divided as to the ship purchase bill which, like the jitneys on Market street, has been obstructing traffic at Washington. Well informed men in the shipping business recognize that any material increase in trade would find the United States short of transportation, without regard to the flag under which carriers sail. Many boats have been sunk, others interned, and still others withdrawn for naval or army use. The obvious thing to do is to buy the idle boats and set them to work, and it is conceivable that they might be so routed as not to provoke resentment on the part of the warring powers. That is, it would be conceivable if such matters were handled on a common sense business-like basis. Unfortunately they are not. Our navigation laws are radically defective and greatly increase the cost, to no good purpose, of operating American ships. If it were merely the difference in wage cost we might fairly expect to overcome the handicap, just as American mine managers have where facing a high wage scale. The labor cost is, however, only one item, and the men who

know how to re-write our navigation laws intelligently either do not have the power or have not the confidence of the country. Ship owners generally believe, and not necessarily selfishly, that the situation can be best met by a system of ship subsidies, but no one familiar with public opinion, especially in the Middle West, considers that this plan, whatever its merits, lies within the domain of practical politics. It may be good or it may be bad—it is unnecessary to decide the point—but any Congress that established a system of ship subsidies would leave few survivors at Washington after the first succeeding election. The situation calls for a remedy that may not be ideal, but which must be the best that is possible under the circumstances.

It has already been shown, in the case of Alaska, that the people will approve government ownership of transportation lines while they will not permit the giving of government aid to private lines, as was done in the past. We believe that the President is right and that public opinion will sustain government ownership of ships. Also we feel reasonably confident that unless something is done there will be a serious shortage of transportation which will react upon many American industries. It does not follow that the ship purchase bill cannot be amended to advantage, though our worst mistakes in legislation have been due to over-specification of details. The Panama canal was well built and without scandal, in large part because the men in responsible control had a free hand, and it would seem that the principle that power should go with responsibility might well be followed in embarking upon such difficult and complex a business as the ownership by the United States government, of merchant vessels.

From a naval point of view, no policy would strengthen the fleet so effectively as to have the new merchant marine actually owned by the government and operated by naval reserve officers. The type of ships needed most also fits into this plan, since in war time it is fast boats that are needed, and in establishing new trade lines it is fast communication that is most necessary. Trade goes from Chile to London and Hamburg to no small degree because of the interest saving on drafts and on shipments, resulting from fast mail service. It is everywhere recognized as proper that the government should furnish good mail facilities regardless of immediate returns, and if a combined rail and water express line could be established from the eastern cities through any convenient Gulf port and the Panama canal down the west coast of South America, it would be one of the most effective stimulants to trade. This is only one of the many possibilities. Wherever the fast boats were put into service they would make work for the slower profit earning freight boats that private initiative might well be expected to furnish, and whatever boats be put to work, they, by so much, increase the carrying capacity available for the world's commerce, and particularly that part in which the people of the United States are interested. The ship purchase bill may be far from perfect, before final passage it seems certain to be materially amended, but essentially it appeals to us as a sensible effort to meet a difficult situation, and we have failed to note any alternative proposal that was at the same time better and politically possible.

CANADA AND CANADIAN NICKEL

Canada is populated with loyal sons of the British Empire, and it also produces a considerable part of the world's supply of nickel, which is used in making armor plate for war vessels, and to a minor degree in the manufacture of munitions of war, such as nickel-jacketed bullets. In the early days of the war the idea occurred to Canadians that possibly some of the nickel employed by the enemies of Great Britain was derived from Canada, and by reiteration the fear grew until it became an obsession. Not long ago a Montreal daily paper published a cartoon showing a British battleship being torpedoed by a German submarine, with the accompanying legend, "Sunk by Canadian nickel." That neither torpedoes nor submarines contain appreciable amounts of nickel is a mere detail; the underlying idea is a patriotic one, which must be regarded with respect.

The two producers of nickel in Canada are the Mond Nickel Company, Ltd., and the International Nickel Company. The former is a British corporation which refines its nickel in Wales and, being under the direct control of the British military authorities is, of course, beyond suspicion. The International Nickel Company is an American corporation which refines its nickel in New Jersey, and the weight of suspicion at once fell upon it. It was at first rumored that the American company was controlled, or at least in part owned, by the Krupp interests, but the most cursory investigation was sufficient to prove conclusively that such an assertion had no basis of fact whatever. It was next charged that the International Nickel Company was selling its product to foreign buyers, some of whom would presumably attempt to take advantage of the high prices in Germany by forwarding nickel to that country. Since the International Nickel had taken precautions, soon after the war broke out, to clear itself of any such suspicion by placing all its foreign business in the hands of its English agents, it was equally easy to show that this was also not the case. That these facts are fully recognized in well informed circles in Canada is made clear by the editorial comment in the January 15 issue of our excellent contemporary, the *Canadian Mining Journal*. It is now proposed, however, to force the International Nickel Company, by appropriate legislation, to abandon its refining plant in New Jersey and carry on its refining in Canada, thus placing the industry wholly within Canadian control. The problem thus at once passes out of the domain of national patriotism into the more exact one of economics, and the factors which govern the situation are business relations into which it will be profitable to inquire more deeply before taking action.

During 1913 there was imported into the United States approximately 47,500,000 pounds of nickel in the form of matte. Of this about 3,000,000 was derived from New Caledonian ores smelted into matte near Antwerp, and forwarded to this country for refining in order to avoid the 10 per cent duty imposed on imports of metallic nickel. The remainder was derived from Canada, and of the total amount of refined nickel produced, a little less than one-half was consumed in the United States and the remainder exported. Very little of this nickel was returned to Canada, only about one-eighth of one per cent of the total. The fundamental question is therefore whether it is better economy to make Canada the production centre from which to export its entire product to the rest of the world (in the case of the United States in the face of an import duty), or to retain New York as a refining centre, with one-half the product for domestic consumption and only the remainder for export. Two factors must be considered—the relative cost of refining in the two places, and the trade conditions to be met in marketing the product.

In a letter published in the *Canadian Mining Journal* of January 8, Mr. R. W. Leonard argues that refining can be done as cheaply in Canada as in New Jersey. It is difficult to see how such a thesis can be supported. As is well known, the production of nickel from matte involves several successive smeltings with salt cake, whereby the copper-nickel matte is separated into copper containing a little nickel and nickel containing a little copper. Fuel costs at Sudbury almost twice as much as in New Jersey; salt cake costs more than twice as much. We have not at hand any record of the average rate of wages paid at Sudbury and Bayonne, but the average daily wage paid to unskilled laborers in the vicinity of New York is $1.75 to $2 per day, according to figures furnished by the Bureau of Municipal Research. It is evident, therefore, that the labor cost would also be higher in Canada. To abandon refining in New Jersey and take it up in Canada would involve abandoning the New Jersey plant and constructing another in Canada; the cost of the new construction would have to be charged to the cost of refining in Canada, and it is difficult for the outsider to see how costs at the two places could be made anywhere near equal.

Refined nickel produced in Canada, on entering the United States, would be subject to a duty of 10 per cent, or approximately $80 per ton. In order to avoid this duty, one of the two French companies operating at New Caledonia, ships its ore to Holland, where nickel matte is produced that is shipped to New Brunswick, New Jersey, for refining; the refined nickel being sold in the United States in competition with the product of the International Nickel Company. To the unprejudiced outsider it would seem that if the International Nickel Company were obliged to remove its refinery to Canada, and attempt to reach the United States market in the face of a 10 per cent duty, the French company would promptly increase its refinery capacity in this country and supply a larger part of the present demand. It is generally reported that the International Nickel Company has considerable holdings in the New Caledonian nickel region which it has not yet developed. If the French company can operate in the field of an old established company, it seems certain that the International Company would not abandon its New Jersey plant, but would instead supply it with enough ore or matte from its New Caledonia deposits to provide for the consumption of nickel in this country. In attempting to force the refining of Canadian nickel in Canada, it therefore appears as though our friends across the St. Lawrence would be doing something like killing the goose that laid the golden eggs; for it apparently means the abandoning of the United States as a market for Canadian nickel. Turning to the pages of history, we find that when a country has placed an embargo on any of its products, the net result almost invariably has been the ruining of home industry and the benefiting of foreign competitors. It seems probable that a similar result would ensue if the Canadian authorities should place an embargo on the export of nickel ore and matte.

PROBLEMS OF LABOR—II

The testimony given by various persons prominent in public life before the federal Commission on Industrial Relations, sitting in New York during the past week, has been productive of much interest throughout the United States. The statements of such men as Messrs. Jacob H. Schiff, August Belmont, Henry Ford, and John D. Rockefeller, Jr., are worthy of careful attention, since men of such large and wide interests presumably have access to data and sources of information which are not available to the majority. The testimony is too voluminous to undertake to reproduce here even in part, but the statements made by Mr. Rockefeller concerning the labor situation in Colorado, as seen from his viewpoint, are of so much interest to mining men that we give below some extracts.

"The Commission has asked my views as to what extent the stockholders and directors of a corporation are responsible for the labor conditions which exist in it and for the social conditions which are produced; how generally and in what manner such responsibilities are assumed by stockholders and directors; and in actual practice how, and upon what general basis, the labor policies of large corporations are determined.

"The responsibility of stockholders is practically limited to the election of directors. They have no power to elect officers, to employ labor, to make contracts, or to intervene directly in the management of the business. A large stockholder, however, is able to exercise considerable moral influence over the directors and officers, and is responsible for exercising that influence properly.

"The directors are responsible for the general conduct of the business. These responsibilities are in general

divided in such a way that the directors attend principally to the financial affairs of the corporation, leaving the actual conduct of operations to the officers.

"Labor conditions, so far as they are within the control of a corporation, are matters for which the officers of the corporation are primarily responsible and with which they, by reason of their experience and their first-hand acquaintance with the facts, are best qualified to deal.

"Labor policies are initiated and determined by the officers, whose efficiency is largely measured by the harmony and good will which they are able to maintain between the company and its employees. It is not customary to submit labor policies to a board of directors for action. Conference regarding them is often had with the directors or executive committee at the instance of the officers, and suggestions are made to the latter by both these bodies. A business to be successful must not only provide to labor remunerative employment under proper working conditions, but it must also render useful service to the community and earn a fair return on the money invested. The adoption of any policy toward labor, however favorable it may seem, which results in bankruptcy of the corporation and the discontinuance of its work is as injurious to labor, which is thrown out of employment, as it is to the public which loses the services of the enterprise, and to the stockholders whose capital is impaired.

"Anyone who has followed the controversy which has arisen out of the Colorado situation will have observed that no effort has been spared to make it appear that I have attempted to exercise a kind of absolutism over the coal industry in Colorado, and particularly that I have sought to dictate a policy of non-recognition of unions. An attitude toward industry and toward labor such as is here implied is abhorrent to me personally and contrary to the spirit of my whole purpose and training. What are the facts?

"First, with reference to my attitude toward labor unions: I believe it to be just as proper and advantageous for labor to associate itself into organized groups for the advancement of its legitimate interests as for capital to combine for the same object. Such associations of labor manifest themselves in promoting collective bargaining, in an effort to secure better working and living conditions, in providing machinery whereby grievances may easily and without prejudice to the individual be taken up with the management. Sometimes they provide benefit features, sometimes they seek to increase wages, but whatever their specific purpose, so long as it is to promote the well-being of the employees, having always due regard for the just interests of the employer and the public, leaving every worker free to associate himself with such groups or to work independently as he may choose, I favor them most heartily.

"Combinations of capital are sometimes conducted in an unworthy manner, contrary to law and in disregard of the interests both of labor and the public. Such combinations cannot be too strongly condemned nor too vigorously dealt with. Although combinations of this kind are the exception, such publicity is generally given to their unsocial acts that all combinations of capital, however rightly managed or broadly beneficent, are thereby brought under suspicion. Likewise it sometimes happens that combinations of labor are conducted without just regard for the rights of the employer or the public.

"Since we first acquired an interest in the Colorado Fuel & Iron Co. in 1902, the Company has paid out in wages to its employees over $92,000,000. During the same period we have received dividends amounting to $371,000 on our investment in the Company's capital stock. Therefore our stock interest in the Colorado Fuel & Iron Co. has yielded a return of about two-thirds of one per cent per annum on an actual cash investment of about $6,000,000. It should be stated that we hold, in addition to the stocks above mentioned, a block of bonds, but that our entire investment in the stocks and bonds of the Colorado Fuel & Iron Co. has yielded during a period of twelve years not more than 3½% per annum. Yet during that time, instead of exploiting the industry, as has been frequently stated, we have supported a policy of development by devoting surplus earnings to improvements, thereby increasing employment, and generally extending the business rather than paying dividends.

"As to the strike itself, its many distressing features have given me the deepest concern. I frankly confess that I felt there was something fundamentally wrong in a condition of affairs which rendered possible the loss of human lives, engendered hatred and bitterness, and brought suffering and privation upon hundreds of human beings. Without seeking to apportion blame, I determined that in so far as lay within my power I would seek means of avoiding the possibility of similar conflicts arising elsewhere or in the same industry in the future. It was in this way that I came to recommend to my colleagues in the Rockefeller Foundation the instituting of a series of studies into the fundamental problems arising out of industrial relations, which resulted in securing the services of Mr. Mackenzie King, former Minister of Labor of Canada, to direct the studies.

"The strike was called off December 10, 1914. On December 16 Mr. David Griffiths, formerly state coal mine inspector of Colorado, was appointed an intermediary between the Company and its employees respecting matters of mutual interest.

"On January 5 a notice was posted at all the Company's mines inviting the employees at each of the mines to assemble in mass-meeting to select by ballot one representative to every 250 employees in each camp to represent the men at a joint meeting of themselves and the executive officers of the Company in Denver 'for the purpose of discussing matters of mutual concern and of considering means of more effective co-operation in maintaining fair and friendly relations.'

"In the published notice of these meetings it was stipulated that in order that the men might feel the greatest freedom in making their selection they should choose their own chairmen, and neither superintendents nor pit bosses should attend.

"I have received from the president of the Company a telegram informing me that a joint conference was held in Denver on December 19, that the meeting had proved most satisfactory to all concerned and that its spirit had convinced the management that it would lead to more active co-operation between the Company and its employees in the future.

"Thus it will be seen that the Company has already taken steps to initiate a plan of representation of its employees. It is my hope and belief that from this will develop some permanent machinery which will insure to the employees of the Company, through representatives of their own selection, quick and easy access to the officers with reference to any grievances, real or assumed, or with reference to wages or other conditions of employment.

"Capital can defer its returns temporarily in the expectation of future profits, but labor cannot. If, therefore, fair wages and reasonable living conditions cannot otherwise be provided, dividends must be deferred or the industry abandoned. I believe that a corporation should be deemed to consist of its stockholders, directors, officers, and employees; that the real interests of all are one, and that neither labor nor capital can permanently prosper unless the just rights of both are conserved.

"If, with the responsibilities I have and the opportunities given me, I am able to contribute toward promoting the well-being of my fellow men through the lessening of injustice and the alleviation of human suffering, I shall feel that it has been possible to realize the highest purpose of my life."

Entirely transcending the importance of this statement as a thoughtful and fair exposition of the viewpoint of the capitalist on these problems, is the sequel which it bids fair to have. The most bitter opponent of the Rockefeller organization in recent years has been 'Mother' Jones, and her activities in inciting and maintaining strikes are well known. A year ago she endeavored to see Mr. Rockefeller, but was refused admission. At the hearing before the Commission, these two opponents shook hands and made an appointment for a conference on January 27. After the conference was over the two principals made the following statements to the reporters of the daily press.

"John D. Rockefeller, Jr., has been misunderstood," said 'Mother' Jones. "He has been defamed. No one has done more of it than I have. I have denounced him everywhere. Now I am going to do all I can to make that right. I used to call him a 'high class burglar.' I know now that he isn't that. I know what he thinks about these things now. I am sure he means to do right."

"'Mother' Jones," said Mr. Rockefeller, "told me about conditions in Colorado as she has found them. She told me of the complaints of the miners, that they want opportunity to buy their supplies at other than Company stores, that they want schools and churches not owned by the Company, and of which the teachers and ministers are not appointed by the Company officials, that they want the right of free speech and the right to assemble and discuss their affairs; that they object to paying fees for the Company's doctors—a variety of things that they believe to be wrong in principle and practice.

"I found that her mind is remarkably clear. She knows a great deal about those matters that I do not know. I told her that I realized that it was my duty as a director of the Company to know more about them. I assured her that I believed that as a matter of principle the things of which she complained were wrong. Of course, there should be free speech, free assemblage, independent stores, public schools, and all that. We found that on all matters which we discussed we were in agreement.

"I pointed out to her the great difficulty of getting all these things in a mining camp far removed from the ordinary community life where there would not even be an approach to these things if the Company didn't supply them in its own way, the best possible under the circumstances. She told me that she realized the practical difficulties of doing many things which the miners want done. She was very fair and reasonable, and told me that she now believes I am also trying to be fair under arduous difficulties."

The importance of this *rapprochement* between the two persons generally regarded as most typical of labor and capital cannot be overestimated. In spite of the fact that the essential factor in the progress of civilization for centuries has been the struggle for liberty, we are all too prone to overlook this vital element, because of the attention which must necessarily be given to practical details. The simplest analogy which can be drawn is with education.

In recent years, Madame Montessori has emphasized that right education must never restrict the liberty of the child. It is so much easier for a mother to wash and dress her child than to await the outcome of his ill-directed and blundering efforts to do it himself, it is so much easier to show a child exactly what to do and how to do it than patiently to encourage him to do it himself, that parents and teachers restrict the liberty and development of individuality of the child in the mistaken idea that it is necessary to get practical results as quickly and easily as possible. The child is powerless to protest, but the laborer is abundantly able to protest, and has made his voice heard insistently during recent years.

The clearing of the air which must result from the happenings set forth above will almost mark an epoch in the solution of labor problems, and if the labors of the federal Commission on Industrial Relations have no other useful result, they will have been abundantly worth while.

Shaft-Sinking at Kelvin, Arizona

By A. L. FLAGG

These notes are not offered as a discussion of shaft-sinking practice, but rather a description of methods, results, and costs in a single instance in which a three-compartment shaft was sunk 220 ft. from a station, 245 ft. from the surface. This shaft, known as the Westfall, is the deepest and main working exit of the Kelvin-Sultana Copper Company.

The first 245 ft. of the shaft was 'raised,' beginning in a small station cut in the long cross-cut driven to the south from the Diamond Jo shaft to the No. 2 vein. After the connection had been made with the surface, a 60-ft. sump was cut before work was discontinued. There are no adequate records of either progress or costs for raising or for sinking the sump.

After the sump was finished, the shaft was in continuous use for six months from the first or so-called 300-ft. level, to the surface, before sinking was resumed. During that time only a nominal amount of water accumulated in the sump. The timbering, which extended 10 sets below the station, was in good condition, needing no repairs or adjustments. However, before any work could be done toward sinking, it was necessary to enlarge the station, which was exceedingly small and ill adapted to use as a point from which to sink.

FIG. 1. HEAD-FRAME AND HOIST-HOUSE.

The rock in which the shaft was sunk is a fine grained greenish black diabase, tough, though locally often extensively shattered. Throughout the entire mass are three sets of joint planes. The strike of the strongest of these is nearly at right angles to the longer diameter of the shaft. The dip is normally 52° to the south. This condition usually kept the south end of the shaft in advance of the north end, though there were times when local irregularities in the dip would cause the opposite condition to prevail. The other two series of joints exerted little or no influence on the breaking of ground.

While the camp is not a mining centre, it is not far from some old established places. Even so, it was not always possible to secure skilled labor on short notice. During the time sinking operations were in progress the Company was able to keep two full crews of excellent shaft men. Only white men were employed, though in other parts of the mine, Mexicans are generally employed. Each crew consisted of a 'jigger,' three miners, and a top-lander. At the outset these men were paid $4.50, $4, and $3.50, respectively. Later, when more water was encountered, the rate was increased 50c. per man. This rate was paid until shaft work ceased.

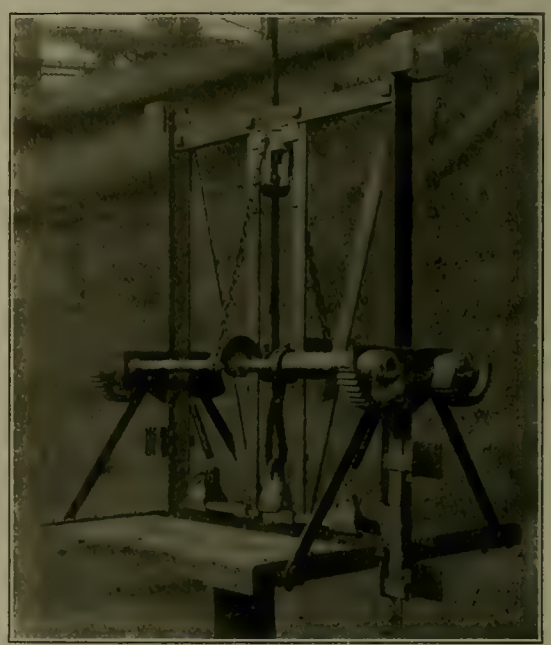


FIG. 2. UNION SAFETY CROSS-HEAD.

Hoistmen operating the sinking engine received $4 per day.

The advantage to be gained by having plenty of light for the men to work by was not overlooked. Throughout the rest of the mine the Wolf acetylene lights are used. In the shaft four 40-watt Mazda lamps, provided with suitable guards, gave abundant illumination. The lamps were spaced at four-foot intervals on twisted strands of No. 14 rubber-covered double-braid wire, which was protected by extra heavy loom. This could be hung in any desired position, and when necessary, as in case of shooting, the end could be hooked to the bucket, and the whole drawn up out of the way. The line was carried down the man-way, paid out from a reel as the shaft progressed.

Sufficient ventilation was provided by a No. 5 Buffalo electrically-driven blower. The air was transmitted through a 10-in. galvanized pipe, with suitable connec-

tions at the blower to permit of using as an exhaust to draw gases out after shooting. The pipe extended to the surface, insuring a positive disposal of the gases as well as pure air when blowing. Fifteen minutes was generally enough to clear the atmosphere after a blast.

Sinking was done from the centre compartment, 'muck' being hoisted to the station by means of a $3\frac{1}{2}$ Vulcan steel-frame hoist, having a capacity of 3500 lb. at a rope speed of 285 ft. The hoist was operated by a 30-hp. 3-phase, 60-cycle, 440-volt motor, with solenoid brake and safety device to prevent overwinding. The capacity is 6900 lb. at a rope speed of 360 ft. per minute, using a one-inch rope.

On arrival at the surface, waste was trammed to the dump by one top-lander, who took care of the combined output of the mine development work. The average distance trammed was 60 ft.; maximum distance, 108 feet.

The buckets were 40 in. high by 27 in. wide, with a

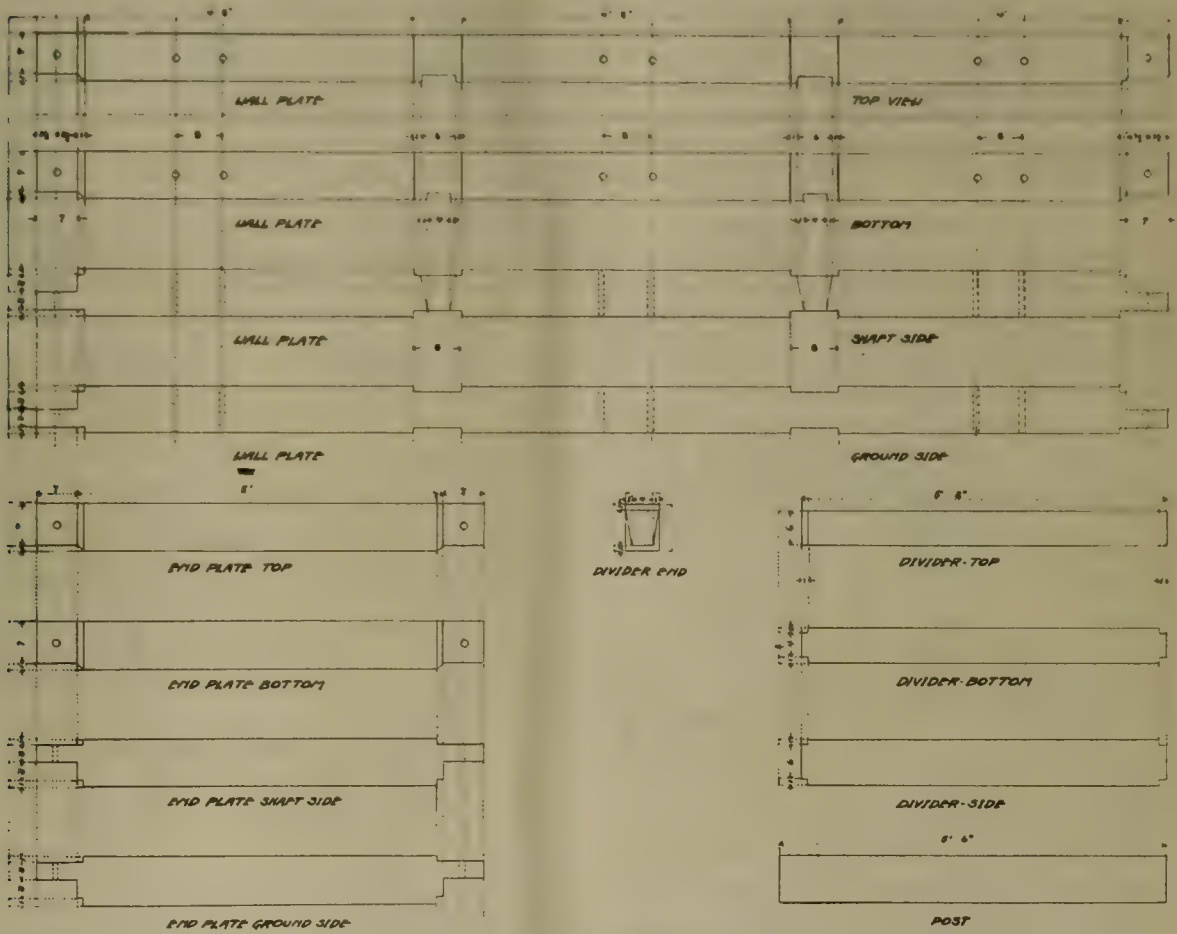


FIG. 3. METHOD OF FRAMING TIMBER.

General Electric 3-phase, 60-cycle, 440-volt motor at 1135 r.p.m. full load. The ¾-in. cable was used.

The rock was dumped directly into 16-cu. ft. end-dump cars, which were run on landing doors. The cars were then pushed over the turn-sheet to the next compartment south, through which they were hoisted to the surface on a single-deck steel cage, weighing 1600 lb. This compartment was also the outlet for all development work on the 300-ft. level, but in all instances preference was given to shaft work. Little or no congestion was experienced except when timbers were being lowered, and then only for short periods. The surface hoist is a double-drum, electric machine designed to operate in counterbalance, though only one side could be used during the period of sinking. The hoist is equipped with a 75-hp., $3\frac{1}{2}$-in. belly. The style of cross-head used, as illustrated, was found quite satisfactory, and proved an economical investment.

The shaft is of three compartments in a straight line, 6 ft. 4 in. by 16 ft. over all. The two hoisting compartments are 4 ft. 8 in. by 5 ft. The third compartment or manway is 3 ft. 11 in. by 5 ft. in the clear. This compartment carries air and water lines, a 10-in. ventilating pipe, and wires for power, light, and telephone, all of which are enclosed in conduit.

The shaft sets were spaced at six-foot centres. The wall-plates, end-plates, and posts are 8 by 8 in. The dividers are 6 by 8 in., and guides 6 by 6 in. Two-inch material was used for lagging. Oregon pine was used throughout, it being found more satisfactory, though of

slightly higher first cost than native pine. All framing was done by hand, one framer and a Mexican helper turning out a set a day with the necessary blocking and lagging.

Details of framing the sets are shown in Fig. 3. Shooting timbers were cut from round, peeled, native pine poles, 6 in. diameter at the top and 15 in. at the butt. The longer ones protecting the wall-plates were suspended by bolts in two parts, joined together by welded eyes making a flexible coupling. One end of the bolt was passed through the shooting timber, and left in place during the life of the timber. The other end was passed through the regular hanger-bolt holes in the wall-plates. The shorter timbers protecting the end-plates and dividers were laid across the longer timbers, then brought into place by tension on the bolts mentioned.

For aligning the sets as they were placed, the usual method of using small blocks $\frac{1}{8}$ in. thick was employed, the line centring one inch from the corner each way. As the timbers were framed, the carpenter marked with his scratch-awl a line one inch from the corner on end-plates and wall-plates, which facilitated lining up. New blocks were placed every third or fourth set.

In the original shaft, 4 by 6-in. guides were used, behind which were placed one-inch fillers. In the new work 6 by 6-in. guides, without fillers, and dapped out one inch, were used. The method of making the joint is

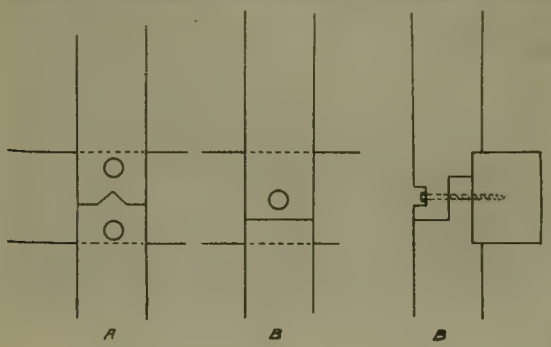


Fig. 4.

shown in Fig. 4. The original joint (*a*) was not found satisfactory; the style (*b*) used below the 300-ft. level has been found to be more secure, besides being more quickly made.

Whenever possible, timbering was done from the top of the 'muck' pile, the last set, as a rule, being less than 20 ft. from the shaft bottom. The timbers were lowered in the usual manner by clevises. For swinging the wall-plates into place preparatory to inserting the hanger-bolts and blocking, a simple but efficient device was used. It consisted of two lengths of $\frac{1}{2}$ in. steel hoisting rope, 22 ft. long. One end of each was looped through a strong welded iron ring and fastened with clamps. The other end was slipped into a piece of $\frac{3}{4}$-in. standard black pipe 14 in. long, and securely fastened by means of babbitt metal. To the bottom end of the pipe was fitted a $\frac{3}{4}$ by 2-in. reducer. The loose ends of the cables were passed through the hanger-bolt holes in the wall-plates of the last set, then through the holes in the wall-plate to be hung, and reducers screwed on. The ring was then attached to the hoisting cable, which easily and quickly drew the wall-plate into place.

Except for the first few rounds, Sullivan UE-2 ($3\frac{1}{8}$-in.) piston-drills were used throughout the shaft work. The machines were mounted on cross-bars $5\frac{1}{2}$ in. diameter by 6 ft. long, which were lifted into place by the hoist as they were lowered. For holding the bar in place, while it was being blocked, a support was made of 2 by 12 in., about 5 ft. long, having a V-shaped notch cut in one end. Cleats were nailed on one side of this support, which was used later by the drill runners to stand on while drilling.

Air at 90 lb. pressure was maintained whenever possible, though owing to the limited capacity of the compressor this often fell below an economical working limit. The number of holes drilled for each round was 24. The average total drilled per round was 166.5 ft. The placing of holes is shown in Fig. 5. The total foot-

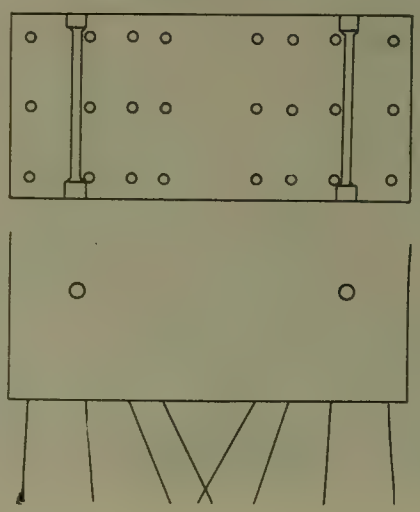


Fig. 5.

age drilled was 5828. The steel consumption was 383.48 lb., or 0.0658 lb. per foot drilled, costing 16.3c. per foot of shaft.

Each set of steel consisted of five pieces, ranging in length from starters 2 ft. 10 in. to finishers 12 ft. long, with a difference of approximately 2 ft. between successive drills. Beginning with a $2\frac{1}{2}$-in. bit on the starters, each succeeding bit was $\frac{1}{8}$ in. less in diameter, the finishing bit being $1\frac{7}{8}$ in. One and one-eighth octagon steel, with a $\frac{1}{8}$ by $4\frac{7}{8}$-in. shank at one end, was used. On the other end 2 ft. of ribbed steel was welded, the latter being $1\frac{3}{4}$ and $1\frac{3}{8}$ inches.

Cut holes were drilled from 10 to 11 ft. deep. Back holes were from 7 to $8\frac{1}{2}$ ft., depending on the ground. The cut holes sometimes crossed, at other times lacked a few inches of coming together. The bars were set up 3 ft. from the ends of the shaft, and 4 ft. 10 in. above

the collars of the breast, and back holes. The collars of the latter were in line with the end-plates. The shaft was broken about 8 by 17½ feet.

The average charge per round was 105 lb. of 1¼×, 40%, Hercules gelatin powder. For the first seven rounds 7/8-in. sticks were used, but were found quite unsatisfactory. Owing to an irregularity in one consignment of powder, it was found advisable to fire the cut holes first, then after 'mucking' out, fire the rest of the round. As this practice was in force only for a few rounds toward the last, it is impossible to say whether there is any real advantage in this system, though there were certain indisputable evidences of increased speed with no appreciable increase in costs.

At no time was the amount of water sufficient to justify the installation of a pump, though considerable bailing had to be done. The water was bailed into the sinking buckets with pails, and hoisted to the 300-ft. level, where it was dumped into a special wooden-body water-car. The car was pushed into the main cross-cut to a point about 70 ft. from the shaft, and the water let out through a trap to flow to a sump from which it was pumped to the surface. One of the notable features of the work was the small number of misfires. In the shaft work proper, 35 rounds of 795 holes were fired, and there were only six misfires. While no records are available as to the number of misfires in previous work, it is known that they were numerous. The small number of misfires is attributed to the use of 'delay action fuses' manufactured by the California Cap Co., which is nothing more or less than an electrical device for spitting fuses. The use of such fuses has already been well described in the technical press.* The method of connecting terminals, Fig. 6, was somewhat different from

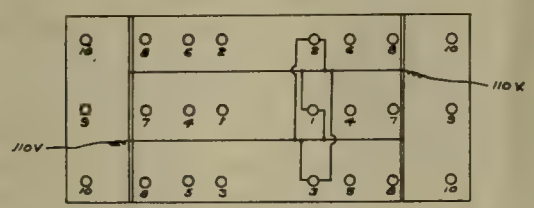


FIG. 6.

that described in the article referred to. Two pieces of scrap timber, usually broken lagging, were placed a few feet from the ends of the shaft, and securely wedged in place. From these, two strands of ordinary hay bailing wire were stretched about four feet apart. The terminals of the fuses were connected to these, which in turn were connected to the shooting circuit, the switches of which were under lock and key, accessible only to the foreman. The numbers in the diagram refer to the order of firing.

As the shaft reached the point where the station was to cut, the initial rounds were drilled. This work is not taken into account in making the estimates of costs. Below the shaft a sump 29 ft. deep was cut.

The station on the 500-ft. level is 14 ft. 8 in. by 35 ft. in the clear, 18 ft. high at the shaft, and 10 ft. high in the back. Under the station, set bearers 16 in. square by 10 ft. long were placed in hitches 2 ft. deep. There are no bearers at the level above. Regular sets begin again directly under the bearers. Back of the station proper is a pump station 15 by 20 ft., 10 ft. high, with a sump having a capacity of 25,000 gallons.

The total number of shifts worked was 218. Of that number, the first seven were occupied in bailing out and 'mucking' the last round fired in previous work. Seven more shifts were given to making alterations and adjustments, caused chiefly by the breaking of the hoist motor. The total number of shifts occupied in actual sinking operations was 204.

The following table shows the costs:

LABOR			
Shift boss	$ 992	Ventilating	18
Drilling	1,105	Timber framing	708
'Mucking'	1,422	General expense (foreman)	654
Hoisting	1,081	Administration	140
Compressed air	44	Survey	24
Blacksmith	313		
Timbering	604		
Draining	56	Total	$7,161
MATERIAL			
Powder	$457	Air pipe	69
Detonators	54	Ventilating pipe	64
Fuse	2	Miscellaneous fittings	23
Carbide	2	Timbers	1,182
Lubricating oils	7		
Steel	36	Total	$1,896
MISCELLANEOUS			
Power	$1,243	Drill depreciation	19
Taxes and insurance	17	Miscellaneous tools	179
Drill repairs	141		
		Total	$1,599
Grand total			$10,656
Cost per foot			$48.43

MINTS in New South Wales, Victoria, and Western Australia transacted the following business in 1914:

Source of gold. State or district.	Sydney. Fine oz.	Melbourne. Fine oz.	Perth. Fine oz.
New South Wales	86,514	9,021	.....
Victoria	.....	404,201	.....
Western Australia	162	5,654	1,450,769
South Australia (inc. Northern Territory)	102	7,052	.....
Tasmania	1,638	15,230	.....
Queensland	223,363	1,518	.....
New Zealand	138,200	33,939	.....
Papua	8,602	.....	.....
Other countries	82	16	13
Light coin	161	26	.....
Sundry	.....	3,320	902
Total	458,824	479,977	1,451,684

TRAFFIC through Panama canal in December totaled 356 vessels with 1,743,899 tons of cargo. Tolls paid amounted to $411,895.

*W. V. DeCamp, *The Eng. and Min. Jour.*, Vol. 96, No. 2, pp. 65-66.

Ore Treatment by the Vandercook Process

By E. C. MORSE

*The apparatus used is simple in both construction and operation, and along lines sufficiently new that the owners have been able thoroughly to cover their apparatus and methods with patents in the United States and several foreign countries, and to obtain a basic patent on their filter.

In the process to the tube-mill, nothing new is claimed. Any standard method of crushing, such as rolls preceded by rock-breaker, if the ore be soft, or stamps preceded by a crusher where the ore is hard, may be used. The tube-mill practice varies according to the peculiarity of the ore.

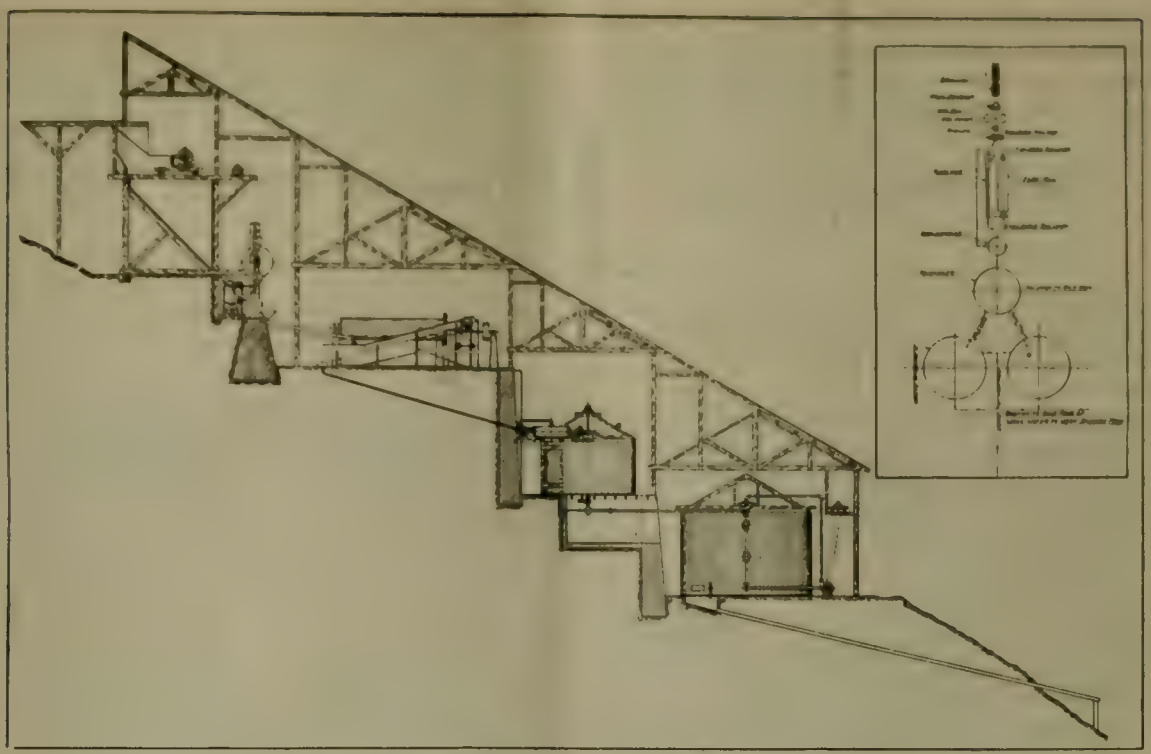
The first device of note is a classifier. Its chief distinction is its extreme simplicity, being designed so that wearing parts can be instantly replaced, and so that its speed can be readily changed according to requirements. While there are some small details that differ, it is roughly a combination of a hydraulic classifier with the Esperanza principle. Endless chain drags are employed to elevate the sand out of the bottom of the cone or hopper and up an incline, from which it is delivered to the scoop feed at the head of a tube-mill, without the use of any other elevator or pump. This classifier is admirably adapted for tube-milling arrangements where it is desired to deliver the ground product of the tube-mill into the cone, allow the finished slime to overflow the weir, and pull the ground sand up a slope to the head of the mill, thus eliminating wet elevators from the grinding and sliming system.

After the ore is slimed it passes to an amalgamator designed as follows: It consists of a 10 by 4-ft. tank with an iron bottom resembling an amalgamating pan, and a Vandercook agitator fed from above. This agitator resembles a lawn sprinkler in its action. It consists of a grit-proof bearing with extended hollow arms, fitted with staggered nozzles and revolves backward by reason of the impact from the discharging nozzles, which are supplied with the solution pressure which actuates them by a large-sized slow-speed centrifugal pump. In the standard units that are made, this apparatus is absolutely dependable, and the manner in which it keeps the bottom of the pan clean is remarkable. On the bottom of this pan is about one flask of mercury, or 75 lb. This continuous agitation of the pulp in cyanide solution in the presence of mercury serves two purposes. Any coarse gold that is clean, and would otherwise be slow to dissolve in the cyanide solution, is recovered here by amalgamation in the same manner as in pan-amalgamation practice. The other purpose which the mercury serves is the desulphurizing action, freeing the solution from alkaline sulphides. According to my tests it also aided in a remarkable degree in the extraction of silver in the ore, as this metal was nearly all extracted from the ore in the amalgamator, while in the ordinary practice in mills at present in operation in Republic the dissolution of the silver is very slow. This agitator operates so slowly that there is no tendency to the flouring of quicksilver, and yet the surface of the mercury is kept clear from accumulations of every sort. This amalgamator is operated continuously, pulp flowing in and going out by overflow.

The pulp from the amalgamator passes to a thickener, driven by worm gear, and using a vat of suitable proportions for the desired tonnage of a given ore. It differs radically from the older thickeners in its internal arrangement. It is provided with rakes of spiral form, well supported and stoutly built, and so arranged as to squeeze the moisture out of the pulp before it is discharged, whenever it is desired to do so. This machine should take less than 1 hp. to operate a tank 30 ft. diameter. When desired, the material can be thickened so as to contain only 30% moisture when it is discharged on a belt, should this be necessary. Such would not be done, however, in ordinary practice. The overflowing solution from this thickener is returned to the storage tank to be re-used in grinding and classifying. The thickened material, which is discharged from the bottom, goes to one or the other unit of the agitating and filtering plant.

The agitating and filtering plant is really the important part of this system. It consists of a steel tank with a Vandercook agitator, similar to the one described on the amalgamator, but of larger size. It has a canvas filter-bottom of about the same design as an ordinary sand-leaching vat, and is supported by burlap and woven wire stretched across a grating. The canvas is held in place by rope corking as usual. The charge of pulp and solution is agitated in this tank during the operation of filling. When it is full, treatment commences. During the action of the agitator the canvas is automatically kept clean so that solution can readily filter through it. When vacuum is applied by a centrifugal pump, the filtering operation becomes rapid. During the agitation the pregnant solution is continually drawn from the filter through the canvas bottom by either natural filtration or the aid of a vacuum, and barren solution continually replaces it, so that the agitator during its operation removes the gold and silver as fast as they are dissolved, sends them to the zinc-boxes, and constantly replaces them with barren solutions from the boxes. This combined filter and agitator can be applied with advantage in a great number of places whenever slime or finely pulverized sand is dealt with, but it is not claimed that it could be successfully

*From a report on the process as tried on ore from the Hope mine, Republic, Washington, at the California Extraction Co.'s plant, Oakland, California.



VANDERCOOK SYSTEM OF ORE TREATMENT.

used on sands coarser than 80 or 100 mesh. It is equipped so that the following operations can be carried on: agitation, aeration, and continuous displacement. It is also equipped so that filtering can be carried on by gravity, pressure, or by the application of vacuum.

The vacuum-pump, receiver, and unloader devices have received considerable attention in order that they might be simple to operate and repair, and repair parts are all standardized, so that repairs and renewals can be obtained from almost any machinery supply house. In fact, that has been the aim in designing the whole equipment. This filter is also an excellent clarifier. The solutions come from it as clear as could be desired for a zinc-box precipitation.

The California Extraction Co. has a basic patent on this filter, the novel feature being that it is the only filter that accomplishes its filtering operation without the building of a cake. On first consideration, metallurgists who have been accustomed to that type of machinery will be prejudiced against it, because of its similarity in appearance to the other machines that have not given entire satisfaction; still that prejudice must disappear when it is remembered that the plant described never gave trouble when operated intermittently, and when there was no chance for the building up by accumulation of the relatively coarse sand, thus stopping the machine. And, of course, the Vandercook machine is discharged at the end of each cycle, so that no accumulation can take place.

The objection to centrifugal pumps can readily be overcome by the installation of two of them with each machine. The strongest point in favor of this system is the small amount of tankage that it will require. Aside from the solution in storage, an amalgamator, and a thickener 12 by 32 ft., will constitute all the tankage necessary for a 200-ton plant. The objection to most modern cyanide plants is that they are spread out over too much ground. The compactness of the Vandercook arrangement is much in its favor. Any finely pulverized ore that will yield to cyanide treatment in any machine for cyaniding will give up its soluble metals in this machine, so that the exact results obtained in these tests are of only secondary importance to me. Any objection that exists to this machine mechanically, exists to a greater degree to a popular displacing machine, and the machine in question has made such a marked success that it has been installed in several mills as an aid to filters, and in some in place of them. This has been notably the case in some of the mills in Nevada, particularly around the Comstock lode.

In discharging the Vandercook machine after it finishes the cycle of treatment, a water wash is applied and the pulp reduced to 40% moisture. Then the charge is sluiced by any available means.

The zinc-boxes employed in the Vandercook system also deserve special mention. There is nothing new in principle about them, but they are designed so as to be handier to clean up and pack. They are cone bottomed and made large enough so that comparatively few will be required, and so arranged that the precipitate can be drawn from the bottom into a filter or

dryer and the handling of zinc is reduced to a minimum.

In the tests on Hope ore assaying $5.37 gold and $2.20 silver per ton, 95.7% crushed through 200 mesh, and treated in the plant described, the extraction was 97.7% of the total value. No lead acetate was needed at all, lime consumption was 8 lb. and cyanide 0.6 lb. per ton, a satisfactory result. The Republic ores were described in the *Press* September 19 last.

New Filtering Process at the Treadwell Cyanide Plant

By W. P. LASS

Among the more recent developments at the concentrate cyanide plant of the Alaska Treadwell Gold Mining Co. that have tended to lower operating costs and increase the extraction, has been the adoption of the Treadwell self-sluicing drum type of filter-press.

The original equipment of filters consisted of two type 1B 50-ton Kelly filter-presses. The principal objection to these was the labor in operating and repairing. It was accordingly decided to build a self-sluicing drum type of filter. Two of these presses have now been in continuous operation for the past nine months, one for clarifying solutions, and the other for filtering concentrate. Their complete success has improved greatly the efficiency of the whole plant. The plant, which formerly required two men on each of the three shifts to discharge 100 tons of material and clarify 800 tons of solution, is now being operated on two shifts by part of the time of one attendant. However, it is not only the operating labor, but the upkeep and repair costs that have been materially reduced.

The filters are closed during the whole of the filtering operation, in fact, they may go for weeks without being opened, and the attendant has only to manipulate the valves. Waste of solution is reduced to a minimum, and the appearance of the plant greatly improved.

The accompanying illustration shows the filter as used at present. It consists of a steel cylinder 8 ft. diameter and 16 ft. long, lined on the inside with concrete, to form a square box to receive the filter-leaves, without leaving void spaces which would require a larger amount of excess pulp or solution in the operation of filling or discharging. The filter was made round as the simplest and most economical means of obtaining the required strength. The heads of the press are boiler plate, reinforced with I-beams to withstand a pressure of 200 tons.

The filter-head is only removed when it is necessary to change leaves. The filter-frames are 16 ft. long and 5 ft. high, made of flat strips of spring steel ¼ by 1¼ in. These are run in by means of rollers and guides fastened into the bottom of the press.

A 1-in. pipe at the bottom of each leaf, for the outlet of clear solution, is run through a hole at the far end of the press, and sealed with gummets and lock-nuts; after all the leaves are in place the heads are bolted on, care being taken to clean the gasketed end of the press from foreign matter that would cause leaks when the pressure is applied.

The apparatus now being closed, the pulp or material to be filtered is allowed to flow into and fill the press by gravity from the pulp tank situated 30 ft. above. An escapement valve on the top of the press is used to relieve the air pressure until the machine is full, when this valve is closed, and the discharge cocks from the filter-leaves are opened for a sufficient length of time (from two to four minutes, depending on the gravity of the pulp) for the formation of a 1½-in. cake on the leaves.

After the desired thickness of pulp has been deposited, the discharge cocks are closed, and the excess pulp emptied from the press by admitting compressed air into the top, driving the pulp back to the original pulp storage tank referred to above. The valve on the pulp-line is then closed, and either a treatment solution or a wash-water run in just as the pulp was admitted, by allowing the escapement valve on the top of the press to open, and thus by lowering the pressure to admit the solution which comes in under a lower pressure than is maintained by the compressed air.

When the press is full, as shown by a pressure gage, the operator closes the escapement valve and opens the discharge cocks, thus allowing the solution to percolate through the cake deposited on the leaf for either treatment or filtering purposes.

In this manner as many treatments or washes as desired may be given to the cake, while still on the filter-leaf. At the conclusion of the wash, the solution is blown back with compressed air, and the discharge cocks opened for drying purposes. By this means the moisture in the cake is reduced to 8%, when it is ready to be discharged.

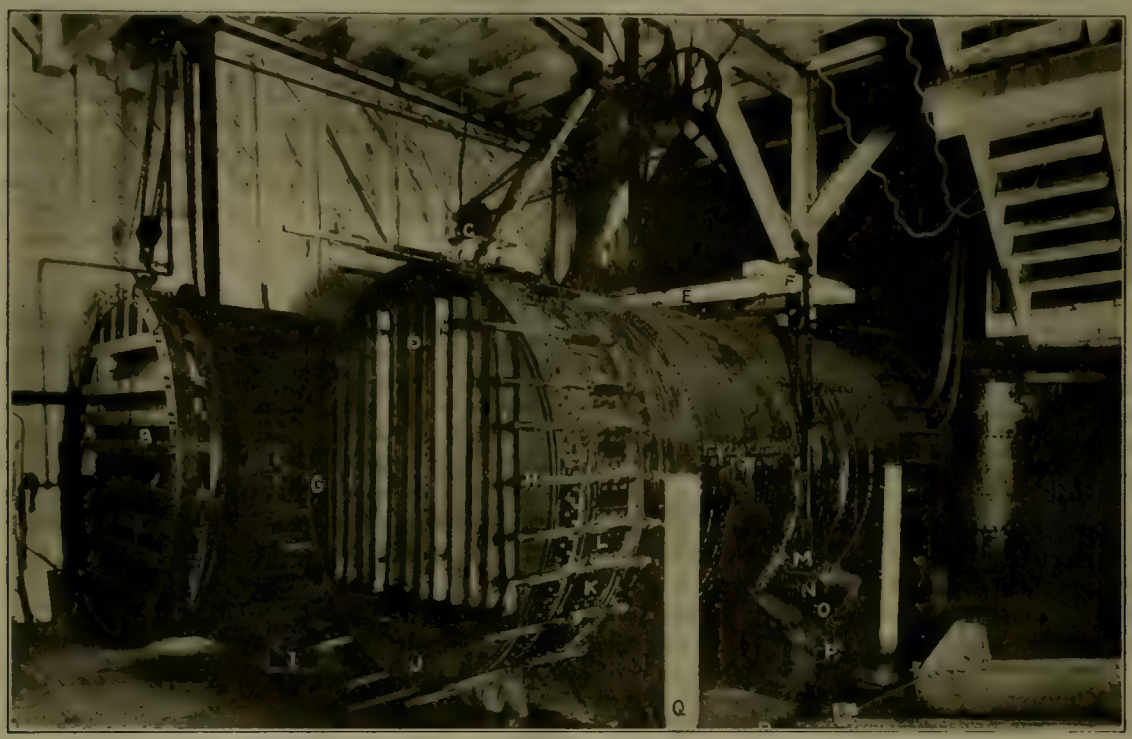
Water is now turned on through a revolving spray-pipe, operated by an electric motor, and running through the under side of the press in such a manner as to wash off the cake and sluice out the residue through the 6-in. pipes leading from the lower side at each end of the press. The time of operation of a complete cycle is 100 minutes. The time allowed to take off the head of the press, remove the old leaves and place a complete set of new ones ready for operation, is four hours or one-half shift, although, if occasion demands, the press may be 'dressed' in less than two hours.

One of the important advantages of this self-sluicing press is that it may also be used as a treatment press, and under certain conditions may entirely dispense with agitation or treatment tanks. Sand deposited on the filter may be given acid washes, alkali treatment, aera-

tion, cyanide treatment, or water washes, without removing the cake from the filter leaves.

No pumps are used in connection with this filter, and the absence of any vacuum is one of the important features. The simplicity of the apparatus makes the construction costs compare favorably with any press of equal capacity.

Instructions posted in the plant for the operation of the Treadwell self-sluicing drum-filters are as follows: (1) Under no conditions allow pressure on filter tank to exceed 45 lb. per sq. in. (2) In order to make a pulp cake in the Treadwell press, it is first necessary to have from 45 to 50 tons of pulp in the pulp storage tank. (3) At 30 to 32 lb. pressure, which 50 tons of pulp in the tank gives, it takes an average of 7 minutes to fill the press. (4) During filling, the cocks in the front of the press are to remain closed, and then be opened as soon as the press is full. By doing this, a uniform cake is made when filtering. (5) Do not allow press to fill suddenly, but by means of the relief valve let air out gradually; when nearly filled, maintain air pressure at 25 lb. to prevent knocking. (6) The condition of leaves, as regards the time they have been in the press and the specific gravity of pulp, has to be considered in forming a cake. (7) Better results are obtained all round, especially as regards tailing, if the cake is not made too thick. (8) A space between each leaf is really necessary, in order that the wash be filtered through each side of the cake. (9) When it is time for filtering, the cocks are closed, and the air is turned into the press from a convenient valve, to blow back the excess pulp in the filter. From 15 to 20 lb. of air above pulp pressure will be plenty for this purpose. (10) The gage on the press indicates what is going on, and as soon as the pressure starts to decrease, if working the press alone, turn off air about half, close the valve opened first, and then the others in turn. (11) While leaves are new, pressure will not exceed 15 lb. per sq. in. (12) It is at no time necessary to wash at more than 30 lb. pressure. (13) A 20-min. wash is sufficient. (14) Excess wash water is returned in the same manner as pulp, using, of course, the proper lines. When this excess is returned, drying is commenced immediately, at about 15 lb. pressure, gradually bringing it up to about 20 to 25 lb. (15) Drying for about 20 min. has been found sufficient, but whether more is to be given will depend on prevailing conditions. (16) The air is then let out of the press, and the cake is ready to be discharged by the sluicing system. (17) In the centre of the bottom of the press is a water connection with a 1¼-in. nozzle pointing toward each end. As soon as possible after opening the 4-in. valve discharge, one at each end of the press, open water valve, in order to keep discharge valves from plugging by the cake dropping. (18) No harm can be done by opening this valve wide. (19) To remove the cake from leaves, a



FILTER PRESS AT THE TREADWELL MINE. A, CRANE; B, HEAD REMOVED; C, MOTOR DRIVE TO SLUICING BARS; D, FILTER LEAVES; E, SHAFT; F, CRANK; G, H, J, CONCRETE FILLING; I, DISCHARGE VALVE; K, L, BOLTS; M, RACK; N, PINION; O, SLUICING PIPE; Q, R, S, WOODEN SUPPORTS.

2-in. drill bar, with nipples attached, so as to come between each leaf, runs through the press ¼ in. below the bottom of the leaves. This bar is supplied from both ends with water, at about 60 lb. pressure. (20) By means of a worm and gear, attached to the bar outside of the press, and having shaft running to a motor, it is kept moving in a circle in order that the high pressure of water will not damage the leaves, and also to facilitate the discharging of the cake. (21) As regards samples, the man in charge will instruct the press operator when and how he requires them taken. (22) Inspect 6-in. sluicing-out pipes for leakage when filling the press.

[An application for a patent for this press has been made, but so far as Mr. Lass is concerned he is quite willing to allow its being used by any millmen.—EDITOR.]

The Ladd Manganese Mine

By SAMUEL H. DOLBEAR

MOUTH OF ADIT 600 FT. LONG, 300 FT. BELOW TOP OF VEIN.

By far the most important source of manganese ore in California has been the mines of the Livermore-Tesla district in Alameda county. A number of properties have been worked in the past, the largest producer being the old Ladd mine.

Interest is again centred in this property through its sale recently to the Western Manganese Co. of San Francisco. The sale brings to mind its history, and the circumstances which surrounded its closing down in 1902. It has been the general impression, I believe, that the ore reserves were practically exhausted, and that its period of activity had passed.

Justinian Caire was the owner some 20 years ago, when the largest shipments of ore were made. The output was largely taken by chlorinating plants. When this process of treating ores gave place to other methods, Mr. Caire sold the mine to the Treadwells. Since that time, the mine has been closed down, and no ore produced except in a small way by occasional lessees.

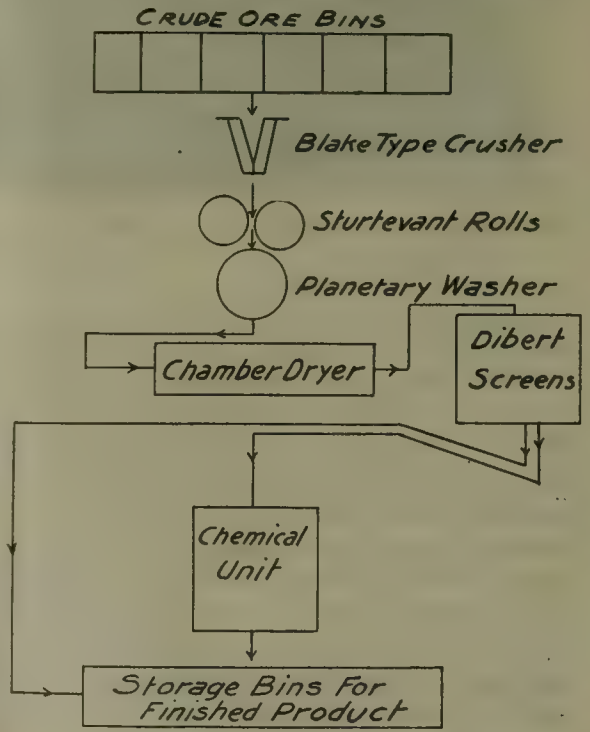
One of the significant factors in this purchase is that the Western Manganese Co. was not the only bidder for the mine. This may be taken to indicate that there is more than a casual interest being shown in manganese at this time.

The Looraine Mining Co. was formed and became the owner of the property. It appears that the most of the stock of this Company was pledged as collateral with the now defunct California Safe Deposit & Trust Co., the trustees of which effected the recent sale.

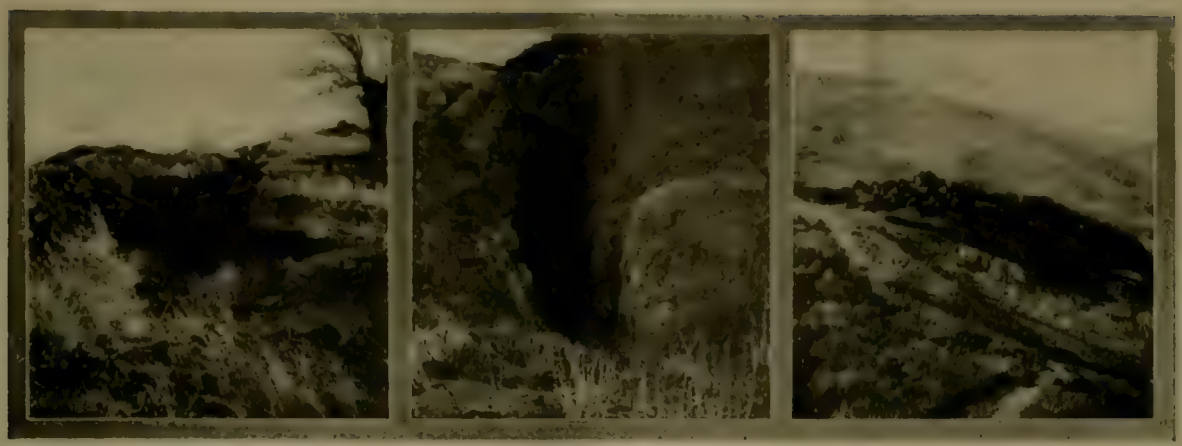
The principal workings of the Ladd mine are reached by a cross-cut about 600 ft. long. This was carried considerably beyond the point at which it cut the orebody, presumably in expectation of finding other deposits of manganese. Stopes have been run to the surface, a distance of about 150 ft. Other than from the main workings, some ore has been mined by making open-cuts on the vein where the contour would permit easy mining. Some of the workings may be seen in the accompanying illustrations.

In the foregoing, it will be noted that I have referred to this occurrence of manganese ore as a vein. E. C. Harder, in his report, says: "The deposit appears to be a filling of a fault fissure between walls of solid rock, and is exposed along the strike for several hundred yards, in which distance it varies considerably in thickness, but averages about four or five feet. It has a strike of about north 80° west, and a dip varying from 45° south to nearly vertical. Smaller veins branch off from the main fissure at low angles and continue for short distances in the wall rock."

The ore is described by Harder as manganite, but such a determination does not conform to recent analyses made for the Western Manganese Co. These analyses would seem to show that the ore is largely pyrolusite with some manganosite, and only a small percentage of manganite. The percentage of combined water is too small to indicate the presence of much psilomelane. The following analysis has been furnished



FLOW-SHEET AT THE LADD WORKS.



LADD MINE OF WESTERN MANGANESE CO., SHOWING OUTCROP OF ORE AND SURFACE WORKINGS.

by the Company as characteristic, and is intended to represent the average grade of ore to be found here:

Minerals.	Per cent.
Mn	48.28
MnO_2	62.10
MnO	18.00
Mn_2O_3	0.30
Fe_2O_3	0.30
Al_2O_3	1.00
SiO_2	8.70
Sulphur and phosphorus	trace
H_2O (combined)	4.40

The principal impurities in this ore are to be removed by treatment in the Company's recently constructed plant at Alameda. A description of this plant and its operation was detailed in the *Press* of January 30. The general method of treatment is shown in the accompanying flow-sheet.

Adjoining the Ladd mine is the Winship-Doak property, which is along the strike of the fissure. As little ore has yet been taken from the latter, the ground is almost intact. Recently a re-survey of this area established the fact that the boundary between the two properties had been marked in error, with a resultant gain to the Western Manganese Co. of nearly 300 ft. of virgin ground. The ore possibilities in this addition are pretty clearly indicated by the old stopes, and insure a considerable tonnage. Operations are to commence here as soon as the sale has been confirmed by the court. In the meantime, the Company has contracted for the entire output of the Winship-Doak mine.

THE BRADEN MILL, Chile, in November treated 83,703 tons of 2.13% copper ore, yielding 6935 tons of concentrate. The Minerals Separation plant treated 82,027 tons, producing concentrate assaying 19.94% metal. The copper output was 2,404,000 pounds.

NEW SECURITIES listed on the New York Stock Exchange in 1914 totaled $671,864,800, against $874,102,000 in 1913, and $1,816,009,000 in 1912, and $2,410,000,000 in 1909.

A Substitute for Danish Pebbles

*As a part of the Boise project, Idaho, the Reclamation Service is building the Arrowrock dam, a masonry arch, 350 ft. high. One of the notable features of this work is the use of sand cement instead of the portland cement. A sand-cement plant was erected at the dam and a finely ground 'blend' made of, roughly, 50% each of portland cement and rock obtained near the site. For this grinding tube-mills are used, and at first the general practice was followed of using imported Danish flint pebbles in the mills. The price of these pebbles plus freight amounted to $26.25 per long ton at Boise.

Dissatisfied with this cost, the engineers looked for a substitute. At first, pebbles found near the dam were used, but these proved unsatisfactory. Then lava rock chunks of roughly cubical form were tried, which have proved highly successful. After a few hours in the mills the angles are worn off and the pieces assume a shape like the ordinary pebble. They are considered to be equal or superior to the Danish pebbles, as they are heavier, break up less, and wear longer.

A plentiful supply of lava rock pieces was found along the government railroad built to the dam, where slides have broken the rock into pieces of the desired size. These slides are mostly on government land within 15 miles of the dam, and the pieces are picked up, sacked, and put on the railroad at a cost of about $2 per ton, including about 50c. for the sacks, which quickly wear out. There is thus saved about $24 per ton, or 90% of the cost of the Danish pebbles.

The supply of lava chunks along the railroad between Boise and Arrowrock is considerable, and it is possible they may find additional and larger markets If the less accessible lava slides were thus utilized, the cost would probably be increased somewhat over the above figures, but there are large quantities within easy reach of the government railroad.

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*Abstract from the *Reclamation Record*, Feb. 1915.

Specific-Gravity Apparatus

By J. M. LILLIGREN

Specific-gravity determinations are necessary and frequently made in the different departments of all cyanide plants. Convenience and rapidity are essential where a number of such tests are made each shift; also, protection of the apparatus used against breakage, and particularly the getting out of order due to rough and careless handling are important.

The accompanying sketch shows the apparatus in use at the Aurora Consolidated Mines Co.'s plant, Aurora, Nevada. The scale is a standard make of the spring type, is adjustable, and has a capacity of 24 lb. The original dial is graduated to pounds and ounces. A

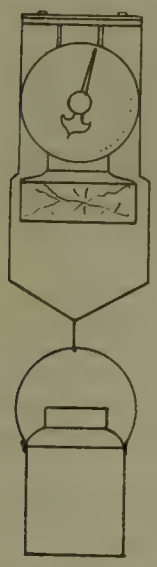


FIG. 1. FRONT VIEW.

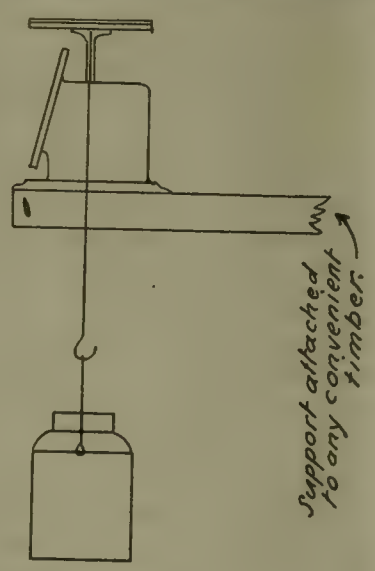


FIG. 2. SIDE VIEW.

disc of heavy detail paper was pasted on the dial, and a sp. gr. scale marked thereon, indicating gravities of Aurora pulp ranging from 1 to 1.75. Calibrating can be done either by interpolation or calculation. The pulp measure used here is an ordinary half-gallon tin milk-can.

The scale is supported on a 2-in. piece, the width of its base, leaving a clear space below the support. The yoke is made of stiff wire twisted together at the bottom to form the hook. The top of the yoke is hinged to a piece of stout galvanized iron, thus leaving it free to swing backward and forward. The iron plate is fitted to the platform of the scale, and held in place by turned-down edges. The reason for suspending the measure below the scale instead of using the platform is to protect the scale from spilled pulp. The interior of this or any other scale of similar type is not immune from pulp dripping down the side of the can, or falling from the dirty hands of the millman, and if the platform were used the accuracy of the scale would soon be impaired. With the measure suspended below, as shown, no moisture or pulp ever comes in contact with the scale.

One scale is set permanently near each place where a number of determinations are made each shift. In this case four sets of apparatus are used. The millman has no occasion to handle the scale, merely confining himself to hooking on the bucket of pulp, taking his reading, and then removing the bucket. The bucket is about the only part of the equipment liable to damage. This style of container will be appreciated by those who have used small-necked bottles or other receptacles. The large mouth of the bucket makes it easy to fill and empty.

This apparatus has the following good features: the scale itself is not expensive, nor are the milk tins; set in a convenient position, it is not handled and put out of adjustment, but will remain reasonably accurate for a long time; determinations are made in a minimum of time and with little trouble; and there are no elusive weights that mysteriously disappear when most urgently wanted.

Dredging Costs at Oroville

Three boats of the Oroville Dredging, Ltd., had the following record during the year ended July 31, 1914:

Actual dredging time, hours per day	20.38
Average gravel handled, cubic yards	3208
Average depth, feet	30.5
	Cents per cubic yard.
Material and labor	1.25
Electric power	0.75
Water	0.08
Repairs	1.06
Smelting and express	0.03
General	0.66
Taxes and insurance	0.21
Total cost	4.04

A total of 2,897,557 cu. yd. yielded $251,599, varying from 7.72 to 12.79c. per yard.

Concentration at Mt. Morgan, Queensland

The new 500-ton mill, as described in the *Press* of December 26, 1914, started in July. According to the report of the Company for the half-year ended November 29, the following results were obtained in the first runs:

	Weight, tons.	Assays: Copper, %	Assays: Gold, dwt.	Recovery: Copper, %	Recovery: Gold, %
Ore treated	31,274	2.365	5.36	....	....
Concentrate produced:					
Table	5,993	3.29	11.44	26.68	40.89
Flotation	3,026	13.94	18.85	57.02	34.00
Total	9,019	6.86	13.93	83.70	74.89

Content of the concentrate was 619 tons copper and 6281 oz. gold.

COAL OUTPUT OF INDIA in 1913 was 15,486,318 tons, an increase of 10.27 per cent.

DISCUSSION

Readers of the Mining Press *are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.*

Amalgamation in Hardinge Mills

The Editor:

Sir—Naturally I take considerable interest in the discussion in the *Press* of January 16 relative to the above subject. The argument, both *pro* and *con*, I must admit is subject to endorsement, owing to the fact that the ores described probably have chemical qualities materially different one from the other. The Mother Lode ores have always been considered very simple to treat. The combined amalgamation and concentration recovery is higher than that of any other district with which I am acquainted. They, however, have a large proportion of a slaty gangue, producing a colloidal slime, which might have a tendency to form a coating on quicksilver which would produce the 'sickening' referred to.

This matter of inside amalgamation was suggested by me to J. M. Elmer, in 1909, when he was in charge of a Mother Lode mine in Tuolumne, California. He then tried it out with highly satisfactory results. Mr. Elmer later reported that the amalgamation recovery advanced from 65 to between 80 and 85%, and a total of over 90% was made with subsequent concentration. From information later gained, however, we must give A. D. Foote, of the North Star mine at Grass Valley, credit for a still earlier use of quicksilver in pebble mills for inside amalgamation. Some months after Mr. Elmer's resignation from the Tuolumne mine, we received a letter from Charles Maass, Mr. Elmer's successor, and from his letter I quote the following:

"The objection usually urged against inside amalgamation, where fine grinding is done, is that the mercury will granulate and thus become useless for amalgamating purposes. This is due to the mercury becoming foul through taking up soluble mineral salts. To prevent this, it is necessary to introduce some agent which will cause the liberation of hydrogen gas from the liquid in the mill, thus deoxidizing the salts when they no longer have an affinity for the mercury. In other words, it is simply necessary to keep the mercury as nearly chemically pure as possible. To accomplish this we have found that, in the case of the silex-lined mill, metallic sodium gives excellent results. In our iron-lined mill the results were not as good, as the action of the metallic sodium was so violent that it caused the amalgam to adhere to such parts of the iron lining as had become brightened through wear. In this case we used an amalgam made up of zinc and aluminum. This also has the effect of liberating hydrogen gas, though the action is slower and will not cause the amalgam to adhere to the polished iron. The objection to the use of this combination lies in the fact that it cannot be made up in quantities to keep, and as a consequence must be made up freshly whenever necessary to add any to the mill.

"To sum up: For successful inside amalgamation in your mills it is only necessary to keep the mercury as nearly chemically pure as possible, and this can be accomplished by the introduction of any agent which will produce nascent hydrogen. As to quantities and proportions, this will vary according to conditions and the nature of the ore treated, and is a matter which can be easily determined by any experienced amalgamator. Mercury should be fed to the mill as freely as possible and yet avoid the resultant amalgam, when it reaches the copper plates from 'running.' It is not our object to catch the amalgam inside the mills, as its recovery there is an expensive matter, but to prepare the amalgam so that it will readily adhere to the copper plates when it leaves the mill.

"Regarding the results we have secured through inside amalgamation in the Hardinge mill, will say that since we have practised this we have cut our concentrate values almost exactly in half, with a corresponding increase in our free gold recovery. Our tailing value has also materially decreased."

From the above, and in view of the internal amalgamation having been carried on successfully for over a year, the results suggest that a failure in one case on the Mother Lode and a success in another, might be due to manipulation rather than physical or chemical conditions of the ores, and also that, as Mr. Elmer suggested in a previous letter, it required some faith to continue the inside amalgamation when he had nothing to show but the difference between heads and tails to recommend its continuance, for it took three or four days before the accumulation of amalgam in the mill produced a normal 'saturation.'

One is likely to jump too hastily at conclusions where gold is concerned. It is this saturation that causes anxiety in the starting up of any new metallurgical plant, from smelting down to chemical extraction. The ores at Tuolumne and those mentioned as at Plymouth both contain a large quantity of slate which forms colloids, which possibly may have some physical effect in coating the 'sickened' quicksilver. It is an open question whether this fouling or sickening is due to the chemical or physical action of an ore.

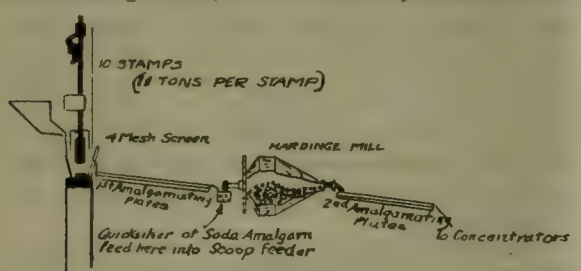
Another instance of jumping at a conclusion in amalgamation in the Hardinge mill came to my attention

in a plant at Jarbidge, Nevada, where excessive losses between heads and tails could not be accounted for. An expert was brought in to check up results, who later reported that all he did was to open the mill, dump the contents, retort three separate balls of 50% amalgam, and hand the manager $16,000 worth of bullion.

Here it was explained that the cause of the trouble was in too small a quantity of quicksilver being added to the charge in proportion to the gold content. As soon as a quantity of quicksilver sufficient to make a fairly liquid gold amalgam was introduced into the mills, the amalgam issued with the charge and was recovered on the plates.

Reverting to the experience at the Incaoro mines, Bolivia, it would appear that this inside ball amalgamation was desirable, not only from a metallurgical result, but also from the fact that 'outside amalgamation on the natives' fingers' was prevented.

The system as practised at Tuolumne is outlined in the following sketch, while at the Plymouth mill the



PLAN OF WORK AT TUOLUMNE.

plate between the stamps and the Hardinge mill was omitted.

From the above I am led to infer that if the quicksilver is fed to the mill with the ore in the form of an amalgam of quicksilver with zinc, silver, sodium, or other metal, there is formed an alloy which is no longer the single element of quicksilver, but a combination or alloy of the elements. Just as brass has a somewhat different physical and chemical action from its components, zinc and copper, so also would amalgam have an effect different from pure quicksilver.

This matter of inside amalgamation in pebble and ball-mills will no doubt be experimented with, but I predict that this will be done with varying results and opinions. A possible loss of a few pounds of quicksilver would, in our opinion, justify the experiment. Flouring or sickening is not due so much to agitation as it is to chemical and physical conditions of the ores under treatment. Experiments on inside amalgamation should be conducted with patience and common sense. The empirical mill investigator, unhampered by theoretical formulae, is more likely to solve this question than the chemist who relies only upon his books in the office.

H. W. HARDINGE.

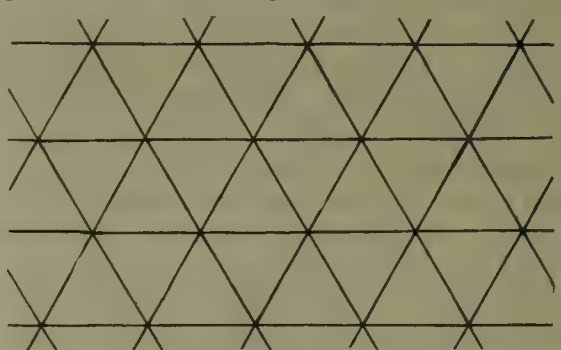
New York, January 28.

Valuation of Dredging Ground

The Editor:

Sir—In the *Press* of September 26, L. J. Hohl's contribution to the discussion on L. A. Decoto's 'Valuation of Dredging Ground' explains the mathematical principles involved in the computation of the average yard value in a clear manner. Although the increasing interest shown in dredging is reflected in the amount of placer boring now being carried on, a surprising lack of uniformity seems to exist in the methods adopted in working out the results. Mr. Hohl has demonstrated what I have always imagined to be the correct way, and also the shortest; and, if this discussion can be the means of inducing everyone to accept one standard form of computation, it will serve a useful purpose.

However, Mr. Hohl says that, as ground can be generally blocked out in a series of squares or triangular half-squares, no other geometrical figures need be considered. I admit that this way of setting out the holes at 90° is the general, if not the invariable practice; but another simple geometrical pattern, easy to lay out in the field, may be adopted by running the lines to intersect at 60°. This gives a series of equilateral triangles, six of which build up a hexagon with a centre point.



Therefore, any hole not on the outside edge of the area is equidistant from the six neighboring holes, and every hole has a balanced effect not to be got on any other pattern. When boring an area of some size and a reasonable width, it does not much matter for practical purposes how the outside holes happen to fit in with the boundaries, and no variation in the lay-out need be made on that account.

The computation of the average yard value should be carried out as explained by Mr. Hohl, each interior hole entering into six triangles. It may be found convenient to set out the bores so that the area of each triangle is an acre, or a simple fraction of one, as follows:

	Feet.
Equilateral triangles of one acre have sides of	317.171
Equilateral triangles of a half acre have sides of	224.274
Equilateral triangles of a quarter acre have sides of	158.586

I shall be interested to learn how this 60° lay-out is regarded by other engineers.

E. J. VALLENTINE.

Intan, Upper Perak, Federated Malay States,
November 27, 1914.

The Mine Mule

The Editor:

Sir—I read with interest in the *Mining Press* of February 6, Mr. Wentworth's comment on the mine mule. As he has obtained his figures as to cost of keep of a mule as compared to the horse, from an agricultural experiment station, and his data are supposed to be authentic, I hesitate to dispute his statement. But I do not hesitate to state that any big teaming outfit, that uses both horses and mules, would say off hand, that a mule, weight for weight, and work for work, will cost considerably less than a horse in keep.

At an experiment station ideal conditions are supposed to obtain for such tests, but the conditions are not ideal. The mule or mules experimented with may have been hearty feeders, and the horses dainty feeders. Why is it that you never can buy a good mule cheaply, whereas at times good horses are practically given away!

I have had considerable practical experience with both horses and mules under varying conditions, and have found that a mule will do a given amount of work, day in and day out, year in and year out, on less feed than a horse. Also a mule will thrive where a horse would starve. Any old prospector will vouch for that statement. The mule will also get along on less water. No one can be a greater admirer of the horse than I am. A horse is a loveable animal and a mule is not; but when it comes to wit, Mr. Wentworth will have to admit that a mule has more wit in a minute than a horse has in a month—to use an exaggerated expression. The mule certainly outshines the horse for wit. We have used mules in the Utica mine for years, and we have found them quick and apt scholars. One never hears of an underground horse; and why? A mule, weight for weight, costs about twice as much as a horse, and still the mule supersedes the horse underground—to which, I suspect, the horse does not object. The mule is used underground because of his superior intelligence, strength, and endurance, and less cost of keep as compared, weight for weight, with the horse. In a low drift a horse would butt his brains out, while Mr. Mule ducks his head and even crouches down when necessary. Maybe a mule is intelligent only as it may affect his well-being, but intelligence remains intelligence, no matter to what use it is put.

Mr. Mule keeps tab on the number of cars you couple on behind him—even when empty—and will let you know that he is 'wise' to you. He also keeps tag on the number of trips to a shift, especially if long hauls. He has strong union proclivities, and objects to doing a hand's turn, or foot's turn, when the regular work has been performed.

Maybe it is his 'tummy' that keeps time, for he seems to know when it's quitting time. Where it is necessary to dump a train of cars, separately at a given point, he will know after a trip or two just when and where to start and stop. There is an old expression extant, 'cute as a mule,' which does not belie him.

His bad point is his contrariness. When I was stationed in Arizona, I used to make occasional trips out on the desert, where it would be necessary to haul drinking water along, and not wishing to be overloaded, would take just enough to last until the next water was reached. Naturally, it had to be carefully husbanded. I always planned to have the mules take a good big drink before leaving; but never a drink would they take. But, offer them a drink ten minutes after leaving on the trip, from the supply being carried along, when too late to replenish it, and the brutes would drink the whole supply if offered. Now this does not argue intelligence; but I believe it was pure contrariness. It may be that the mules considered that the water would be easier and safer to carry inside than to haul. We all have our limits in intelligence, and so has the mule.

F. J. Martin.

Angels Camp, California, February 7.

[We are glad to have someone speak up for the mule when criticized. While he is abundantly able to kick for himself, he must rely on his friends, the miners, when it comes to writing for the papers. Just why mules have been preferred in coal mines and horses in metal mines is a mystery we have never solved. Does anyone know? —Editor.]

Smelting Copper Sulphide Ores

The Editor:

Sir—I have had considerable discussion lately concerning the smelting of sulphide ore, with prominent smelting men, some of whom claim that great improvements have been made in blast-furnace smelting during the past few years. I fail to see where these improvements are; the only thing that I will admit is that the furnaces have been increased in size, but this increase has been going on for over 30 years. During the first 15 years, furnaces increased from 3 to 20 ft. in length, and then from 20 to 50 ft. in length. There has not been what might be termed any metallurgical improvement, such as the utilization as fuel of more of the sulphur content of the ore, or reduction in the quantity of coke used, which would mean a reduction in the quantity of ore roasted and an all around saving in the cost of smelting. The fact is that with excessively high-blast pressure, more coke is used and less sulphur oxidized and a lower-grade matte is produced. I maintain that smeltermen are using more coke and producing a lower grade matte today in the large furnaces than they were 20 years ago, when smelting in furnaces with a capacity of 150 tons per day.

Take, for instance, the large smelters in Arizona at the present time, using 15% coke and producing a low-grade matte. During the time the smelters had a capacity of 150 tons per day in several of the smelting plants the consumption of coke did not exceed 11%. What is the cause of this great difference? Why should 15% coke be used to smelt sulphide ore when from 5 to 10% will do the work with less blast and produce a

higher grade matte and also increase the smelting capacity of the furnace?

At the Copper Belle mine, Gleeson, Arizona, in the year 1904, I smelted copper sulphide ore with 7½% coke (coke containing 24% ash) in an old blast-furnace 36 by 76 in. The furnace ran on sulphide ore containing 38% sulphur and 4% copper, two parts; and sulphide ore containing 16% sulphur and 5% copper, one part, with some silicious silver ore, producing a matte containing 26 to 30% copper and 22 to 28 oz. silver per ton. The following figures were copied from old charge sheets of the Copper Belle smelter:

	Tons.
Sulphide ore (38% sulphur)	2883.00
Sulphide ore (16% sulphur)	1446.00
Silver-bearing quartz	316.10
Foul slag	267.00
Matte re-smelted (24% sulphur)	102.00
Coke	378.20

The amount of charge smelted was 5014.10 tons with 378.20 tons of coke, or 7.54% coke on the charge, the sulphur content of the charge averaging 26.94%. The furnace was run during the day shift only, the blast being put on at 6 a.m. and shut off at 6 p.m. At night the furnace was left full of charge right up to the charging door, and about 30 minutes after the blast was put on in the morning the slag was running freely from the furnace. There was no trouble with the furnace freezing up. If the furnace had been run night and day shift continuously we could have smelted with 6% coke. I do not consider this as being exceptionally good work, but there is no smelter in Arizona doing even approximately as good smelting at this time even with their modern plants. In the year 1888 I went to Venezuela for the Quebrada Railway Land & Copper Co. and found that they were using mahogany wood to roast sulphide ore containing 40% sulphur, and using coke (made from coal, 45% of which was consumed in producing this coke) to smelt the roasted ore. This struck me as a very extravagant and idiotic method of treating ore, first to use fuel (wood) to burn fuel (sulphur) out of the ore which should be utilized. Second, burning 45% of the fuel value of coal to make coke to smelt the ore already deprived of more than sufficient fuel to smelt itself. But smeltermen are doing no better today. Large roasting plants are built, using coal or oil to roast the sulphur out of the ore, and coke is made by burning 45% of the coal or fuel value, and then used to smelt the sulphide ore already deprived of its natural fuel. So I cannot see where any progress has been made in blast-furnace smelting of sulphide ore. Smelters are simply using a furnace with a method which was designed to smelt oxide ore and which has a reducing action, while in smelting sulphide ore an oxidizing action is required, which is directly opposite to what is being done. There is plenty of room here for improvement, but do the copper smelting companies want to improve their methods? I think not.

WILLIAM KEMP.

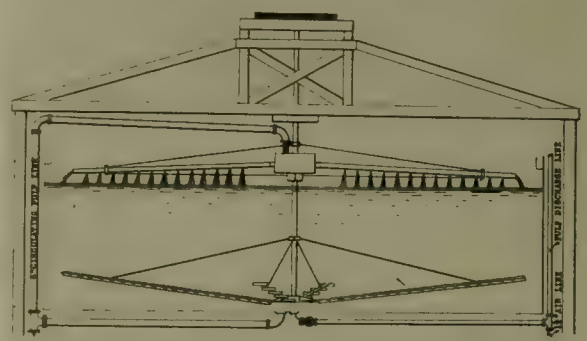
Tucson, Arizona, January 9.

An Agitator From a Thickener

The Editor:

Sir—The remodeling of a Dorr thickener into an agitator at the Commonwealth mill at Pearce, Arizona, is interesting because of the simplicity of the change, and the increased agitation capacity gained at slight cost. The thickener was one of two 38 by 12-ft. placed after the classifiers of the sliming department, and delivering thickened pulp to a line of nine 38 by 12-ft. Pachucas. They were designed to handle half of the mill flow each, but tests showed that one thickener was sufficient.

The purpose of the change was to prolong the period of agitation, and was effected by changing the speed of the arms from one revolution in five minutes to two revolutions in one minute, adding an air-lift for circulating the pulp from the bottom to the top of the tank,



and a radial launder for its distribution. The original shafting, arms, and drive gear was used.

The Dorr agitator and its companion thickener are driven from a common line shaft by a 3-hp. motor, the overload alarms on the two showing the same load.

The air for the 6-in. circulating pulp air-lift is supplied by a 1¼-in. pipe, the valve being 'cracked' only. The air pressure is the same as that supplied for the Pachuca agitators, that is, 20 lb., a higher pressure than that needed for economical work. Whitman Symmes gives figures for air consumption at varying pressures, lift being constant and ratio of liquid to solid of 2 to 1, as follows: air pressures of 8, 10, and 15 lb. require 29, 80, and 94 cu. ft. per minute, respectively, so that for the lift necessary for the pulp circulation, 10 lb. would be ample. The total power consumed certainly does not exceed 3½ hp., and as the capacity of the tank when filled to 10 ft. with a 2-to-1 pulp is 118 tons dry weight, the cost per ton agitated is low. The pulp handled is a quartzose slime, 1.25 to 1.30 sp. gr., 70% passing 200 mesh.

Since the agitator has been in use there has been trouble from the 'sanding up' of the Pachuca agitators to which it delivers pulp, although the passage of that pulp through the Dorr agitator gave no trouble.

The agitator was stopped on one occasion for 2½ hours, yet started without raising the arms.

D. W. MINIER.

Pearce, Arizona, January 15.

CONCENTRATES

Readers of the MINING PRESS *are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.*

MEN EMPLOYED in metal mines, coal mines, and quarries of the United States totaled 1,047,010 in 1913. There were 3651 fatalities, equal to 3.49 per 1000 employed.

THE REMEDY, or variation allowed in England on the fineness of bullion above or below that legally standardized, amounts to 2 parts per 1000 for gold bullion and 4 parts per 1000 for silver bullion.

POPULATION of the Canal zone and the towns of Panama and Colon, based on a census taken between December 22, 1914, and January 1, 1915, shows about 120,000 persons resident therein. The zone has 31,160 at present.

GOLD, SILVER, COPPER, LEAD, AND ZINC production *per capita* of population of the western states is as follows: Alaska, $298.38; Arizona, $346.76; California, $11.55; Colorado, $44.35; Montana, $164.65; Nevada, $459.21; South Dakota, $12.71; and Utah, $122.02. This is based on the census of 1910 and production in 1913.

COINS are to be made at the Panama-Pacific Exposition at San Francisco. Authority has been granted to the Mint to execute 3000 of $50, 10,000 of $2.50, and 25,000 of $1 gold pieces; and 200,000 of 50-cent silver. These will all be of the legal weight and fineness. Half of the $50 coins will be octagonal, similar to those issued in 1851.

BOILERS EXAMINED internally and externally in Montana in 1914 by the inspector, P. L. Brown, totaled 4301. There were 5695 defects noted, 2917 of which were considered dangerous, and suitable repairs were ordered made. Thirty-one boilers were condemned as unfit for further use, and the pressure was reduced on 1450 others.

NATIONAL FOREST AREAS of the United States were threatened with 6112 fires in 1914, up to December 1, with probable outbreaks in southern California and certain parts of the East. Of this total, 81% was extinguished by the Forest Service of the U. S. Department of Agriculture before 10 acres had been burned. The loss of merchantable timber in 1914 was about $400,000, against about $15,000,000 in 1910. In Montana and Idaho, 2000 fires threatened timber worth over $59,000,000, but were put out in time; and in Washington and Oregon fires menaced a property value of $24,000,000.

MOISTURE IN TUBE-MILL FEED should be approximately 38% by weight, if maximum efficiency for power consumption is desired. In some installations, however, where the regrinding plant is overloaded under these conditions, it is practicable to reduce the percentage of moisture below this limit, the increased power consumption being counterbalanced by increased economy in other parts of the plant following the handling of a larger tonnage.

COSTS at the Ashanti Goldfields property, West Africa, totaled $11.61 per ton during the past financial year. This included mine development, shaft sinking, London expenses, royalty, and prospecting, but not construction and treatment of old tailing. This cost is expected to increase somewhat on account of mining the Obuasi ore-shoot. Mining cost $1.74; retimbering, 22c.; ore transport, 12c.; treatment, $4.48; and general charges, $1.32 per ton. The miscellaneous expenses are high, amounting to $58,000, or 5c. per ton, but this includes sanitation, medical, holiday, and royalty pay, and white staff transit, rendered necessary in that climate.

ORE from the Cam & Motor mine, Rhodesia, contains antimony, as has been mentioned in this journal before, and the recovery in the new mill is now only 73%. A great deal of experimenting has been done, and the following will be the flow-sheet: The roasted ore will be first pulped with water in order to wash out the deleterious compounds before mixing with cyanide solution. Coarse sand will be separated for tube-milling by Deister classifiers. The ground product will then be classified into sand and slime by Dorr classifiers, and, as the gold content in the sand is quickly dissolved, it is proposed to treat this product in small tanks with cyanide solution. Finally the sand will undergo a short leaching treatment in vats. The slime treatment will consist of continuous decantation on the Dorr system.

PROSPECTORS' METHODS are useful for others than miners at times. During the making of some indicator cards in the engine-room at one of the Coffeyville factories, Kansas, the engineer accidentally dropped one of the very small brass screws for the indicator down into the flywheel pit. The bottom of the pit was partly covered with dirt, sweepings, etc., which promised to make the recovery of the screw all but impossible. One of the helpers about the place had once been a prospector, and said that he could recover the screw immediately. This is how he did it, according to J. I. Blair: Taking the engineer's wash-basin, he dropped into the pit, and carefully skimmed the surface of the slime and mud. Then going to a tank of water he panned the dirt, with the result that the screw was quickly found, and the cards finished.

MINING IN THE FAR NORTH

Ruby District: Prospecting, Gravel Washing, and Gold Production

By EMIL EDWARD HURJA

Perhaps more life was evident in the Ruby district during the season of 1914 than in any other interior camp visited. The revival from the depression which followed the stampede of 1911 and 1912 was due to the discovery of good 'pay' in quantity on the benches of creeks originally prospected and deemed worthless, as well as the finding of gold on streams of the adjacent Innoko watershed. The 1914 production has been estimated variously at $750,000 and $1,000,000. The 1912 production was $300,000; that of 1913 amounted to $550,000.

The first attention to placer prospecting was given the Ruby district in 1907, when prospectors found colors in Ruby creek,

RUBY TOWNSITE, MAY 1911, AND MAIN STREET, AUGUST 1914.

a three-mile stream emptying into the Yukon from the south near the present site of the town of Ruby. Many mining men stampeded there from the Fairbanks and Hot Springs districts, but the resultant prospecting did not yield any appreciable results.

In 1911, Fornander and Johnson, two prospectors, found gold in profitable quantities on Long creek, at the mouth of Bear creek. They staked the discovery claim, and carried on prospecting for some months before allowing news of the find to seep out into the Alaskan camps. By June of that year, however, the stampede was in full swing, and Ruby grew in a few months from a few tents to a healthy town. The population was estimated at from 1000 to 1500 for the summer of 1911 and 1912. Many of the surrounding creeks were staked, and as the old association claim law was still in force, the claims were all 160 acres in extent. Because the old law demanded but $100 worth of work on each association, no real development ever resulted, and the next year or two after the first discovery marked no advance in the future of the district.

When the Wickersham law went into force, limiting the number and size of the locations, the revival in prospecting started. That the operation of the law has been a godsend to the Ruby district is the opinion of the mining men of the camp. It has made the recent development possible, as prospectors are encouraged to develop their claims, particularly because one of the provisions of the act is that $100 worth of assessment work must be done annually on each 20 acres of placer ground. The Ruby district embraces, roughly speaking, 1000 square miles of territory, lying about 175 miles below Tanana, and 110 miles above Nulato, on the southern bank of the Yukon.

Most of the mining is done in the Salatna watershed, the headwater tributaries furnishing most of the gold. The Innoko streams on the other side of the divide also have been showing gold in profitable quantities. The mining district is situated south of Ruby City, 30 miles by the direct winter trail or 42 miles by the long summer road along the summits of intervening ridges. The United States government, through the War Department, has expended considerable money in road building in the district, but not enough to make hauling conditions satisfactory to the mining men of the district.

The work on Long creek and its tributary, Bear Pup, will be the first to be considered. Burke & Strite, operating on 3, Bear Pup, have been employing 40 men in two shifts all summer long on their lay. The ground is 16 ft. deep, of which from 6 to 8 ft. is pay-gravel. The overburden of 'muck' and waste gravel is ground-sluiced off, and the gravel scraped into the sluice-boxes by slip scrapers operated by steam. The season's product of the claim was 50,000 sq. ft. of bedrock. John Gidlund & Co., formerly of the Dome Creek district in Fairbanks, own and operate No. 1 and No. 2 Below, Bear Pup. They employed 50 men during a greater part of the summer, and mined 55,000 sq. ft. of bedrock.

X. Ditz & Co., operating ground owned by B. H. Walker and M. Sells, are reported to have opened 'pay' this summer which averaged over $6 to the square foot. The work is conducted on the Mascot bench, opposite No. 1, Bear Pup, on the left limit. The pay-streak is in the bench gravel, at a depth of 65 ft. Another 40-ft. streak was found 200 ft. away. Forty men were employed this summer, in two shifts, with a 50-hp. boiler capacity for the plant. As the ground is wet, pumping has been necessary.

Below Ditz & Co., on the Windy bench claim, the A. L. Kells company had a crew of 20 men working during the summer in ground 65 ft. deep that averaged $2 to the square foot. Below the Windy bench, Erickson & Graham worked during the summer on the Deacon bench. They had a 20-hp. plant and employed 10 men. Webber & Co. worked the lower end of Deacon creek, with a 20-hp. plant and a small crew of men. Buckley Brothers are blocking out on the Novikaket claim, situated at the mouth of Fourth of July creek, a Long tributary. They have a 30-hp. plant on the ground and intend to do considerable work during the winter, when the ground is solid and permits easy hoisting. Wally LaBoski has a 20-hp. plant and five or six men at work at the mouth of Fourth of July creek. E. W. Ward & Co. have a small plant on the Keystone claim, with a 20-hp. boiler and five shovelers. Farther down in the Long Creek valley, Ives & Larson worked a small open-cut this summer on Short creek, a tributary to

Long on the left limit. On upper Long creek Alex Larson had a 30-hp. plant at work all summer on 2 Above Discovery claim. Twenty-five men were kept at work and considerable pay was hoisted.

Perhaps the most important development of the season in the Ruby district is the planning for a dredge on Greenstone creek, where was announced late in the summer following an examination of ground by Walter Johnson of the Union Construction Co. Greenstone creek is a tributary of Long creek emptying into it on the left limit about seven miles below Discovery claim. John Holmgren, Peter Jensen, and several others have worked an open cut on Greenstone during the past two summers. The creek is five miles long, and three miles has been secured for dredging purposes by the Company. This has been thoroughly prospected, and some 300,000 sq. ft. of bedrock was scraped into the boxes this summer. The dredge will have buckets of 1-cu. ft. capacity. It will be constructed by the Union Construction Co. of San Francisco, to be shipped by water to Ruby and freighted from there to the creeks during the winter of 1915-16.

On Midnight creek, also tributary to Long, a lot of prospecting is being done. Some fair ground was worked there two winters ago. On Swift creek, tributary to Basin, John Hanson, prospecting on the right limit, recently found 'pay' averaging $1.50 per square foot. The ground is 16 ft. deep. Hanlon & Co. are working on Monument creek, a tributary of the Salatna river from the north. Five feet of pay-gravel has been found, but water invaded the workings recently and they have not done anything for a few months. They expect to resume work as soon as cold weather furnishes an opportunity to free the workings from water. Tamarack creek, a Salatna tributary from the south, has several prospecting plants on it. One is owned by McGillis & Co. They are reported to have found ground averaging $2 per square foot, but had not definitely ascertained the width of the pay-streak.

One of the most recent indications of the healthy tone of mining in the Ruby district was evident in the organization of the Ruby Development Co. by business and professional men of the camp. The Company obtained a Keystone drill from Nome late in the fall, and expected to start work immediately. The holdings of the Company will be tested, and then it is planned to drill ground for others for an interest. Several quartz lodes have been staked in the Ruby district, but assays made of what was considered the more promising one showed only a very faint trace of gold.

RUBY, ALASKA, IN JUNE 1912.

THE CARRIER DUMPING INTO SLUICE-BOXES, LONG CREEK, RUBY.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

NEW YORK

COPPER AND ZINC.—UNITED STATES SMELTING, REFINING & MINING CO. INCREASES OPERATIONS IN MEXICO.

Resumption by the Calumet & Hecla of normal production results in practically all the Lake Superior mines being at capacity, and foreshadows what the most of the other copper companies in the United States will probably be doing before long. The Anaconda made a small increase in its January output, and a similar tendency will likely be reflected in the January figures for the other companies when these are available. Copper has risen to about its normal level, and if it were to go much above, with the companies operating at only part capacity, there would be not a little probability that some of the consumers would begin to talk about conspiracies in restraint of trade. Of course, it is much to the advantage of all the companies to work at full capacity if the consumption will permit, and it is quite evident that that time has not yet arrived, as exports for the past four months have been about two-thirds of the average for 1913. Domestic consumption probably has been similarly restricted. The Department of Commerce has just given out figures showing that in 1914 copper exports amounted to 840,080,922 lb., compared with 926,241,092 lb. in 1913. As the exports in the first half of 1914 were higher than the average of 1913, the net decrease of 86,000,000 lb. for the year represents the very large falling off in exports since the war broke out.

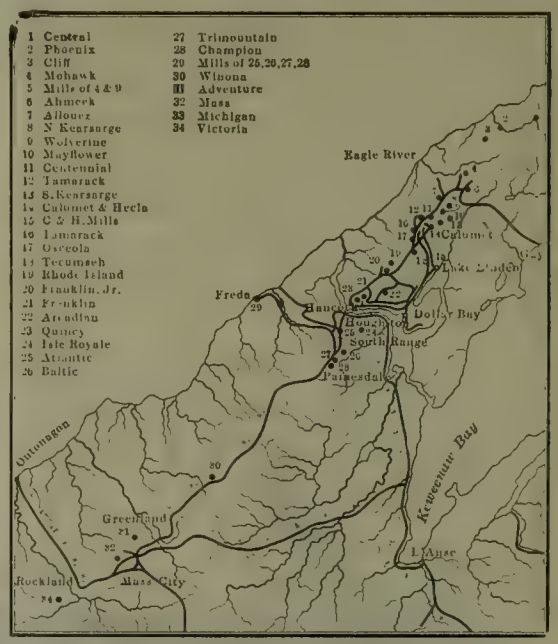
The high price to which spelter has risen has given rise to an amusing canard which circulated in New York last week. This alleged that the reason for the high price of zinc was that the metal is controlled in this country by sellers of German extraction, and that they had boosted the price of the metal to its present high figure in order to hamper the British as much as possible. Apparently those who started the story were quite unaware that the smelters about which the armies are now fighting produced nearly half of the world's output of zinc in 1913, and that the Butte & Superior, the largest single producer in America, has been shut down for several months on account of repairs to its shaft. The lead producers will doubtless be interested to learn the secret of boosting the price of a metal when desired, as that metal is characteristically dull. There is a real shortage of the highest grade of spelter, since a great deal of the present buying is for the manufacture of cartridge cases, for which the New Jersey Zinc Co.'s 'Horsehead' brand enjoys the highest reputation. Apparently there is not enough of this available to meet the demand, for it has sold as high as 15c. per pound and there is a strong market for other high grades of spelter. Now that the Butte & Superior is operating again, it is probable that the price of the metal will ease off, as that Company can produce about 5000 tons of spelter per month, or one-sixth of the total United States output.

Reports from Mexico state that the United States Smelting, Refining & Mining Co. has been able to increase considerably the output of its mines at Real del Monte and Pachuca since the first of January. For a while the properties were so hampered by the revolution that they were running at only about one-third capacity, but conditions have now been improved until the mines are making about two-thirds of their normal output. When the question of cyanide supplies from Germany was in doubt, the situation looked very dubious, but since then a sufficient supply has been received from that country, and there is now no trouble on that score. The decline in the price of silver is, of course, a serious matter for this Company, since nearly half of its gross output is derived from its silver mines. The Company's Utah coal mines are reported to have produced only 800,000 tons in 1914. This is a disappointment, since it requires a production of about 1,000,000 tons to produce net earnings sufficient to take care of the interest on the bond issue outstanding. It had been hoped that the increase in production last year would be sufficient to take care of this, but as a result of the bad conditions in general business the hoped-for increase did not materialize.

HOUGHTON, MICHIGAN

NORMAL CONDITIONS RETURNING.—TONNAGE TAX.—STAMP-MILL NOTES.—ISLE ROYALE SHAFT.

The Copper Country is gradually returning to a more normal condition. Feeling keenly the effects of the Western Federation strike and the curtailment due to the European war, Michigan operators are willing to take advantage of every opportunity the copper market may offer. The Calumet



MAP OF THE COPPER COUNTRY, MICHIGAN.

& Hecla and all its subsidiaries will run full time from now on. This new schedule will mean an average of 26 working days per month instead of 20. The old Osceola branch of the Osceola Consolidated and the Centennial mines have been operating full time for over two months. This will probably not mean any increase in the forces now working.

People of the Michigan copper and iron districts have been much concerned over the proposed tonnage tax. A report comes from Lansing that at the recent meeting of the execu-

tive committee of the state grange it was decided not to ask for a tonnage tax bill during the present session of the legislature.

It is reported that repairs are now being made to the old Tamarack stamp-mill preparatory to placing in commission two heads for the treatment of rock from the Isle Royale mine, which mill was recently destroyed by fire. The Tamarack mill was closed when the strike was called in July 1913. The Centennial-Allouez mill is now handling rock from the Isle Royale and Superior mines and is working at full capacity. Because of the present large tonnage of these two mines, it was necessary to transfer the small output of the Winona mine to the Trimountain mill of the Copper Range Consolidated. The Winona rock is now stamped at higher cost than at the Centennial-Allouez mill, but the shorter haulage just about makes up for the difference. The stamp-mill of the Mohawk and Wolverine mines is also being worked overtime to handle the large tonnage from these two mines.

The report comes from Boston that the directors of the Isle Royale have decided to proceed with the repairing of the No. 1 shaft, which was destroyed by fire several years ago. It is reported that the repairs will cost from $2500 to $3000 per month, and will require from six to eight months' work. The repair work on this old shaft was undertaken last summer, but the work was suspended in the fall, when all construction work ceased.

WASHINGTON, D. C.

CHANCES SEEM GOOD FOR PASSING THE BILL FOR MINE EXPERIMENT AND SAFETY STATIONS.—GERMAN POTASH.

At least one mining bill has now a chance to go through Congress at this short session, provided the shipping legislation is finished in time before March 4. This bill is that of Congressman Foster, from Illinois, and chairman of the House Committee on Mines and Mining, providing for mining experiment and mine-safety stations. Some opposition was expected to the bill on account of the large appropriations involved in the measure, about $750,000, but as read to the House no figures were specified as to the sum required, and so no obstruction was encountered on that score. The bill simply authorizes the creation of the stations, and it remains for future committees on appropriations actually to supply the money required, but there ought to be no trouble over that, for the provisions of Congress are mandatory enough. The bill came up in the House under suspension of the rules, and required a two-thirds vote to pass it. No opposition was encountered, and so it passed practically by unanimous consent. Nor was there much questioning. It is expected that 2,000,000 miners will be benefited by the bill. It is so short and reads so well that it carries its own description admirably, being as follows:

"*Be it enacted, etc.*, That the Secretary of the Interior is hereby authorized and directed to establish and maintain in the several important mining regions of the United States and the Territory of Alaska, as Congress may appropriate for the necessary employees and other expenses, under the Bureau of Mines and in accordance with the provisions of the act establishing said bureau, 10 mining experiment stations and 15 mine safety stations, movable or stationary, including those already established, the province and duty of which shall be to make investigations and disseminate information with a view to improving conditions in the mining, quarrying, metallurgical, and other mineral industries, safeguarding life among employees, preventing unnecessary waste of resources, and otherwise contributing to the advancement of these industries: *Provided*, That not more than three mining experiment stations and mine safety stations hereinabove authorized shall be established in any one fiscal year under the appropriations made therefor. * * * That the Secretary of the Interior is hereby authorized to accept lands, buildings or other contributions from the several states offering to cooperate in carrying out the purposes of this act."

The senators interested want to pass the bill in the Senate with all expedition, and Senator Shafroth of Colorado has asked that a special meeting of the mining committee of the Senate be called to hasten the measure, passed by the House, in the Senate. As it is, the bill is in good parliamentary position, as it, in like words, practically has already been favorably reported out of the committee, and put on the calendar of the Senate, and awaits only consideration there, when that body can consider bills other than the ship-purchase bill and the appropriation bills. If the jam is ever broken in the Senate, legislation unobjected to, as is this mining bill, will move with remarkable celerity. All that will really have to be done is to move the substitution of the House bill for the Senate bill, and this the mines committee will be able to arrange.

Miners of potash salts will be interested to learn that the State Department has official information from Germany that the Kali Syndicate, on February 1, in Berlin, decided to form a commission for the denaturing of potash salts so as to preclude the possibility of using them for ammunition and military purposes, and making them valuable only for fertilizers. Upon the report of the commission, the Syndicate will confer with the government relative to moderating the embargo on potash. It is declared that the Syndicate would be seriously embarrassed by a continued absolute embargo, and that large quantities of salts now under way would be detained.

LONDON

INSTITUTION OF MINING AND METALLURGY AND INSTITUTION OF MINING ENGINEERS RECEIVE ROYAL CHARTERS: THIS HONOR EXPLAINED; OTHER SOCIETIES.

The granting of royal charters to the Institution of Mining and Metallurgy and to the Institution of Mining Engineers is an event of importance to the mining profession in Great Britain, though naturally in America the advantages will not appear particularly obvious. Let it be said at once that the royal prerogative of giving the charters is not quite the same thing as the prerogative of bestowing the garter on the Earl of Chesterfield, who was at one time chairman of Stratton's Independence. The election of the noble earl to the knighthood of the garter at New Years was not in recognition of his services to mining, but as a pleasant personal recognition of his life-long connection with the court. The granting of a charter to a society is something very different. An application for a charter goes before the authorities of the Privy Council, who carefully sift the evidence as to the reputation of the members and council of such society, ascertain whether the objects and the methods of propagating them are of public benefit and interest, and judge whether the society as a body can rightfully claim a share in the advancement of knowledge and its beneficent application. The men who sit in judgment are not politicians or time-servers, so that lobbying is of no help. Nor are the aims the only point considered. The society has also to prove that it has 'made good.' Thus the granting of a charter is a public recognition of the standing of a society. It becomes an 'institution,' not a 'club' nor 'debating society.' Not only has the society to convince the Privy Council of its suitability to receive the honor, but it has to run the gauntlet of criticism and stern opposition of older societies that already belong to the privileged circle. For instance, when a society interested in any branch of engineering applies for a charter, it becomes exposed to violent counter attacks (as the military dispatches say) from the Institution of Civil Engineers. This, being the doyen of engineering societies, considers that it covers the whole range of subjects effectively, but the papers of interest to the mining

engineer read at the meetings during the past 30 years may be counted on the fingers of one hand without reckoning the thumb. It is true that a small proportion of our friends connected with metalliferous mining are members or associate members of the 'Civils,' but nearly all joined before the formation of the Institution of Mining and Metallurgy, or in its earlier days before it had got properly on its feet. The Civil Institution has been making itself ridiculous lately by attempting to dragoon its members in all sorts of pettifogging ways. Not only must you not carry a professional card in a reputable technical paper but you must not answer an advertisement offering an appointment. In the last circular relating to technical education issued by the 'Civils,' the word 'mining' is not once mentioned. How can they say that they take a human or practical interest in the welfare of a great industry and of the men who earn their living in it and who have its prosperity at heart? However, their day is ended as far as the professional control of mining is concerned, and in all probability a number of our mining friends will withdraw from membership, now that the two mining institutions have won their charters.

In all probability the American reader will wonder why there are two societies in England connected with mining, worthy of receiving a royal charter. The explanation is that the iron and coal interests in Great Britain are entirely separate from those connected with the non-ferrous metals. Gold, silver, lead, copper, and zinc are not produced in this country to any great extent but the number of English engineers connected with the mining of these metals abroad is large. The only metal of importance other than iron produced in this country is tin, and the tin miners are so much identified with ventures in other parts of the world, that their affiliation with a cosmopolitan society is more natural than one with the society devoted to the home industries of coal and iron. Thus the Institution of Mining and Metallurgy claims as its objects the advancement of the science and practice of mining in respect of minerals other than coal, and metallurgy in respect of metals other than iron. The Institution of Mining Engineers fills the rest of the bill. It is interesting to glance through the history of the two societies. The Institution of Mining and Metallurgy was founded in London in 1891, and last year its prosperity was so great as to warrant the purchase of a freehold house in Finsbury Circus. The Institution of Mining Engineers has had an entirely different history, as it was formed in 1889 as a federation of seven local societies, the name and dates of foundation of which I give as follows: The Manchester Geological and Mining Society, 1838; the North of England Institute of Mining and Mechanical Engineers, 1852; the Midland Institute of Mining, Civil, and Mechanical Engineers, 1857; the South Staffordshire and Warwickshire Institute of Mining Engineers, 1867; the Midland Counties Institution of Engineers, 1871; the North Staffordshire Institute of Mining and Mechanical Engineers, 1872; and the Mining Institute of Scotland, 1878. Of these societies, the North of England Institute was always the most powerful, and in fact organized the formation of the federated society. It is noteworthy that for some reason the South Wales Institute of Engineers never joined the federation, presumably being desirous of retaining its cherished nationality.

The second general meeting of the Institution of Mining and Metallurgy was held in London on December 17, 1914, F. H. Hatch, the president, being in the chair. After business was concluded, members took up the adjourned discussion on 'Persistence of Ore in Depth,' by T. A. Rickard. Those taking part were H. F. Marriott, S. J. Truscott, J. Morrow Campbell, J. W. Evans, and the author. The latter said that his paper might have been called 'The Impoverishment of Ore in Depth,' or 'The Continuity of Mining in Depth.' Contributed remarks were given by C. Baring Horwood, S. J. Speak, A. R. Weigall, H. F. Collins, J. H. Collins, E. Homersham, Henry Louis, J. H. Goodchild, and George E. Collins.

PLATTEVILLE, WISCONSIN

Extraordinary Features of the Spelter Market in January, and Results.—Bad Weather Affects Operations.—Lead and Carbonate Transactions.—District Production and Buyers.

The month of January 1915 will pass into the history of the zinc-mining industry as one of the most exciting ever recorded. The beginning of the month showed spelter in good form, East St. Louis ranging from $5.50 to $5.75 per 100 lb. The third week showed mysterious undercurrents at work, giving apprehensive minds something to ponder over. The U. S. Geological Survey, usually prompt in distributing spelter statistics, notified correspondents that producers refused to divulge vital data regarding production. Later, discriminating people associated this attitude on the part of the smelters as a keen move on their part to keep mining concerns in the dark and in this manner hold down the price of blende ore. In this the spelter manufacturers succeeded admirably for a time, but when the secret finally leaked out they brought down on their heads the wrath of the ore producers, who are primed for measures of retaliation not soon

FIRST STAGES IN WISCONSIN MINING.

to be discarded. The local correspondent of the *Mining Press*, puzzled at the wide divergence between current newspaper and trade journal quotations and prices admitted by large consumers of metal, interviewed one of the leading officials of one of the largest spelter manufacturing concerns in this country, who readily admitted that large tonnages had been disposed of at from 25 to 30 points in advance of published quotations. It was even then stated that producers were seriously considering the advisability of withdrawing quotations entirely, as they were sold out for February and March. The last week of the month witnessed metal quotations breaking all restraints, and the close of the month carried St. Louis quotations at $7.25, with sheet-metal quotations withdrawn entirely after having rounded the 10c. mark.

The immediate causes of this sky-rocket ascension is found in first an avalanche of foreign buying orders, and the disposition of home consumers laying low on buying orders, with restricted inventories, in the belief that the metal market was being manipulated. When they finally awakened to the real situation there was a scramble to cover buying orders, and bids were made freely at $6.50 to $6.75, but without avail. Many large consumers found themselves 'in bad,' and their importunities for metal are apt to set spelter at prohibitive figures.

The blende markets were somewhat slow to respond to the quickened tone in the spelter markets, but when the true situation was revealed, there came incidents identical with the flurry witnessed in the metal exchanges. December had

closed at $52 per ton for standard commercial ore, and this figure was well maintained until about the 20th of the month when the ore began to climb, and the close of the month found buyers anxious to close on a base of $60, with premiums commanding prices in advance of this exceptional figure. Production was low even at these prices, owing to severe winter weather. Gasoline and electric driven plants without heating arrangements were in many cases compelled to shut down temporarily, and even steam heated plants found it difficult to keep plumbing and milling machinery keyed up efficiently in the face of 10 to 20° below zero weather. Heavy snowstorms drifted the roads badly, and all outlying producers were as completely shut off from transportation facilities as if located in the Arctic zone. Prospect and mine development work, which had received fresh impetus under the glowing advances in the price of metal and ore, were retarded seriously by the weather. Yet, in the face of these difficulties, the field made a fair showing in output and deliveries for the month.

Lead ore was in poor demand all the month, and prices remained stagnant, $47 per ton being the best offer made on a basis of 80% metal. Pyrite producers received little encouragement, and production reached the lowest level recorded in years. Some ore is being carried over, less than 1000 tons all told.

Miners of carbonate zinc ore in the northern districts of the field were sadly mistreated. Prices bounded up toward the close of the month to a point never reached before in all the history of mining in this class of ore, $27 to $32 being the range on a basis of 40% metal content, but buyers refused to pay any attention to producers, and absolutely no ore cleared for the entire month. Production was good, an even score of operating concerns digging with increased forces. The 1914 output is being carried over intact, and thousands of dollars are tied up in the ore-piles, mostly represented through the single item of labor alone. However, miners are far from despondent. They claim their day is coming, and that good profits will be realized on their investment. Over 1500 tons of this grade of ore was carried over at the close of the year.

The following ore deliveries were reported for the month of January, by districts:

District.	Zinc, pounds.	Lead, pounds.	Pyrite, pounds.
Benton	8,584,000	220,000	1,950,000
Galena	5,424,000	.....	.....
Hazel Green	3,662,000	.....	.....
Livingston	3,560,000	.....	.....
Cuba	3,024,000	.....	.....
Platteville	1,948,000	.....	.....
Linden	1,678,000	.....	.....
Mifflin	1,612,000	.....	.....
Highland	460,000	.....	.....
Rewey	126,000	.....	.....
Shullsburg	120,000	.....	.....
Mineral Point	72,000	.....	.....
Total	30,270,000	220,000	1,950,000

The Mineral Point Zinc Co. delivered 61 cars (4,652,000 lb.) of high-grade ore to DePue during the month. The gross production of raw ore from all mines totaled 26,011,960 lb., and net deliveries to smelter 21,083,380 pounds.

Sales were distributed among buying concerns as follows: Mineral Point Zinc Co., 6679 tons; National Separating Works, 2373 tons; Grasselli Chemical Co., 1541 tons; M. & H. Zinc Co., 990 tons; Illinois Zinc Co., 947 tons; American Metals Co., 585 tons; Linden Zinc Co., 558 tons; Empire Roasters, 580 tons; American Zinc Co., 512 tons; Campbell Separating Co., 235 tons; a total of 378 cars with 15,000 tons, showing an average carload lot of 40 tons. More high-grade ore cleared during the month than is usual for this field.

JOPLIN, MISSOURI

MINING ACTIVITIES STIMULATED BY HIGH PRICE OF ZINC, AND LARGE SALES OF ORE. NEW PROPERTIES OF J. M. SHORT

The sharp advance in the price of zinc ore which reached $65, basis 60%, blende at the beginning of February, has stimulated unusual activity throughout the district. New derricks are going up in every camp, and some larger development is in progress. One or two new concentrating plants are contemplated on leases that have already been developed. Every prospecting drill rig is in demand, and work is being done in virgin regions. The zinc ore prices at the beginning of February were the highest ever paid, being 50c. stronger than the previous high record of $64.50, basis, paid in September, 1912. Zinc metal prices were much higher in London than ever before, quotations of £37 being reported while the previous highest was £29 10s. in 1906. New York metal reached $7.50 to $7.90 while the highest previous price was $7.65, in 1912. Production of zinc-blende from this district is about 5200 tons, and doubtless will increase to about 6000 tons in the course of a few weeks, as many producing mines that have been operated on single shift will more than double their output. Several companies that had been holding their ore for higher prices are making heavy sales. The Mont B. Mining Co., north of Webb City, began holding ore two years ago, and the pile has reached approximately 5000 tons, the greatest reserve pile of ore ever accumulated in the district. During most of this time this ore was accumulating, prices were much below $50, basis, and sometimes below $40. The value of the pile now is placed at $300,000, and a heavy tonnage of it has been sold at existing prices.

The former operator, J. M. Short of the Sitting Bull and Pocahontas mines, north of Joplin, has recently opened some new claims which appear to be rich. The Sitting Bull and Pocahontas were considered the richest soft-ground areas developed in the past 10 years in any part of the whole district. Within the past few months, however, Mr. Short has developed what is known as the New Geronimo lease, the fee of which, consisting of 40 acres, is owned by the Short Land Mining Co. A concentrating plant of 150-ton daily capacity, run by gas engines, is now in operation, and the concentrate produced is running as high as 63% metallic zinc, thus bringing a premium of $3 per ton above the prevailing basis price. The new mine is situated five miles northwest of Joplin in what is known as the Belville camp. Many years ago the property, which is in a low-lying creek valley, was mined at shallow depths and rich deposits of lead were found, but because of the heavy volume of water encountered at shallow depth, it was impossible to mine deeper although a number of drill-holes had revealed ore beneath the level of the mines of those days. Mr. Short drilled the lease to prove the old prospect holes and found that their richness had not been exaggerated. He placed 12 prospect holes on the ground, ore being shown from a depth of 30 down to 105 ft. Two new shafts were then sunk, one of which is used for pumping in which two large centrifugal pumps have been installed, the capacity of each being 1500 gal. per minute. The double installation was made in order that one unit could be used as an emergency. The ground has been drained to a depth of 95 ft., drifts are into good ore and a third shaft, to be connected with the mill by inclined tramway, is now being sunk. In addition to this property, the owner has acquired a first lease from the landowner of the Pocahontas lease, which was such a heavy producer, and has the right to remove the old pillars which contain rich ore. The ground at the Pocahontas was permitted to fill with water about a year ago, at the time when fire broke out in the heavy timbers. The old shafts were sealed at the top, and have never been reopened. It is not known in what condition the old drifts were left as a result of the fire, but this question will be settled by the sinking of a new shaft in virgin ground west of the former workings.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press.

ARIZONA

Cochise County

As copper averaged over 13c. per pound in January, the Copper Queen and Calumet & Arizona companies, at Bisbee, fixed the wage scale for February in accordance with their promise. The Hoatson shaft of the latter property is again in operation, having been closed since August.——Eighteen gold claims in the Bowie district have been sold by T. Quillan to T. K. Mitchell, of Wilcox, for $30,000. A three-stamp mill is being erected.——The Commonwealth mine at Pearce continues to show good results from development. At 300 ft., 100 ft. from the C shaft, the Smith vein is 5 ft. wide, worth $42.75 per ton. It is hoped that the February tonnage will be about 10,000.

Greenlee County

The Shannon mine and smelter at Clifton are to be started again as soon as possible. The Shannon-Arizona railway is being repaired for resumption of traffic.

Yavapai County

Three carloads of ore from the Great Belcher mine have been sent to the smelter at Humboldt. This ore was really a large sample to test its real value. Open-cut mining is planned for the future, also a 200-ton mill to treat the gold ore.——W. W. Lewis is superintendent. The Emporia mill started on January 29.——The Excelsior claims, near Prescott, are giving satisfactory results.——A long shoot of high-grade gold ore has been opened in the Little Jessie at Chaparal. In this same district a new vein was cut in the Union claim. ——Foundations are being prepared for the Gray Eagle Reduction Co.'s plant at Crown King. Some of the machinery is on the ground.——Considerable apparatus has been ordered for the Fortune mill being erected in the Big Bug district. ——If copper remains steady, ore extraction is to be resumed from the Copper Basin and Snoozer mines of the Commercial Mining Company.

CALIFORNIA

Amador County

The Central Eureka company has paid a dividend of 2c. per share, equal to $20,000.——The old Hayward mine, three miles from Ione, is being reopened after 50 years' idleness. At 300 ft., $6 to $28 copper-gold ore has been cut.

Following is the preliminary report of output and costs of the Plymouth Consolidated for January: ore crushed, 10,800 tons; value of output, $49,991; working expenditure, $23,685; development, $7268; surplus over these charges, $19,038; and other capital expended, $616.

Butte County

In the suit of the Leland Stanford University trustees *v.* the Butte Creek Consolidated Dredging Co., an agreement has been made by which the plaintiff receives $300, and dredging will be continued.

Mariposa County

(Special Correspondence.)—The Queen Regent Merger Mines Co. of San Francisco last August bought a large group of claims over a mile long and about one-half mile wide, situated about three miles southeast of Mariposa, on which development work has been steadily carried forward by sinking prospect shafts and the driving of adits. The Company reports opening rich sulphide gold-copper ore at water-level in shallow shafts of 30 to 40 ft. depth. The heavy flow of water could not be handled without placing expensive machinery equipment, so the general manager, J. E. Kerr, advised the directors that by driving an adit about 1000 ft., four veins would be cut which would give 300 ft. of backs above the level on the No. 1 vein, and about 800 ft. on the No. 4 vein, which would afford drainage for a large area and save heavy development expense and cost of machinery. An adit was started, which has already been driven 335 ft., and the face is now in the iron foot-wall of the first vein, in which crevices occur showing particles of native copper and quartz containing gold in fair amounts. As the first vein at the surface is from 12 to 30 ft. wide, showing high copper and gold content, the Company states that if at adit level the vein shows the same width and value as at the surface, it will result in opening a large body of highly profitable ore. About 300 ft. ahead of the present face of the adit the second vein occurs, on which a shaft sunk to 40 ft. encountered water. This vein is a bold outcrop of hematite, and the ore taken from the shaft contains 6.3 to 23% copper and about $1 gold per ton. Operations of the Company are attracting considerable interest, as it is the first attempt systematically to develop at depth the copper veins of this district.

Mariposa, February 1.

Nevada County

Rich ore is reported to have been cut at 4800 ft. in the Empire mine.

Shasta County

The Mountain Copper Co.'s smelter at Martinez, Contra Costa county, is being blown-in after a shut-down since August. The Iron Mountain mine has also been reopened. The new mill and sorting plant is nearly completed.

Sierra County

So far about 50 ft. of the rich shoot has been opened in the North Fork quartz mine at Forest City. G. F. Stone is in charge.

COLORADO

Eagle County

Owing to litigation, the Lady Belle silver mine has been closed for several months, but R. A. Messa has secured a lease and resumed work. Some good ore has been opened recently.

Lake County (Leadville)

Considerable activity prevails at the larger properties of the district, including the Colonel Sellers, Yak, and Western. These are extracting large tonnages of carbonate and zinc sulphide ores.——Some rich gold-silver-lead ore has been opened in the Gordon-Tiger in the Twin Lakes district.——The new electric hoist has arrived at the Big Four.——The old Antioch mine on Breece hill, adjoining the Nome gold claim, is to be reopened by Leadville people. It was formerly worked through a 3200-ft. adit.——Mines on Breece hill are producing about 750 tons of ore per day, and the railroad is very busy.

San Miguel County

The snowslide season is now due, and on January 31 the first slide carried away two towers of the Black Bear tramway. ——The Primos Chemical Co. has 45 men in its mine in the Daily district, and according to the manager, Harold Boericke, the plant at Vanadium is soon to start again.

TELLER COUNTY (CRIPPLE CREEK)

The output of Cripple Creek in January was the highest for 10 years, due to the rich ore from the Cresson mine, where further discoveries are being made. The yields were estimated as follows:

	Tons	Average.	Total.
Smelters	4,500	$166.11	$ 747,500
Golden Cycle	29,000	20.00	580,000
Portland (Colorado City)	8,500	19.50	165,750
Portland (Cripple Creek)	16,000	3.12	49,920
Stratton's Independence	9,400	4.56	42,864
Colburn-Ajax	3,250	7.00	22,750
Gaylord-Dante	1,400	2.50	3,500
Kavanaugh-Jo Dandy	1,400	2.00	2,800
Neville-Free Coinage	600	4.00	2,400
Wild Horse	600	4.00	2,400
Isabella	1,000	2.00	2,000
Total	75,650		$1,621,884

At 1860 ft. in the Vindicator mine, the Christmas vein has been cut, showing 4 to 5 ft. of rich ore.——Construction of the new building and plant for the El Paso is well under way.——At the Aileen, between the Mary McKinney and Chicken Hawk, old workings are being repaired, and a compressor plant installed.

IDAHO

SHOSHONE COUNTY (COEUR D'ALENE)

The increase in the price of spelter has made mining more interesting in the Coeur d'Alene, and companies are 'crowding' their output.

The Stewart Mining Co., of Kellogg, will distribute 10c. per share, or $123,836, on February 20. This makes a total of $1,424,083. New orebodies have been opened below 600 ft. The Company has acquired the Old Sport copper mines on Vancouver island.——In the Silver Cable is a shoot of ore 300 ft. long and 20 ft. wide of milling grade, in which is 80 ft., 6 ft. wide, averaging 47% zinc.——As the Montana Power Co. will be able to supply current on Beaver creek about July 1, in place of April 1 as stated recently, the Oregon-Washington Railroad & Navigation Co. may build an electric line in the Sunset district. This would aid shipments from the Interstate-Callahan mine.

The office of the *News* at Kellogg was destroyed by fire on January 25, the loss being about $8000, with only $3800 insurance. No issues will be missed, as *The Wallace Miner* has lent its plant for publication.

The Success company, operating near Wallace, has opened a large body of ore at 900 and 1100 ft. The daily output of zinc ore is 100 tons, and 120 miners are employed.

MICHIGAN

HOUGHTON COUNTY (THE COPPER COUNTRY)

Present production of the mines of this district is estimated by *The Daily Mining Gazette* as follows:

Name.	Daily rock tonnage.	Mo. output refined copper, lb.	Percentage of normal.
Baltic	1,400	728,000	100
Trimoun'ain	1,300	540,800	100
Champion	2,700	1,474,200	100
Victoria	300	93,600	100
Mohawk	2,500	1,300,000	110
Allouez	1,600	510,000	75
Isle Royale	2,200	750,000	85
Osceola	4,050	1,265,000	75
Wolverine	1,700	800,000	100
Centennial	500	168,750	65
Mass Con.	800	421,200	100
Superior	700	280,000	75
Calumet & Hecla	8,000	4,500,000	75
Quincy	4,000	1,560,000	85
Winona	200	104,000	50
Ahmeek	2,500	1,200,000	75

The report of the commerce through Portage Lake canal in 1914 shows a total of 1,900,588 short tons of freight, valued at $70,010,151. This is a decrease compared with former seasons.

At the Mohawk, No. 6 shaft is down 1100 ft., and a large tonnage of 'rock' is showing in this area. The mill is producing copper at the rate of about 15,000,000 lb. per year.——At the Calumet & Hecla company's White Pine mine, a heating plant is being installed in the new mill. In three shafts there are 14 machine-drills at work.

Resumption of full time at the Calumet & Hecla and its subsidiaries was ordered on February 5.

KEWEENAW COUNTY

It is reported that some old properties near Copper Harbor are to be prospected this summer. Diamond-drilling was done there in 1909 and 1910. This place is a beautiful holiday resort.

MONTANA

SILVERBOW COUNTY

'The Water Resources of Butte' is the subject of *Water Supply Paper* 345-G of the U. S. Geological Survey, by O. E. Meinzer. The discussion covers 125 pages and is illustrated with maps, etc. The district is one of the important mining centres of the United States and has a population of over 50,000. It is situated on the north side of a small rock-bound basin in the mountain region of western Montana, with an area of about 130 square miles. The average temperature is 42°F.,

ARTIFICIAL CANYON MADE OF SLAG AT BUTTE, THROUGH WHICH SILVERBOW CREEK FLOWS.

and rainfall 13.89 in. The author describes the geology, valley fill, soil, vegetation, climate, surface waters, water in bedrock, quality of water, water in valley fill, yield of wells, irrigation, and public supply. The daily consumption is 9,000,000 gal., including that used by mines, railroads, and other industries. The Butte Water Co.'s plant is valued at $4,513,000. Large consumers are charged from 20 to 50c. per 1000 gallons.

The report of the North Butte Mining Co. for the quarter ended December 31, 1914, gives the following information: Development totaled 1874 ft., and skip-chutes cut 16,700 cu. ft. Ore reserves were maintained at the usual tonnage. High-

grade ore was found in the Edith May vein at 2800 ft. The mine was worked at 50% capacity, and costs were no higher than formerly. There was treated 50,858 dry tons of ore and 6.6 tons of precipitate, yielding 3,466,483 lb. copper, 194,585 oz. silver, and 176 oz. gold. Copper and silver on hand are valued at $1,074,819, against which are advances of $551,343. The surplus and reserve is $3,141,771. At the Granite Mountain shaft the 2600-ft. station was finished, and nearly all chutes to 2800 ft. are ready. The electric hoist is being installed and should soon be ready.

NEVADA

Elko County

(Special Correspondence.)—The Dome Mining and Reduction Co. is operating at Bullion. Work in timbering old adits, drifts, and stopes was started early in May 1914, and development to January 1 totaled 950 ft. The first ore shipment was made on June 30, and to December 1, 1814 tons of silver-lead-copper ore, worth $57,053, was sent to the United States company's smelter at Midvale, Utah. The ore is hauled 12½ miles in auto-trucks to Raines siding on the Eureka Nevada line, and transferred to the main road at Palisade. On account of the metal markets and winter, ore shipments have been suspended. An average of 10 men was employed, there being 6 at present on No. 3 and No. 4 levels.

Bullion, January 25.

Esmeralda County

The estimated production of the Goldfield Consolidated Mines Co. in January is as follows: ore mined, 30,563 tons; gross extraction, $414,000; operating expenses, $182,000; and net realization, $232,000.——Some rich gold-silver has been opened in the Klondyke district midway between Goldfield and Tonopah.

Humboldt County

Bullion output of the Seven Troughs Coalition in January was $34,000. A dividend of 2½c. per share, or $36,000, is expected on March 1. At 1300 ft. depth there is 200 ft. of ore exposed, and recently 5 ft. was opened, 1 ft. assaying $1200, and the balance $160 per ton. The new 100-ton mill should be at work in a few days.

Lyon County

The old Western Nevada copper mine has been purchased by the Nevada-Douglas company. Prospects are said to be good.——A 100-hp. gasoline hoist and other machinery recently passed over the Copper Belt line for the Pittsburg-Liberty mine at Masonic.——Some rich gold ore has been opened at 180 ft. in the Rescue mine.

Mineral County

Owing to alterations and overhauling, the Aurora mill will be shut down for about 60 days.

Nye County

Six mines at Tonopah produced 10,372 tons of ore, worth $212,656, during the week ended February 6.

The Merger has joined the shipping list and sent 100 tons to the West End mill. At 1170 ft. the vein is 6 ft. wide, assaying over $30 per ton.——The Extension's yield for the second half of January was 102,000 oz. silver and 20 tons of concentrate, valued at $68,000.——At a meeting of the Dexter White Caps Mining Co., of Manhattan, the shareholders decided not to sell out to the Tonopah Mining Company.

NEW MEXICO

Grant County

(Special Correspondence.)—The Burro Mountain Copper Co., at Tyrone, has finished with its 50-ton experimental mill and will dismantle it. Work is still going on at the 100-ton concentrator, situated several miles east of the mines and on a spur of the Burro Mountain branch of the El Paso & Southwestern railroad. Drilling for water continues in many places on the property.

One hundred seventy-six carloads of ore was shipped from the Lordsburg mining district during January, being more than has been recorded for some time.——The Monte Rico Mining Co. is making excellent progress on its adit at Lees peak, and by the end of March should be into ore and making shipments.——The Octo Mining Co., near the Lees Peak property, is building a boiler-house, and will soon start work on a fair scale.

About 1900 ft. of flume of the Chino Copper Co. collapsed last week owing to the weight of icicles, and a good deal of water went down an *arroyo* before the water could be turned. The Company continues to operate about two-thirds of normal capacity.

Lordsburg, February 5.

Sierra County

A custom concentrating plant is proposed by several operators at Kingston.

Socorro County

(Special Correspondence.)—Mogollon has suffered from lack of fuel oil and supplies, and several mines and mills have closed down temporarily.

The Ernestine Mining Co. continues to operate its mill and is shipping bullion to New York. A modern chemical laboratory is being built, and it is said that a new shaft is to be sunk. The most noteworthy development made in the district for many months is the deep exploration of the Last Chance vein by this Company. On No. 5 level, below the mail adit, which was the bottom level when the present owners took charge, and which is 1200 ft. below the apex of the main vein, a drift has already been driven into the orebody for a distance of 170 ft. The ore shows a width of 10 to 15 ft. where cross cut, and the value is above the average. A drift has also been started on No. 7 level, 200 ft. deeper, and it will soon reach the trend of this ore-shoot, which has been one of the most regular and heaviest contributors to the state's gold and silver production.

The Oaks Co. at Alma is conducting work on several different properties, and is making extensive tests on ore from the Queen vein, the mother lode of the Mogollons. Some excellent smelter returns were received from a small shipment, and development will go forward on a large scale.

The Mogollon sawmill, operated for a quarter of a century by Harry Herman, has been sold to Frank Kelly. Practically all the timber used in the Mogollons has been furnished by this mill.

The large power project of the Socorro Power & Lumber Co. is under way, and is furnishing timber to the district at a low rate. A flume is transporting lumber to the mines from Whitewater creek, and power is to be generated by water-wheels at the terminus after the project is completed. It is stated that the Socorro Mining & Milling Co. has given up its option on the Pacific mine, which was held at $250,000. An aerial tramway was under construction and a large amount of development work had been done. No reason has been given for this decision.

Mogollon, January 22.

OREGON

Baker County

The Imperial mine at Cable Cove, 11 miles north of Sumpter, has been acquired under bond and lease by the Blue Mountain Mining Co. Five veins have been opened, and reserves are estimated at $240,500. C. L. Arzeno, of Cincinnati, is manager.

SOUTH DAKOTA

Custer County

The Custer Peak Copper Co. is resuming mining, and the 250-ft. shaft will be unwatered and development started.

UTAH

Juab County

Twenty four mines at Tintic produced 430 cars of ore, valued at $555,000, in January, compared with 295 cars and $390,000 in December.

Salt Lake County

The Salt Lake City Stock Exchange has been exceptionally busy, and transactions last week totaled 338,871 shares, valued at $46,150, the largest turnover for years.

The report of the Alta Consolidated Mining Co. for 1914 shows that development totaled 2280 ft., from which 216 tons of ore was recovered, netting $4951. Prospects are encouraging, but since August the force has been reduced to a minimum.

The Utah Copper Co. started another steam-shovel last week, and has 40 more men at work.

Summit County

The flow of water from the Snake Creek tunnel is 7500 gal. per minute, and work has been temporarily suspended.——Ore production of Park City in January totaled 7824 tons, worth about $320,000, from the following mines: Silver King Coalition, 3753; Daly-Judge, 2278; Silver King Consolidated, 1460; Daly West, 243; Mines Operating (Ontario), 30; and

SILVER KING CONSOLIDATED MINE, PARK CITY, UTAH.

Daly, 60 tons. The December output was 7316 tons.

At 1800 ft. in the Silver King Consolidated the vein has been opened 500 ft. east and west, assaying 60 oz. silver and 30% lead. This level is far better than at 1700 ft.——As the Daly-Judge mill had been working its men over the regular hours, and the state labor commissioner interfered, 50 miners have been paid off. The general manager, G. W. Lambourne, stated that he had employed extra miners to relieve the labor excess supply, consequently the plant had to run longer to treat the extra ore. No millmen had complained of overtime.

CANADA

British Columbia

For the sum of $55,000, Spokane people headed by T. A. Russell, have purchased placer claims 20 miles from Vernon. Joseph W. House has been appointed superintendent. Hydraulic plant is to be ordered and installed by May 1. It will handle 3000 cu. yd. of gravel per day. This material is of high grade. A 1¼ mile ditch will supply 1500 in. of water with 202 ft. head.

Ontario

The annual report of the Crown Reserve states that the output to the end of 1914 was 18,429,141 oz. silver, of which the Carson vein yielded about half. The average price received in seven years was 54.57c., and cost 13.675c. per ounce.

A dividend totaling $240,000 was paid to Conlagas shareholders last week, making a total of $7,480,000.

The Hollinger mine produced 20,775 tons of $12.28 ore during the last 28 days of 1914. Working costs totaled $4.371 per ton, and the profit $156,059. Dividends are now $120,000 per month. The annual report shows that 208,936 tons of ore treated in 1914 yielded 1,786,680 gross profit, of which $1,170,000 was paid in dividends.——Six levels are being developed in the Dome. Diamond-drilling from the surface was stopped in December, but machines are working on No. 4 and 5 levels. The mill is increasing the tonnage treated each month.

KOREA

The Oriental Consolidated reports as follows for November 1914: 240 stamps worked 26.4 days crushing 28,056 tons of ore. The various plants recovered $154,323. The net profit was $56,078.

The Seoul Mining Co. reports the following results for January 1915:

Stamps working	40
Time, days	29
Ore crushed, tons	6,680
Total recovery	$60,850
Operating expenses	25,850
Net earnings	35,000

MEXICO

Hidalgo

The Santa Gertrudis mill treated 13,900 tons of ore for a profit of $34,000 in December. Cyanide was short.

Sonora

Ore and bullion passed through Agua Prieta from Sonora to Arizona in January were as follows: concentrate, El Tigre, 81 tons; and Moctezuma, 4410 tons; ore, Panama, 6 tons, and Santa Rosa, 21 tons; bullion, El Tigre, 128 bars and 146 sacks of precipitate; and value of shipments: copper, ₱1,246,000; silver, ₱491,000; and gold, ₱235,600.

On account of bridges being burned between Agua Prieta and Fronteras a few days ago, about 300 American people are marooned, principally at El Tigre and Nacozari. This was done by General Calles in his attempt to cut off Maytorena's communication with the border.

The San Toy Mining Co. reports as follows for the year ended December 31, 1914:

	1914.	1913.
Gross income	$ 56,228	$317,332
Expenses	148,607	148,905
Deficit	92,379	*132,427

*Surplus.

Tamaulipas

Exports of crude oil from the port of Tampico to United States ports in 1914 amounted to 11,710,508 bbl., compared with 11,150,399 in 1913 and 5,805,476 in 1912. Notwithstanding the adverse conditions suffered by the oil companies, the exports for the year show a substantial increase over the preceding year, which was considered a banner year for the oil industry in Tampico. On January 1, 1915, there were about 20,000,000 bbl. of oil in storage in this district. At present most all of the companies have shut down their wells, allowing only those wells to flow that cannot be entirely shut off on account of their high pressure. Had conditions remained normal throughout the year, double the amount of oil would undoubtedly have been shipped to the United States.

PERSONAL

H. M. Wilson is in San Francisco.

A. H. Wickham has gone to Tepic.

W. H. Knowles is down from Sonora.

G. A. Roush was in New York last week.

J. R. Finlay was at Grass Valley this week.

George S. Rice was in Washington last week.

C. A. Rodgerdts has gone to Mazatlan, Mexico.

Gardner F. Williams arrived in California this week.

J. Ballot, of Minerals Separation, Ltd., is in San Francisco.

J. A. Holmes is visiting various mining districts in Arizona.

F. G. Cottrell will visit Butte on his way back to San Francisco.

Charles Janin is visiting the dredging fields of Colorado and Montana.

Seeley W. Mudd and Philip Wiseman were in San Francisco this week.

A. H. Lawry, of the Montana-Tonopah mine, is in San Francisco for a few days.

James Butler, the discoverer of Tonopah, was at Randsburg, California, last week.

R. B. Lamb, of Toronto, is in California and has been examining properties at Grass Valley.

H. C. Hoover was in Berlin recently arranging with the German government for relief of non-combatants.

E. P. Mathewson is expected in New York next week to attend the annual meeting of the American Institute of Mining Engineers.

W. S. Noyes, Charles F. Helman, and L. M. Parkes, of the El Oro Mining & Dredging Co., visited the Natoma dredging district last week.

Thomas T. Read is expected in San Francisco immediately after the New York meeting of the American Institute of Mining Engineers.

W. H. Harrison, mill superintendent for Stratton's Independence, Ltd., has returned to Victor, Colorado, after several months spent in the Silver City district, New Mexico.

Edgar L. Newhouse has been made first vice-president of the American Smelting & Refining Co., succeeding the late Barton Sewall. Edward Brush succeeds Mr. Newhouse, and S. W. Eccles succeeds Mr. Brush, leaving one vice-presidency still vacant.

C. A. Filteau, who has been in Japan and Korea for the past two years, has been appointed general manager for the Inca Mining & Development Co., province of Carabaya, department of Puno, Peru, and sailed from New York by way of Panama for his new post.

E. M. Breed, who for the past eight years has been district manager of the Canadian Allis-Chalmers, Ltd., with headquarters at Vancouver, has been appointed district manager for the Pelton Water Wheel Co. in that city. Previous to becoming manager for the Canadian company, he was with the sales force of the Canadian Westinghouse Co. at Montreal.

Obituary

Isabel Love Wightman, for seventeen years with the Brown Hoisting Machinery Co., died on January 25.

James Gow Black, professor of chemistry for forty years at the University of Otago, Dunedin, New Zealand, died in December.

SCHOOLS AND SOCIETIES

The Utah branch of the A. I. M. E. will meet at dinner on February 25.

Abolition of the Virginia City School of Mines, Nevada, is proposed in a bill introduced into the State Legislature last week.

The American Museum of Safety held its annual meeting at the United Engineering Societies building, New York, on February 10.

The University of Iowa *Bulletin* No. 8 contains water-works statistics of 38 cities of Iowa, with the meter rates of 70 cities, compiled by John H. Dunlap.

The Canadian Mining Institute holds its seventeenth annual meeting at Toronto, on March 3, 4, and 5. A number of interesting papers are to be read and discussed.

The Institution of Mining and Metallurgy will meet in London on January 21, February 18, March 18, April 17, and May 20. The new president is Sir Thomas Kirke Rose of the Royal Mint.

The Institute of Mining Surveyors, Western Australia, is the name of a new society in that state. Holders of certain degrees from Australian and New Zealand schools entitles licensed surveyors to membership. Kalgoorlie is the headquarters of the society, and P. G. D. Lavater, first president.

The Canadian Mining Institute, at its annual meeting in March, will be asked to make several amendments to the by-laws. The word 'province' as hereinafter referred to in these by-laws shall be interpreted to mean each of the following divisions of the Dominion of Canada: Quebec; Ontario; British Columbia, including Yukon territory; Alberta, including Saskatchewan and Manitoba; and Nova Scotia, including New Brunswick and Prince Edward island.

The International Engineering Congress meets in San Francisco on September 20 to 25. The technical success of the Congress is now well assured. Notwithstanding the difficulties arising as a result of the present European war, the committee on papers is able to count on from 200 to 250 papers and reports, covering all phases of engineering work, and contributed by authors representing some 18 different countries. The Congress will therefore be truly international in scope and character.

What's Wrong with Rand Scientific and Technical Societies, is the subject of an editorial of *The South African Mining Journal* of November 28. It said: "The sparse and disappointing attendance at recent meetings of Rand scientific and technical societies cannot be wholly attributable to the war. It is true that a great many men from the mines, including many members of the societies, are on active service, and that the leisure of those who remain is mainly devoted to drilling and special police work. These excellent activities, however, can hardly be said to explain the evident reluctance of so many members of our leading societies to spare even the two or three hours a month, which is the maximum demand they make on one's time. The reason, we believe, in the case of the larger societies lies deeper. The Geological Society, of course, never boasted a big roll of membership, and its attendances have always been composed of the select and learned few. The Institution of Electrical Engineers is a comparatively young body, and, for its years, has less to complain of, in point of its monthly musters, than any of its sister societies. The two senior societies, the Institution of Engineers and the Chemical, Metallurgical and Mining Society of South Africa, appear to be the worst sufferers in this respect."

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, February 11

Antimony	.20	20¼
Electrolytic copper	15½	15¾
Pig lead	4.95	5.00
Quicksilver (flask)		$60.00
Spelter	9	— 9¼
Tin	.38	39½
Zinc-dust, 100-kg zinc-lined cases	14½	15

Both quicksilver and zinc-dust are strong and likely to advance. The range of prices in the latter indicates carload and small lots.

EASTERN METAL MARKETS

(By wire from New York.)

NEW YORK, February 11.—Copper is quiet, lead firmer, and spelter strong.

The Calumet & Arizona company has declared a dividend of 50c. per share. Superior & Pittsburg, 20c., and Crown Reserve, 3%. Unfilled orders of the U. S. Steel Corporation on January 31 totaled 4,248,571 tons, an increase of 411,928 tons compared with December.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.		Average week ending	
Feb. 4	48.25	Dec. 30	48.65
" 5	48.25	Jan. 6	48.65
" 6	48.25	" 13	48.98
" 7 Sunday		" 20	48.98
" 8	48.12	" 27	48.77
" 9	48.12	Feb. 3	48.52
" 10	48.25	" 10	48.20

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	....
Feb.	57.53	....	Aug.	54.35	....
Mch.	58.01	....	Sept.	53.75	....
Apr.	58.52	....	Oct.	51.12	....
May	58.21	....	Nov.	49.12	....
June	56.43	....	Dec.	49.27	....

The silver market has been steady during the past week.——The Cobalt district shipped 837,585 oz. to London in January.——At the end of September the Jim Butler company at Tonopah had 170,600 oz. in storage, showing how a small concern has to contend with the market.——India has supported business, but the demand is less persistent than formerly.——The Hongkong government is continuing its policy of retiring large quantities of subsidiary silver, and in time it may be anticipated that there will be an end to the discount as to Hongkong coins, though even in such case the situation may easily arise where small coins will be at a premium. The real difficulty in the matter is the disposition of the Chinese people to regard silver in any form, coins as well as bullion, as a commodity, rather than as an established currency with fixed value, according to a recent consular report. To the Chinese, trained by generations of dealing in silver by weight as a means of exchange, every transaction is a barter. The possibility, and even practicability, of manipulating the market for coins just as a market for any commodity might be manipulated, are taken as a matter of course. Until this bartering in coins can be prevented there will be no freedom from currency troubles in China, and any scheme of currency reform for China or for any colony using a similar currency must have regard for this fact.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	....
Feb.	39.76	....	Aug.	50.20	....
Mch.	38.10	....	Sept.	33.10	....
Apr.	36.10	....	Oct.	30.40	....
May	33.29	....	Nov.	33.51	....
June	30.72	....	Dec.	33.60	....

Tin is somewhat weak at 35.70 to 36.50c. per pound. In London it is £174 per ton for spot metal.——Exports of tin from the Federated Malay States during 1914 amounted to 49,042 tons, compared with 50,128 tons in the previous year, and 48,250 tons in 1912.

COPPER

Prices of electrolytic in New York, in cents per pound

Date		Average week ending	
Feb. 4	14.50	Dec. 30	12.75
" 5	14.37	Jan. 6	12.92
" 6	14.37	" 13	13.30
" 7 Sunday		" 20	13.53
" 8	14.25	" 27	14.00
" 9	14.13	Feb. 3	14.50
" 10	14.13	" 10	14.29

Monthly averages.

	1914.	1915.		1914	1915.
Jan.	14.21	13.60	July	13.26	....
Feb	14.46	....	Aug.	12.34	....
Mch.	14.11	....	Sept.	12.02	....
Apr.	14.19	....	Oct.	11.10	....
May	13.97	....	Nov.	11.75	....
June	13.60	....	Dec.	12.75	....

The New York letter in this issue covers the copper situation.——The visible supply in England and France was 30,002 tons on February 1, a decrease of 1183 tons compared with January 15. Spot metal in London is £62 17s.6d. per ton.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Feb. 4	3.80	Dec. 30	3.80
" 5	3.80	Jan. 6	3.80
" 6	3.80	" 13	3.70
" 7 Sunday		" 20	3.70
" 8	3.80	" 27	3.70
" 9	3.80	Feb. 3	3.80
" 10	3.80	" 10	3.80

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	....
Feb.	4.02	....	Aug.	3.86	....
Mch.	3.94	....	Sept.	3.82	....
Apr.	3.86	....	Oct.	3.60	....
May	3.90	....	Nov.	3.68	....
June	3.90	....	Dec.	3.80	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
Feb. 4	7.50	Dec. 30	5.40
" 5	7.50	Jan. 6	5.50
" 6	7.50	" 13	5.85
" 7 Sunday		" 20	6.13
" 8	8.00	" 27	6.88
" 9	8.00	Feb. 3	7.58
" 10	8.00	" 10	7.75

Previous records for zinc ores in the Missouri-Kansas-Oklahoma region were again beaten last week, prices ranging from $61 to $69, one choice lot selling at $71 per ton.——London quotations are £39 15s. per ton.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	5.22	....	Aug.	4.45	....
Mch.	5.12	....	Sept.	5.16	....
Apr.	4.98	....	Oct.	4.75	....
May	4.91	....	Nov.	5.01	....
June	4.84	....	Dec.	5.40	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Jan. 14	50.00	Jan. 28	52.50
" 21	52.50	Feb. 4	55.00
		" 11	60.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	....	Aug.	80.00	....
Mar.	39.00	....	Sept.	76.25	....
Apr.	38.90	....	Oct.	53.00	....
May	39.00	....	Nov.	55.00	....
June	38.60	....	Dec.	53.10	....

The Nevada Cinnabar Co. of Ione, Nevada, recently shipped 350 flasks of mercury to New York.

RECENT PATENTS

1,122,062.—Process of Hardening and Welding Copper. Charles Bittner, Stafford, Kansas. This process consists of heating the copper to a cherry red, and then successively subjecting portions thereof to the action of acidified hyposulphite of soda, until the whole of the surface of the copper is treated.

1,117,601.—Filtering Medium. James Edward Porter, Syracuse, New York, assignor to General Filtration Co., Inc., Rochester, New York. A rapid filtering medium composed solely of from 75 to 85% of silica-containing substance, and from 25 to 15% of powdered glass mixed therewith and fused in the mixture.

1,118,894.—Process of Producing Pure Zinc Oxide. Henry William de Stuckle, Paris, France. A cyclical process of producing pure zinc oxide, which consists in reacting upon a dissolved zinc salt with ammonium sulphite in presence of caustic ammonia or ammonium carbonate, calcining the precipitated zinc sulphate and utilizing the evolved sulphur dioxide for regenerating the ammonium sulphite.

1,124,503.—Ore-Feeder for Stamp-Mills and the Like. Edward Henry Moyle, Los Angeles, California. The combination of an inclined rotatably mounted ore-feeder table, of a hopper having its lower edge inclined correspondingly with the table, and supporting means provided with horizontal ways in which the hopper is slidable horizontally to enable it to be adjusted with its lower edge close to the table.

1,123,672. Nodulizing Ores. Niels S. Borch, Copenhagen, Denmark. The process of nodulizing ores in rotary kilns which consists in raising the temperature of the mass in a reducing heat nearly to the critical temperature, and then subjecting the mass to an oxidizing action, whereby the temperature of the mass is raised suddenly through the degree required for nodulization, without a corresponding rise in the temperature of the wall of the kiln.

1,126,182.—Method of Treating Complex Carnotite Ores. Charles W. Danforth, Youngstown, Ohio; William P. Samuels, Newcastle, Pennsylvania; and William T. Martersteck, Youngstown, Ohio. The process of treating complex carnotite ores consists of subjecting the finely reduced ore to a plain oxidizing roast, to transform the highly refractory complex carnotite ore to a condition in which it may be worked up, and recovering the valuable products from the roasted ore.

1,121,606.—Process of Treating Sulphide Ores and Other Metallic Sulphides. Kristian Birkeland, Christiania, Norway. The process of treating sulphide ores and other metallic sulphides with superheated steam for removing the sulphur, which comprises superheating the steam to substantially the temperature of a flaming arc, passing said steam through the sulphides, separating hydrogen from the resulting gases and returning it with fresh quantities of highly heated steam for treating the material.

1,122,759.—Process of Extracting Copper from Ores. Noak Victor Hybinette, Christiania, Norway. The process of electrolytically extracting copper from sulphide ores containing iron, which consists in leaching a material containing copper both in the form of sulphide and oxide, with an acid sulphate solution containing iron to an amount of 25 to 35 gm. per litre as ferric and ferrous sulphate, electrolyzing the resulting solution and interrupting the electrolysis when 10 to 20 gm. of iron is present as ferric sulphate.

1,125,897.—Process of Concentrating Ores. John M. Callow, Salt Lake City, Utah, assignor to Metals Recovery Co., Augusta, Maine. The process herein described of breaking down and discharging the froth, foam, or suds, accumulating on the surface of an aerated and agitated mineral-bearing pulp containing a frothable agent having a selective affinity for metalliferous particles, said process consisting, essentially, in producing in a vessel open to the atmosphere a difference in pressures between the inside and outside of the air bubbles forming the froth, foam, or suds, and conducting the fluid contents of the broken down bubbles and mineral particles thereof to a receiver.

1,125,480.—Mine-Drill Support. Howard P. Corsa, Bingham Canyon, Utah. A drill support comprising an extensible horizontal bar, a second bar, a block bolted to the second bar, and slidably and pivotally holding it on the first, said block being provided with a cut-away portion adjacent to the first bar, a second block seated in said cut-away portion and adapted to engage the first bar and means supported in the first block and engaging the second to force said second block against the bar.

1,124,528.—Mining Machine. Lige Robinson, Empire, Alabama. This machine comprises an imperforate tubular drill having a circular bit at its outer end, a feed screw extending through the drill and having means at its forward end to engage the material being drilled, said feed screw being smaller than the inner wall of the tubular drill to allow a space to receive material bored out, a feed nut to move on said screw and connected with the tubular drill to move with the same and means for rotating the feed nut and drill.

1,123,116.—Amalgamator. James P. Dovel and Charles C. Glidden, Birmingham, Alabama. An ore concentrator comprising a rotatable concentrating-table having a series of annular grooves therein containing each a body of mercury and disposed transversely to the line of flow of the material to be treated, said table having non-amalgamated surfaces interposed between the grooves, and said grooves having amalgamated surfaces with which the mercury therein contacts and which tends to prevent the globularization of the mercury while in the grooves.

1,116,642.—Method of Concentrating Ores. William Sydney Stevens, Magdalena, New Mexico, assignor, by mesne assignments, to the Ozark Smelting & Mining Co., Cleveland, Ohio. The process of concentrating ore, which consists in mixing together at a temperature of not less than 60° C. crushed ore, sufficient water to form a flowing pulp, sulphuric acid, and a mineral oil in amount only sufficient to preferentially coat the desired sulphide particles of the ore; and thereafter presenting the pulp to the air and then to the surface of a liquid to cause a flotation of the oiled sulphide particles by surface tension.

1,123,778.—Precipitating Metals From Solutions. Louis David Mills, Johannesburg, Transvaal, South Africa, assignor to Merrill Metallurgical Co. The process of precipitating metals from their solutions which consists in maintaining a homogeneous mixture of said solutions and a mobile precipitant at the surface of a filter medium, withdrawing solution through said medium whereby the solid matter suspended therein is deposited as a homogeneous and uniformly permeable layer on said medium, and circulating the excess mixture adjacent to said filtering medium.

1,118,944.—Process of Recovering Rusty Gold and Native Platinum Metals. R. E. Lyons, Bloomington, Indiana. The process of recovering precious metals consisting in adding to material containing particles of precious metal in a condition that will not normally amalgamate, a metal capable of alloying with the precious metal at normal temperatures, metallic mercury in quantity sufficient to form a substantial amount of amalgam, and a substance capable of attacking the alloying metal, such attacking substance being in quantity sufficient to maintain a continuous reaction during amalgamation of the precious metal.

New Machines and Devices

Motor-Driven Mine Pump

The illustration shows a group of motor-driven pumps developed especially for sump and gathering service in coal mines. These pumps have brass-lined water cylinders, tobin bronze piston rods, and bronze valve-seats, stems, springs, stuffing box-caps and glands, and bronze adjustable cross-head shoes, so that they are thoroughly protected against the action of mine water. The motors are direct-current Westinghouse Electric manufacture, and they are mounted on top of the

MOTOR-DRIVEN MINE PUMPS READY FOR SHIPMENT.

pump, where they are kept out of the water, and are supplied with impregnated windings, which afford protection from dampness. A special feature is the use of automatic control by which the pump can be started and stopped from any convenient point. The unit formed by motor and pump is very compact, and is readily mounted on a truck, so that it can be easily transported from place to place as needed. The group shown is a lot ready for shipment one week after receipt of order. The maker is the Weinman Pump Manufacturing Co., Columbus, Ohio.

The Marathon Mill

The Johnson Engineering Works, Chicago, Illinois, has devised, tested, and is supplying a machine called the Marathon mill. The apparatus has been installed in the plant of the Detroit Copper Co., Arizona, and the following are some features claimed by the makers: The Marathon mill is of the revolving cylinder type, but unique in that the grinding is done by a charge of round steel grinding rods, of different diameters and the full length of the machine. The material being ground completely, fills all the spaces between and is confined by the near contact of the bars so it cannot escape. This confinement of the material, together with the great weight of the rods on it and the revolving motion of the drum keeping all the rods in constant motion, causes most of the grinding to be done by attrition of the material on itself. This accounts for the small amount of wear on the steel grinding bars per ton of material ground. Another feature of the Marathon is that practically all of the grinding bars are used up in actual work. Starting, say with rods 5 in., they should be withdrawn when worn down to about ¼ in. diameter. The Marathon, without any alteration, is a wet grinder when water is added with the feed; otherwise it grinds dry, or with any percentage of moisture the feed may contain. It is a continuous feed and discharge machine, and is therefore a great improvement over the dry or wet pan pug mills for brick making, and other uses. The capacities shown, of from 245 to 540 tons per 24 hours for a mill taking only 18 to 19 hp. and grinding through different screens, is remarkable.

The Rise of Steel Pipe

There is a real romance in the rise of steel pipe in the last eight years, from 983,198 tons in 1905 to 2,189,218 tons in 1913, when, during the same period, wrought iron pipe decreased from 452,797 tons in 1905 to 312,746 tons in 1913. The percentage of iron pipe in 1913 was 12.5, and steel pipe 87.5. There is another phase of this which may probably be of interest, namely, the greatly increasing use of steel pipe in the world for gas and water mains. It will be noted in this connection that this use is not so much confined to the United States as it is to foreign countries. The National Tube Co. of Pittsburgh, *Bulletin* 11-C, of 48 pages, deals with the history, characteristics, and advantages of 'National' pipe. Early methods of pipe manufacture, from the bamboo, pottery, and lead tubes, to the present high-grade type are explained.

Most Powerful Dipper Dredges in the World

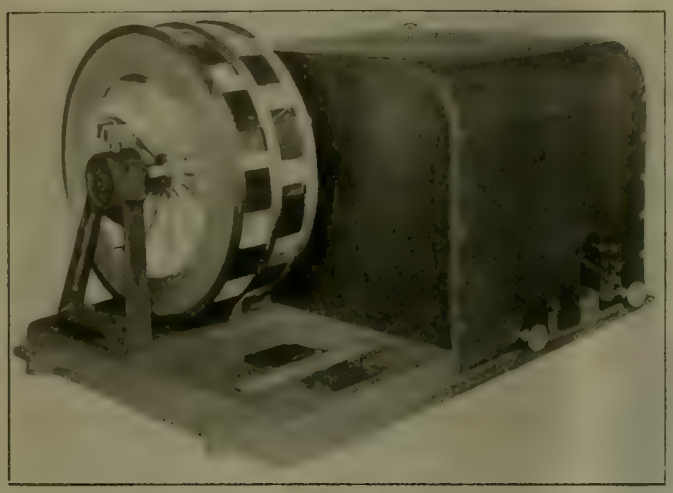
Dipper dredges of large capacity are needed at the Panama canal, and the accompanying illustration shows the *Paraiso* in Culebra cut, lifting a 50-ton boulder. This boat and the *Gamboa*, of Bucyrus Co. manufacture, were partly constructed on the Hudson river at Newburg, New York, towed to Staten island, completed, and tested. The booms, dipper handles, and dippers were taken down and shipped to the

U. S. DREDGE (BUCYRUS) *Paraiso* RAISING A 50-TON BOULDER FROM BOTTOM OF CULEBRA CUT, PANAMA.

Isthmus, while the steel hulls were towed to Colon. Of the 1500-tons displacement of each dredge, the boom (62 ft. long) and its machinery weighs 66.5 tons, and the dipper handle (72 ft. long), 40.5 tons. Both are equipped with 15-cu. yd. dippers, and are designed to dig 50 ft. below the surface of the water. The dredges are equipped with high-power machinery, and have been handling about 125,000 cu. yd. per month with hard digging. When first started they withstood a 30-day test successfully. Boulders weighing up to 50 tons each are lifted by the dredges.

The Denver Siren

This apparatus is a motor-driven fire alarm for cities, mills, and factories, and is made by the Hendrie & Bolthoff Manufacturing & Supply Co. of Denver, Colorado. The siren creates a distinctive sound suitable for fire and general alarms, and could be operated by a switch placed alongside the telephone central's desk or any other suitable place. The revolving part



DENVER SIREN.

of the siren is made of aluminum, mounted upon Hess-Bright ball-bearings, and the outside portion, or stator, of bronze. The rotor does not touch the stator at any point and thus revolves very easily. The siren gives the best results when equipped with a three-phase induction motor. The motor and transmission are protected from the weather by a close-fitting metal hood; but the siren itself cannot be covered and is therefore made of bronze and aluminum, neither of which will corrode. Two sizes are made, 3 and 5 hp., weighing 300 and 400 lb., respectively, and the noise can be heard for six miles.

Commercial Paragraphs

The American Vanadium Co. of Pittsburgh. *American Vanadium Facts* for January devotes several pages to illustrating the types of automobiles and trucks in which vanadium steel is used.

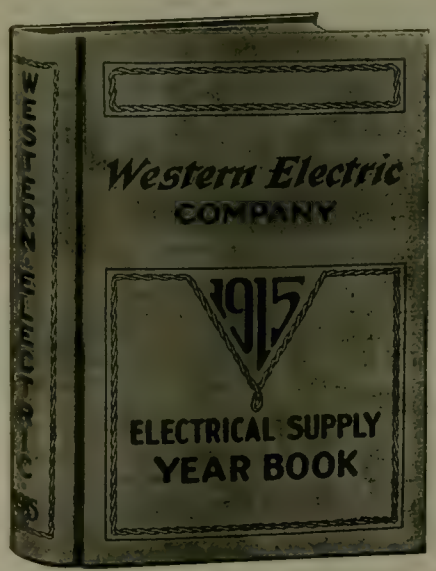
The Atlas Car & Manufacturing Co., Cleveland, Ohio, has issued *Bulletin* 1175 on 'Storage Battery Locomotives, Cranes, and Cars.' With full page and smaller illustrations it covers 32 pages. These locomotives were designed for low vein mine use, having a low and narrow frame. A generating set for charging storage batteries is also made. The total cost of such locomotives is 2c. per ton, against 4 or 5c. using mules. The storage battery tractors and cranes are also of good service.

The General Electric Co., Schenectady, New York. *Bulletin* 49,901 for January describes an oil-testing set for transformers. In order to insure the successful operation of high-tension oil-insulated apparatus, the dielectric strength of the oil must be maintained at a certain value. The Company devised a testing transformer with a capacity of 3 kva. at 30,000 volts. It can be supplied either for 25 or 60 cycle current. The low-voltage winding is suitable for service on 100, 200, or 400-volt supply. Other apparatus is attached to the set.

The Terry Steam Turbine Co., Hartford, Connecticut, *Bulletin* 19, of 64 pages with illustrations, describes its turbines for pump drives. The principles of operation and construction of the centrifugal pump are clearly explained, as are the details of the steam turbines which have been successfully used during the past 10 years for driving them. Because of the wide latitude of speed possible with the turbine, the unit occupies a much smaller space than would be required for a pump performing the same duty but driven by a reciprocating engine. The range of conditions in this service varies from large volumes of water pumped against low heads, such as circulating water for condensers or for irrigation, up to high head work, such as boiler feeding or fire service. This apparatus is made to any size. Much useful data are included in the catalogue. The Company announces that it has appointed Earl F. Scott, with offices at 702 Candler building, Atlanta, Georgia, as representative for that state; and H. A. Rapelye is now in charge of the Pittsburgh office, at 1624 Oliver building.

The Mesta Machine Co., Pittsburgh, Pennsylvania, in an attractive booklet, describes the plant and products of the Mesta Machine Co. The plant covers about 20 acres and has about 500,000 sq. ft. of floor space and over 400,000 sq. ft. covered with electric cranes. The only limit as to the size and weight of the machinery which the Company builds is that fixed by the capacity of railroad cars. Castings weighing over 100 tons have been made in the foundries and finished in the machine shops of this Company. The principal products of the Company include blast-furnaces and power plants, gas and steam engines, barometric condensers, air-compressors, iron and steel rolls, and pinions and other equipment. The booklet is fully illustrated and contains in concise form a description of the plant and the purpose of the Mesta company.

The Western Electric Co. has published its 'Electrical Supply Year Book' for 1915, the accompanying cut being a reduced facsimile of the front cover. It contains 1216 pages, and is profusely illustrated with almost every electrical device



known, and which is manufactured by this Company. The price of each article is also given, and there is given a catalogue of electrical technical books, and several pages of useful formula. In many particulars this catalogue is unusual and it will be invaluable for handy reference. This valuable publication should be in the library of all interested in electrical work.

Mineral Resources of Jujuy Province, Argentine Republic—By Arthur W. Jenks, page 291

MINING PRESS

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SAN FRANCISCO, FEBRUARY 20, 1915

Contents Page 2
Buyers Directory Page 26
Advertisers Index Last Page

METALLURGICAL PRACTICE in the Lake Superior copper district has many peculiarities. It is the one great district in which native copper forms the basis of operations, and this fact has made possible development of an ore dressing and smelting practice that is unique. Steam stamps dominate the field. Regrinding and concentrating follow the stamps, and probably leaching of the tailing will follow them. The smelting practice is relatively simple, but possibly open to criticism. In the PRESS for December 5 and February 6, Mr. Read discussed the occurrence and mining of the orebodies. In this issue he discusses the treatment of the ore as conducted in the newest plants, typified by the Calument & Hecla regrinding plant illustrated below and built to treat tailing dredged from Torch Lake.

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VOL. 110 SAN FRANCISCO, FEBRUARY 20, 1915 No. 8

TABLE OF CONTENTS

EDITORIAL Page.

Notes 281
The War and Japan 282
War's Menace to the Copper Industry 283

ARTICLES

LAKE SUPERIOR COPPER MINING, PRESENT AND FUTURE—III.
By Thomas T. Read 284

In this article Mr. Read follows his discussion of the occurrence and mining of the ore by an account of the metallurgical practice in this district. The first peculiarity is the separate coarse crushing in the 'rock-houses.' This is followed by stamping and fine concentration in great mills, the principal operations being dewatering and classifying the stamp pulp, concentrating classified material on Wilfley tables, regrinding in Hardinge mills, and re-treatment on tables. Eventually the tailing will be leached. There are four smelting plants, but, in Mr. Read's opinion, smelting is the least advanced part of local metallurgical practice. Coarse crushing costs 1.5 to 8.6c.; transportation to mill, 3 to 17.5c.; stamp-milling, 18.7 to 40c.; smelting, freight on copper, and selling costs, 13.9 to 31c. per ton.

MINERAL RESOURCES OF JUJUY PROVINCE, ARGENTINE REPUBLIC.
By Arthur W Jenks 291

Jujuy province adjoins Bolivia. It contains numerous quartz veins and placers, but has little gold production. Borax and salt are important, and there are distinct possibilities of petroleum production. Mr. Jenks gives numerous practical hints on travel and exploration in the region, based both on his experience as manager of the Famatina, and later in studying the province for the Argentine authorities.

PROFITS AND HOLDINGS OF GUGGENHEIM EXPLORATION COMPANY 295

In 1914 the net income was $3,383,622, equal to 16.27% on outstanding stocks, and the dividend rate was increased from 12% to 14%, certainly an excellent record for a year of general business depression.

REVIVAL OF THE MEADOW LAKE DISTRICT, CALIFORNIA.
By W. Prince Catlin 296

Meadow Lake district was active in 1863 to 1865, but has since been nearly deserted. Within the last year the Excelsior mine has been reopened, other properties taken under option, and the breath of life breathed into the district. Mr. Catlin gives brief notes on the geology and occurrence of the ores.

THE BOSS MINE, GOOD SPRINGS, NEVADA. Page.
By Seeley W. Mudd 297

Mr. Mudd gives a short account of the occurrence of gold and platinum in limestone in southern Nevada. Such an occurrence is so unusual as to be almost unique.

PROSPECTING DREDGING GROUND AT PATO, COLOMBIA 298

An interesting abstract from a recent report by Mr. W. A. Prichard. This supplements the discussion that has been running in the *Press* on methods of prospecting placer ground.

U. S. GEOLOGICAL SURVEY EXHIBIT AT THE EXPOSITION 303

A few details regarding one of the most interesting exhibits that will be made.

DEPARTMENTS

DISCUSSION:

The Copper Beds of the Coeur d'Alene.
By James C. Ray 299
Mr. Ray takes issue with Mr. Huston as to the origin of the Snowstorm ore.

Electric Smelting in 1914.
By John Crawford, Jr. 302
A note of correction as to use of coke at Heroult, California.

The Uwarra Mill.
By Percy E. Barbour 302
Mr. Barbour objects to criticism made by Mr. Andrew Walz.

Milling Gold Ores in Cyanide.
By A. W. Allen 302
Mr. Allen continues the discussion, with especial reference to remarks by Mr. Noel Cunningham.

CONCENTRATES 304

REVIEW OF MINING: Special correspondence from Boston; Butte, Montana; Reno, Nevada; Leadville, Colorado; Kalgoorlie, Western Australia; New York 305

THE MINING SUMMARY 309

PERSONAL 313

SCHOOLS AND SOCIETIES 313

THE MARKET PLACE:
Metal Prices 314

BOOK REVIEWS 315
Mining Costs of the World.
By E. N. Skinner and H. R. Plate.
Northern Patagonia. *By Bailey Willis.*

RECENT PUBLICATIONS 315

NEW MACHINES AND DEVICES:
The Mill That is Different 317
Improvements in Water-Wheel Generators and Mine Locomotives 317
Commercial Paragraphs 318

EDITORIAL

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ONTARIO will investigate, through a government commission, the feasibility of refining nickel matte in Canada. We discussed the general problem last week.

PIG IRON production of the United States is increasing, and the 1,591,024 tons made in January is the largest output since October, when it was 1,767,227 tons. In January 1914 the yield was 1,879,336 tons.

APPROXIMATELY once a year it seems necessary to remind contributors that we cannot accept for publication anonymous articles, though we are willing, when there is good reason, to allow the printed article to appear under a *nom de plume*. If 'Another Engineer' will send us his name and address we shall be glad to consider his letter.

WESTERN CANADA is to have another technical publication, *Mine, Quarry, and Derrick*, printed at Calgary and issued under the experienced editorship of Mr. J. C. Murray. The first number includes an excellent article by Mr. J. B. Tyrrell, on 'Gold on the North Saskatchewan River,' and other matters of interest. We salute our new contemporary and extend good wishes.

APPEALS are being made for funds for the American Ambulance Hospital, an auxiliary to the American hospital in Paris. The institution is entirely neutral and is doing what can be done to minimize the suffering incident to the war. It is in excellent hands and funds contributed will be well used. Contributions may be sent to Messrs. J. P. Morgan & Co., 23 Wall street, New York city.

CURB prices are often queer in more senses than one, and meteoric advances, followed by equally rapid drops, are registered upon the slightest occasion. Not long ago a young broker, excited over his first telephone order, which chanced to be for 1000 shares of San Toy, bid up Standard Oil, to an increased valuation of $150,000,000 before he got the name right. The announcement in the *Daily Commerce Report* that the Standard had found oil in China resulted in a rise in 'values' of $15,000,000. In fact, the amount of oil found was insignificant, though a good omen for the extensive surveys the Company is now making in Shensi.

TODAY sees the opening of the Panama-Pacific Exposition and the beginning of the period of realization following several years of preparation. It was in 1909 that San Francisco formulated definite plans for an exposition to celebrate the opening of the Panama canal. Doubtless, if the business depression, and, especially, the European war had been foreseen, there would have been no exposition; but, fortunately, the work was begun so early that the most difficult tasks had been accomplished before either arrived. The result is that on the opening day all the Exposition buildings are complete and the grounds are beautifully planted, paved, and lighted. A few of the state buildings are not open, and several foreign buildings are incomplete. Most notable is the absence of German, British, and other European special buildings such as have been features of great preceding fairs. The list, however, of states and foreign governments participating is a long and notable one, and the few unfinished buildings but emphasizes the unusual completeness of the Exposition. In many particulars the fair is unprecedented. For one thing, it is held without any appropriation from the United States government, other than the small amounts spent by various departments to collect and place exhibits in buildings furnished by the Exposition company for the free use of the government on the same terms as to any private exhibitor. For another, the main buildings and the grounds are planned as a single architectural unit, with a result that its beauty surpasses any previous achievement. Color has been used lavishly, and in the bright California sunshine, with the background of ocean and mountain, the effect is one that all visitors will long remember. It will be our pleasure to describe in detail, as the weeks pass by, the various exhibits that are of especial interest to mining men. In general, we can say that from the first day any mining engineer or metallurgist will find more than enough of technical interest and value to repay him amply for time spent on the grounds. In the Palace of Mines and Metallurgy, Mr. C. E. van Barneveld has brought together a surprising array of exhibits of processes and products. From the bottom of the mine under the floor to the top of the tallest oil derrick, the space is full of sights familiar to the men of the profession and of high educational value to the general public. Among the larger exhibits may be mentioned those of the United States Steel Corporation, Standard Oil Company, Union Oil Company, Anaconda Copper

Mining Company, the Japanese mining companies, the United States Geological Survey, the Bureau of Mines, besides which there are many others that must be reserved for later mention. We can assure our friends that the Exposition is really worth while, and we extend to all a cordial invitation to look in at the model foreman's office in 'The Mine,' equipped by the *Mining Press*. Naturally, being a model office, the *Press* itself will be found there on file.

TELEGRAPHIC advices from New York are to the effect that the proposed amendments to the constitution of the American Institute of Mining Engineers were carried by a majority of more than 500 votes. As we indicated in our editorial of January 2, this removes the bars to any expression of opinion by or on behalf of the Institute and marks a fundamental departure from long established policies. It remains for the board of directors to formulate plans for making the action effective and to devise means of securing a consensus of opinion in cases where it is desired. This is a matter of detail, but one that requires, and will doubtless receive, most careful consideration. Naturally we are pleased at the result of the referendum, since the *Press* was the only technical paper that came out frankly and squarely in favor of these changes, just as it was the only one in 1912 to advocate the changes then made in the organization. We would not arrogate to ourselves credit that belongs to the membership at large, and particularly to the group of active and unselfish engineers who have been so prominently connected with the rejuvenation of the Institute, but we are glad to have confirmation of our faith that the members of the Institute are neither so uninterested, nor so inactive, as to be unmoved by sound argument fairly presented.

FLOTATION, as applied to the saving of copper minerals, received an endorsement of the highest character this week when the Anaconda Copper Mining Company announced that it had signed a contract with Minerals Separation, Limited, for use of the process at Anaconda. As readers of the *Press* know, the staff of the Anaconda company has been engaged for several years in an exhaustive study of mill losses and in endeavoring to improve the flow-sheet so as still further to decrease them. Few American companies have put in on research problems as much time, money, and first-class skill as has the Anaconda. The Butte meeting of the American Institute of Mining Engineers in 1913 was especially notable for the contributions to technology made by the staff of the Anaconda company. As we had the pleasure of announcing in May 1913, Mr. Frederick Laist and his associates devised a plan of roasting and leaching to be applied to low-grade tailing from the wet mill, and since then a 2000-ton plant has been built to employ this process. Later Mr. L. D. Ricketts recommended that flotation be tried as an alternative or supplementary process, and an experimental unit has now been in operation for nearly a year. The results have been so satisfactory as to surpass the requirements laid down by the Company at the beginning of the test. Detailed figures of recovery and cost are not yet available for publication, but the contract made with Minerals Separation permits general use of the process. The plant, which will be built immediately, will consist of 24 units of 100 tons per day capacity each. This will be employed upon current material, and it is expected that the leaching plant will be worn out on accumulated tailing. If the working plant proves as satisfactory as is anticipated, additional units will be erected. The cost of the copper won by the new plant has been said to be as low as four cents per pound. If this be the correct figure, there will be an excellent profit realized, since the copper is won from material previously untreated. The four cents does not include the ordinary charge for mining and milling, which is proper enough under the particular conditions. Another phase of the matter that is significant is that the Anaconda company takes a license from Minerals Separation despite pending patent litigations. This is recognition of which that Company may well be proud.

THE WAR AND JAPAN

Underneath the circumstances which led directly to the outbreak of war in Europe can be clearly seen the economic considerations which are its fundamental causes, but with which we here have nothing to do. The small and widely scattered colonial dependencies of Germany were quite easily seized by her adversaries, but the more difficult task of reducing Kiaochow fell to Japan, with England's co-operation. This was a German protectorate, with an area of 200 square miles, on the east coast of the province of Shantung, which was formally leased until 1998 to Germany by China as compensation for the murder of two German missionaries. Surrounding the leased zone is a neutral area of 2500 square miles in which Germany had certain privileges which gave her commercial advantages. The German government spent considerable sums in fortifying the seaport of Tsingtao, at the terminus of the railroad connecting with the interior and the main line between Nanking and Tientsin, and in improving the harbor until it became one of the best of the few good harbors in China. These improvements and privileges now have passed into the hands of Japan, which will undoubtedly retain them. Some of the economic advantages which will accrue to that country are obvious, others may require further explanation.

It has always been the ambition of Japan to hold in the Pacific the position which Great Britain holds in the Atlantic. Unfortunately she lacks two of Great Britain's national assets: coal and iron. Japan has no iron ore deposits of importance, and her coalfields, while yielding a large present output, are limited in extent, so that it can be clearly seen that at the present rate of mining the coalfields will be exhausted at no very distant date. One estimate of the coal resources of Japan

corresponds to less than ten years of the present annual production of Great Britain. The government iron works at Wakamatsu has been operating for years on imported iron ore and pig iron, chiefly from China, and the unfavorable position Japan might occupy in the event of war doubtless has been a source of concern to her far-seeing statesmen. As a result of the series of events following the war with China in 1894 and with Russia in 1904, Japan has now secured possession of Korea and a lease on the southern half of Manchuria extending to 1923. Intelligent prospecting work has disclosed iron ore deposits of fair quality in Korea; the ore from these is already being shipped to the plant at Wakamatsu, and a blast-furnace will soon be erected in Korea to produce pig iron for shipment to Japan. Manchuria has proved even more productive. The coal mine at Fushun, which was worked in a small way by the Russians, has proved with adequate development to be one of the big mines of the world, and this one property will yield over 100,000,000 tons of coal, a notable addition to the resources of Japan. At Pensihu both coal and iron ore occur. Coke ovens have been erected and the first of the blast-furnaces was to have been in operation this fall, while two more have been contracted for. This is just the beginning of developments by which the economic position of Japan has been greatly improved. If now there is added to this the lease on eastern Shantung a further improvement will be made. The Germans had the right to develop mines for 10 miles on each side of the railroad from Tsingtao to Tsinanfu, and although their ventures at Fangtze and Poshan have not so far proved profitable, it is quite probable that valuable mines may in time be developed. A great variety of minerals have been reported from Shantung and there are two gold mines of great promise which have not been worked for a variety of reasons not connected with their richness. Quite a few diamonds are picked up in Shantung each year, and the province may prove very productive of mineral wealth if intelligently developed by good business methods.

Hotheads in this country and Japan continually harp upon the possibility of war between the two countries, like small boys who, by discussing the possibilities of a fight between two of their comrades, hope to bring about the fight which they desire to witness. There is no adequate reason for a war between this country and Japan. Such sources of irritation as have at times existed are merely minor affairs which should be adjusted in a less destructive way. As to economic rivalry in the Pacific, the conflict of our interests with those of Japan is entirely too slight to lead to a war. Our trade with China is too small to warrant attempting to protect it at the cost of a war, with its corresponding possibilities upon our trade with Japan. As to our attempting to check Japan in her expansion on the mainland of Asia, there are three good reasons against such a course. The growth of Japan's influence on the mainland is the effect of natural economic forces, which can scarcely be opposed, and only at great cost. Public sentiment here does not support such a course of action, and the advantage to be gained is too little in comparison with the cost. Finally, the relations between foreign countries are none of our business; no one has yet constituted us an international policeman. Our true interest lies in a working alliance with Japan which will safeguard and foster the mutual interests of the two countries in the Pacific, and no time should be lost in bringing it about.

WAR'S MENACE TO THE COPPER INDUSTRY

The immediate effect of the European war upon the copper mining industry has been a restriction of foreign markets for the metal, which has been fully discussed in previous issues. This has its serious features, but it should not be allowed to obscure the fact that the war may have an ultimate effect which, if it eventuates, will have much more serious consequences than the temporary difficulties with export shipments that now engage the attention of producers. The possibility arises out of the simple fact that copper is now selling in Germany at 35 cents per pound and is likely to go higher before the end of the war. This high price of copper will, of course, stimulate the opening of copper mines in Germany which could not be worked at a profit in competition with cheap American copper, and some of these mines, once equipped, will doubtless be able to continue to operate when normal conditions of trade are restored. This is but a minor matter, the great danger lies in the possibility that the German people through having to get along with a decreased supply of copper for a considerable period may learn how to do it permanently, and the practice may spread to the rest of the world. When France was cut off from trade with the rest of the world by the Napoleonic wars, French chemists set to work with high zeal to learn how to make France economically independent, and from their labors a large part of the distinctly modern science of industrial chemistry arose. When we speak of the scientific achievements of LeBlanc, Berthollet, Gay Lussac, Thenard, and Dulong we are apt to forget the influence which the wars of their day had on their scientific labors.

The patient industry of German chemists and metallurgists is almost a proverb. A shortage of copper in Germany is equivalent to saying that many brilliant minds are at work on the problem of devising substitutes for copper or bringing about changes in engineering practice which will decrease the need for that metal. Aluminum is already a competitor of copper for electrical transmission. The Aluminum Industrie Aktien Gesellschaft produced 33,000,000 pounds of aluminum in 1913; what could be more desirable from the German viewpoint than to increase the consumption of the product of a German company and decrease the imports of foreign copper?

The rôle of a prophet is always a dangerous one, but it seems clear that copper producers would do well to consider the possibility that one outcome of the war may be to decrease the consumption of their product.

Lake Superior Copper Mining, Present and Future—III

By THOMAS T. READ

Metallurgical Practice

In the two preceding articles I have briefly considered those factors in the character and occurrence of the Lake Superior copper deposits and the methods employed in their exploration and mining which seem most significant as regards the present and future prosperity of the district. It remains to take up next the metallurgical operations and consider them in the same way. Of metallurgical operations three sub-groups may be distinguished; the preliminary crushing and sorting of the ore at the shaft head; the separation of the copper by wet concentration; and the smelting of the concentrate. It will be well to discuss these in order. I shall here, as previously, assume that my readers are familiar with the general features of Lake Superior practice, which have been clearly described by T. A. Rickard in his 'Copper Mines of Lake Superior,' and will confine my discussion to only those features which bear on my theme—the trend of progress and its probable effect on the future of the district.

Coarse Crushing

The ore from the mines is hoisted in Kimberly skips holding from 5 to 10 tons. The shaft-houses, locally known as 'rock houses,' are all much of the same design, as will be evident from the illustrations in this and the preceding article, but differ a good deal in detail. The path followed by the material after it is discharged from the skip is illustrated by the diagram, already used* and taken from an admirable paper on the 'rock house' practice of the Quincy Mining Co., presented before the Lake Superior Mining Institute by T. C. DeSollar. The diagram illustrates the practice at the Copper Range properties and is typical of the district as a whole. At the Quincy No. 2 an improved practice is in vogue. Thus, for example, the dull drills brought up from below in the skip are gently slid out upon an inclined apron, from which they can be easily loaded upon a wagon and taken to the blacksmith shop. Thus the labor cost and delay of throwing the drills out of the skip by hand are done away with and there is less breakage of the steel; the throwing of it a considerable distance into a confused heap being as much of a strain on the steel as actual service. This arrangement is typical of future progress; it is by just such attention to details that unnecessary labor is being eliminated and costs decreased so as to permit the cheap and efficient work on a large scale which must characterize the district if it is to achieve its destiny of long life and large production with a small working profit reaped from low-grade material.

The operations which go on in the shaft-house appear somewhat complicated at first glance, but they are all necessary. It must never be forgotten that the copper occurs in pieces of microscopic size, and from that up to masses weighing several tons, the upper limit of the size of piece hoisted being the weight which can be loaded into the skip underground. If such a piece is quite free from adhering rock it is discharged at the same place as the dull steel and sent directly to the smelter. Masses which contain adhering rock are dumped over the grizzly like ordinary ore and lifted, usually by the aid of an air-operated hoist, beneath a heavy drop-hammer, commonly also actuated by air, where the adhering rock is broken away by heavy blows and the copper mass then sent to a bin or platform whence it can be sent to the smelter.

The undersize of the grizzly goes directly to the bins, from which the railroad cars are loaded, the oversize discharges into the upper bin, from which it is drawn out on the feed plate of the jaw crushers. Here again any large masses of copper are picked out and freed from adhering rock by the blows of a smaller air or steam hammer. The final product of the 'rock house' operations is, therefore, ore crushed through a 4 to 6-in. ring and mass copper, the one being sent to the stamp-mills and the other to the smelter. The purpose of these operations is to insure that no mass of copper larger than 5-in. diameter shall find its way into the mortars of the steam stamps. The necessity for this will be more evident when I come to consider the operations of concentration. Incidental to this work a small amount of waste is picked out and thrown away, but it may be questioned whether there is much economy in so doing. The cost of transporting such material to the stamp-mills only averages 14c. per ton, and the cost of putting it through the mill 21c. per ton, a total of 35c. per ton, which is probably little if any greater than the cost of picking it out and disposing of it. To this view may be opposed the argument that the attendance in the 'rock houses' has already been reduced to a minimum and the men may as well pick out the waste as to allow it to proceed, while the cutting down of the tonnage sent to the stamp-mills allows both the railroad lines and stamp-mills to handle a correspondingly large quantity of richer material. It may be tentatively concluded therefore that the picking out of waste is economical wherever it does not involve any additional labor, but that if it is ever found possible to decrease the labor required in 'rock house' crushing by abandoning the sorting out of waste, its cessation will be justifiable. As has been already hinted in what has preceded, the new concentration methods will tend to the same end, for masses in which no copper can be distinguished by the eye may yet yield a good quantity to proper concentration processes, and they cannot therefore be safely discarded.

The first impression of the visitor familiar with coarse-

*See *Mining Press*, February 6, p. 211.

crushing practice in other districts is that the scheme of operations thus outlined is uneconomical. It is necessary to have a great number of shafts, but there is no obvious necessity for an equal number of coarse crushing plants. Since the output of a number of shafts goes to a single milling plant the natural thing to do would be to construct a single coarse crushing plant, to do the work of a number of the present 'rock houses,' adjacent to the mill. The shaft houses could then be much smaller and cheaper to construct, while the cost of the coarse-crushing plant would be much less than that of an equivalent 'rock house' capacity, for a variety of reasons which at once suggest themselves, but chiefly because the coarse-crushing plant could easily be kept in continuous operation throughout the 24 hours of the day, whereas crushing operations in the 'rock house' are subject to the routine of shaft work: lowering and hoisting men, timber, supplies, and in some cases bailing out of water, so that the net operating time is not over 15 to 16 hours per day. The logic of this is unimpeachable and most of the arguments brought forward against it do not seem to have much real weight; for example, that the large masses brought up in the skips would seriously damage the railway cars and bins. The convincing argument on the other side is that the costs in some of the 'rock houses' are less than in large central coarse-crushing plants. Most of the companies do not keep, or at least report, their accounts in such a way that it is possible to determine the cost of the various steps in the production from ore, and the only companies which report the cost of coarse crushing are the Mohawk, 8.6c. per ton; Copper Range Consolidated, 5.45c. per ton; and the Wolverine, 4.9c. The most interesting feature of these figures is that the Copper Range cost is made up of 2.62c. per ton for labor and 2.83c. per ton for power, repairs, supplies, etc., having been decreased to these figures from 6.29 and 3.42c. per ton, respectively, five years previously. The labor cost at the Mohawk is 6.05c. and power and supplies 2.59c. per ton. The notable saving in present practice is in the decreased labor necessary. The old No. 2 Quincy 'rock house' employed 17 men per shift, now only 3 are required. The present working cost for this 'rock house' is stated as averaging less than 2c. per ton, and I am told that when working at full capacity,

CALUMET & HECLA REGRINDING PLANT. NOTE THE CRANE FOR REMOVING MILLS AND MOTORS FOR REPAIRS. THE CONCENTRATING TABLES ARE TO THE RIGHT AND LEFT ON THE FLOOR BELOW.

handling 1000 tons per shift, the cost is not over 1½c. per ton for monthly averages. Comparing this with coarse crushing at the Ray Consolidated mine, Arizona, handling 8400 tons per day, at which the cost per ton during the second quarter of 1914 is reported as 3.337c., it is seen that the advantage lies with the Lake Superior practice. It may justly be argued that these figures are not comparative, since the Lake Superior costs do not include any amount for interest and depreciation, but even allowing for this, the Lake Superior work is apparently the cheaper. Whether better results could have been attained by adopting centralized crushing in the beginning is somewhat beside the mark, since it is clear that the advantage is now problematical and is in any case too small to justify the reconstruction necessary to adopt it at the present time. A step toward the central crushing idea was taken when the Ahmeek No. 1 and No. 2 shafts were equipped. In equipping these shafts the crushing plant was placed nearly midway between the two shafts, which are 1500 ft. apart, and the ore is conveyed to it by semi-automatic tramways. The designer here fell between two stools, failing to secure the advantages of a large crushing plant placed adjacent to the stamp-mill and linking up two shafts to a single crushing plant by means of equipment which is conducive neither to simplicity of operation nor economy of cost, which is reported as 4½c. per ton. We may therefore conclude that, on the whole, there is but little room for improvement in the present best coarse-crushing practice of the district. Considerable change may in time be made, but can scarcely lead to any large decrease in the cost of preliminary crushing.

Concentration

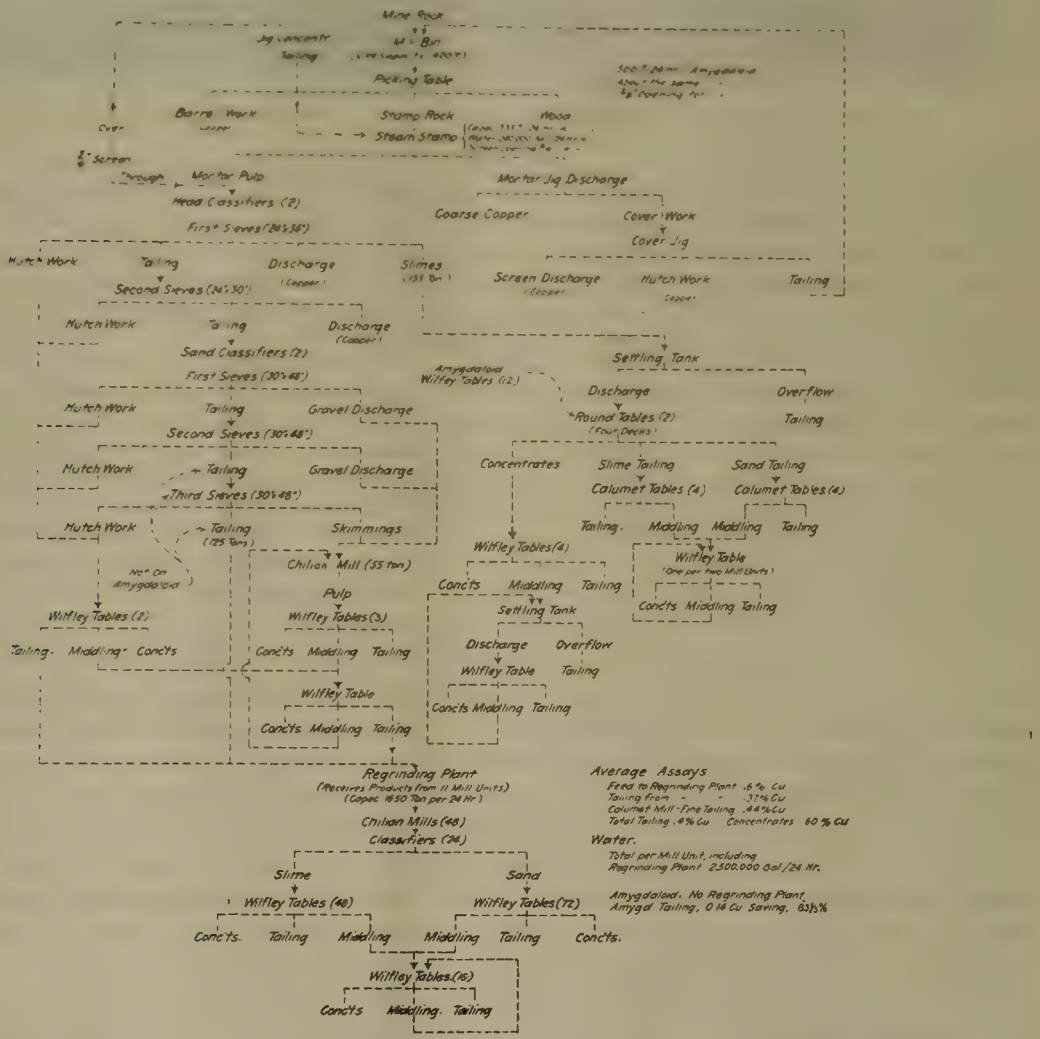
The methods of concentration pursued in the district are the logical and inevitable outcome of the conditions which have to be met; namely, masses of a tough and ductile metal disseminated through rock, and in pieces varying from microscopic size up to masses weighing several tons. The method which must be followed is to free the large masses from adhering rock and separate them out so that suitable means may be taken to recover smaller particles. The large masses are separated out in the 'rock house' and the rock broken away by blows of an air or steam hammer. Particles of copper larger than 4 to 6-in. ring do not find their way to the stamp-mill, therefore, but are diverted to the smelter, and it has already been indicated that the chief end of coarse crushing is the preventing of larger masses of copper from reaching the mills. At the mills the crushed ore, 4 to 6 in. ring and finer, is fed to steam stamps which crush it through $\frac{3}{16}$ to $\frac{5}{8}$-in. mesh screen. Some provision must be made for the masses of copper which are just small enough to pass the feed opening and which cannot possibly be reduced to pass through the screen except by a process of gradual attrition, which not only causes a tremendous consumption of power but also leads to the loss of most of the copper thus ground away. This is provided by an ingenious device known as the Krause discharge, a 5-in. pipe opening into the bottom of the stamp mortar. Through this pipe rises a hydraulic jet sufficiently strong to prevent ore from working its way into the pipe but not strong enough to prevent the heavier copper from so doing. The jet serves to provide part of the battery water needed for crushing; the coarse copper liberated by the blows of the stamp accumulates in the pipe, where it does not interfere with crushing operations, and by opening a gate valve from time to time it is quickly discharged without interrupting crushing operations. This provision for the removal of coarse copper appears like a detail of milling practice; it is in reality a vital factor. From time to time the suggestion is made that gyratory crushers and rolls would prove more economical crushing machines than jaw-crushers and stamps, and they have even been tried, though it would scarcely seem that an experiment would be necessary to demonstrate that a mass of copper, just small enough to pass the feed opening of a gyratory or a set of rolls would at once put the machine out of commission. Any superior mechanical efficiency in regular operations is more than counterbalanced by the frequent delays thus caused. Masses of copper too large to pass the jaw crushers are easily pulled out with a chain block and tackle, while the coarse copper is removed from the stamp, as indicated, without hindering regular crushing operations.

In order to give opportunity for this collection of copper the mortar must be made more roomy than is the custom in stamping gold ore, and this in turn requires the use of an unusually large amount of water in order to secure quick discharge of the crushed material. This necessitates placing the stamp-mills at a point where an abundant supply of water can be cheaply obtained. The early mills were therefore placed along the shores of Portage lake, but when this was made an inland waterway by the dredging of the ship canal to permit exit to Lake Superior at its head the tailing could no longer be discharged into the channel, and the mills were removed to their present positions on Torch lake and elsewhere. The move proved a good one for those that chose Torch lake as their new site, for the tailing since accumulated is now recognized as a considerable asset. Those companies which had to seek sites on the outer edges of the peninsula were not so fortunate, since the winter storms sweep away most of the tailing and often batter away the cribwork through which the water supply is drawn, as has been described by Edward Koepel in the *Transactions* of the Lake Superior Mining Institute for 1912. Another drawback of a millsite on Lake Superior is that it generally involves a greater length of haul for the ore. The small increase of cost due to this factor may easily be more than offset by any one of a number of other factors which will suggest themselves. Transportation as a factor in operating costs, though it represents as much as 14c.* out of a total of $2 per ton for mining and treatment or almost two-thirds of the cost

*At the Calumet & Hecla the cost is 6c.; at Isle Royale 4c. per ton.

of milling, may be dismissed with the statement that it differs little from railroad transportation problems everywhere, and except for the effect of the rather rigorous winter climate of the district on the moist ore in bins and cars, the effect of the rather heavy snowfall on winter traffic, and the influence of relative situations, mentioned above, it has no especial significance.

The operations of concentration are rather simple, as indicated by the accompanying flow-sheet, which is reached. Until very recently every effort was made to recover all the copper freed from the rock by the stamp, but the copper in the crushed particles of ore was allowed to escape unheeded in the tailing. The amount that thus escaped in the earlier milling work was sufficient to render the tailing fair grade ore of today. Through the researches of C. H. Benedict, metallurgist for the Calumet & Hecla, regrinding of the tailing from the concentration of the stamp pulp has been introduced



TYPICAL FLOW-SHEET OF MOST MODERN LAKE SUPERIOR MILLING PRACTICE.

typical of the best practice of the district. It is interesting to remark at this point the analogy with the biological fact that an individual in its development summarizes the history of the development of the race. Something of this sort can be discerned in the operations of concentration, when we remember that the earliest mining in the district was directed toward the securing of large masses of copper, and from time to time efforts have been made to recover smaller and smaller particles until, as indicated farther on, the ultimate limit is and developed to a point in which it is one of the most important of the series of operations.

Referring again to the flow-sheet, it is seen that the principal operations of milling include dewatering and classifying the stamp pulp, concentration of the classified material on Wilfley tables, regrinding the tailing in Hardinge mills, and re-treatment on tables without classification; leaching of the table tailing will eventually be adopted. This general plan has been developed on the results of some decades of experience. It would be

SPARE MILL ON STAND; NOTE CAR INSIDE BUILDING.

METHOD OF DRIVING REGRINDING MILLS.

interesting to trace the historical development of Lake Superior milling practice, but it would take us too far afield here. The introduction of the Woodbury-Benedict jig classifier was an event of importance, as it at once furnished a means of removing some of the floods of water introduced into the mortars, of removing the coarse copper liberated by the stamp, and of furnishing a classified feed for the Wilfley tables. The use of these latter is the standard practice of the district. They are simple, cheap, and efficient, and nearly all the millmen of the district seem to believe that the better saving claimed for other types of tables is not sufficient to compensate for their greater cost. Whether this general opinion is based on experimental results or mere 'information and belief,' I cannot say.

Present practice in regrinding is due to the initiative of C. H. Benedict, who, perceiving that the way to recover copper escaping with the tailing is to recrush so as to set it free, set about determining the most efficient method of performing the work. Chilean mills, Hardinge mills, and a 5 by 18-ft. tube-mill were studied in comparison over a considerable period. The results definitely disqualified the Chilean mills, as might perhaps have been expected, since I have already pointed out that with a tough ductile metal occurring in ordinary rock the means of crushing adopted must imitate the blows of a hammer, breaking away the brittle rock from the tough metal, an action for which grinding machines are but ill adapted. In addition, the cost of repairs is heavy with this type of machine. Both tube-mills and Hardinge mills are well adapted theoretically to the work to be performed, and the result of the work of the Hardinge mill was enough superior to the tube-mill to lead to its adoption. The advocates of tube-mills are inclined to question this, urging that experiments with tube-mills of various sizes and designs would perhaps have given different results. With such a discussion we have here no concern, the vital factor being that a means has been devised for regrinding and reconcentrating the coarse tailing at a cost which permits a profit to be made on the copper recovered by the operations.

The operation of these Hardinge mills is sufficiently unusual to require further discussion. The ground pulp is not classified, as the coarse copper thus liberated would be returned to the mill until it was ground away and lost. The mills are therefore fed with only a small quantity of thin pulp, a 20 in. by 8-ft. mill, driven by a 40-hp. motor handling 35 tons of solid in a 4 to 1 pulp per day. In crushing amygdaloid, this runs up to 55 tons. The ground product all passes 40-mesh and 50% will pass 200-mesh.

I have already referred to the fact that some of the copper occurs in particles of microscopic size, lying along the cleavage planes of the minerals in the ore, that in some of the newer mines much of the copper is thus finely disseminated, as contrasted to the 'mass' ore mined in earlier years, and that in all the mines 'mass' copper tends to be less in evidence with increasing depth. The recovery of this fine copper is therefore not only a problem of present weight, but will be of increasing importance. It is evident that this copper cannot possibly be recovered by any of the ordinary methods of wet concentration. Two methods seem possible; flotation and leaching. It would seem that the leaf-like form in which such copper undoubtedly occurs would render it unusually amenable to flotation, but I am told that some preliminary experiments indicated that this is not the case. Leaching the ore has the advantage that it can be applied directly to the tailing from the tables in the grinding plant, from which it can extract the copper without any further grinding. On the other hand, so far as at present developed, it cannot be applied to the considerable quantity of slime made in the preceding crushing operations, and the tailing from the regrinding plant will doubtless have to be deslimed before subjecting it to leaching. It is quite possible that a combination of leaching for the sand tailing and flotation for the slime will prove more satisfactory than the use of either alone, since flotation cannot recover any except free metal, and the cost of grinding sufficiently fine to liberate the valuable mineral is a large factor in the use of flotation.

The sand recovered by dredging is elevated by a belt-conveyor to the distributer bins at the head of the regrinding plant; the Hardinge mills are set on an elevated platform of steel, so that their discharge may go directly to the tables on the floor below. Each mill is driven, through Wuest gearing, by its own motor and, as seen, a crane travels the full length of the plant and

can pick up either a mill or motor. Spare motors are kept on hand, a broken motor can be replaced in a few minutes, and the defective one repaired at leisure. At the far end of the plant two concrete stands to support mills are provided. On one of these a mill ready for use is always kept; a defective mill is lifted out by the crane, its contents emptied into the waiting mill, and the defective one set aside for repairs. The mill just filled is put in the place of the one removed and work proceeds with a total delay of as little as 25 minutes. Methods of design and operation such as these show their direct results in decreased operating cost and increased output. Standard-gage railroad tracks running into the plant also decrease handling costs.

Ordinary leaching methods could not be used with this ore, as the use of acid solutions or salts of an acid radical is rendered impracticable by the presence of considerable quantities of calcite, which would cause a prohibitive consumption of the chemical reagent. A clever modification of the ordinary cupro-ammonium reaction for the absorption of oxygen has therefore been devised by C. H. Benedict; this method was discussed in more detail in an editorial in the *Mining and Scientific Press* of September 5, 1914. Construction of a 2000-ton leaching plant to employ this process was started early in 1914 and it would doubtless have been in operation by the end of this year if the situation with respect to copper created by the war in Europe had not rendered it necessary to stop all new construction for the time being. It must be made clear that while I have here discussed regrinding of tailing and leaching as features of standard concentration practice in the district, the use of regrinding has only so far made its way into the mills under control of the Calumet & Hecla, Winona, and the Copper Range companies, while the first leaching plant is yet only in process of construction. Regrinding and reconcentration will be adopted by all the mills as soon as their own operating conditions render it practicable, and the same will be true of leaching if it proves as successful as hoped.

The success attained in regrinding and reconcentrating tailing and the indicated success of leaching operations naturally directed attention toward the tailing accumulated from earlier work. Of this the Calumet & Hecla alone has 40,000,000 tons, averaging 16 lb. copper per ton, and it has been computed that the recoverable copper content of this is 560,000,000 lb. It is thus seen that a tailing pile may become a tremendous asset, and the disadvantage of a millsite where the tailing is carried away and lost is thus clearly brought out. In the case of the Calumet & Hecla, Tamarack, and other nearby mills this tailing has accumulated in the quiet waters of Torch lake. A suction dredge, described in detail by the *Mining and Scientific Press* of November 22, 1913, has been built by the Calumet & Hecla to recover this sand and pump it to the regrinding plant on shore, where it will undergo regrinding, reconcentration, and leaching. On sand containing 16 lb. copper per ton it is estimated that 5½ lb. per ton will be recovered on the tables, and 70% in the remaining sand (excluding slime) will be recovered by the leaching operations. The details of the proposed method are given in the editorial, already mentioned.

Summarizing the foregoing, it may be said that recent developments in milling practice have extended rather than transformed time honored methods. Improvements have been made in equipment and design, which increase the efficiency and decrease operating cost, but what is of most significance is the introduction of methods which permit the recovery of the copper which formerly escaped in the tailing. The current tailing from the mills treating Calumet & Hecla conglomerate ore contains 8 lb. copper per ton, and the use of methods which permit this tailing to be reduced to 2 lb. copper per ton is practically equivalent to permitting the treatment of ore containing 6 lb. less copper per ton than was formerly profitable, with a correspondingly great increase in the ore reserves and the probable profitable life of the district. Perhaps even more important is the fact that the new methods recover the finely divided invisible copper which was formerly ignored, but which will have to be considered in future mining operations, and, as already indicated in the preceding, article, it may prove no longer possible to depend upon the eye alone in exploration and stoping. The average cost of stamp-milling is given by five companies as follows:

Cost of Stamping

	Baltic.	Champion.	Mohawk.	Osceola.	Wolverine.
1911..	$0.187	$0.230	$0.219	$0.172	$0.264
1912..	0.214	0.202	0.220	0.181	0.260
*1913..	0.271	0.279	0.295	0.235	0.370

*Strike year.

Smelting

There are four smelting plants in this district; that of the Michigan Smelting Co., owned jointly by the Copper Range, Mohawk, and Wolverine companies and situated 2½ miles west of Houghton, on the south shore of Portage lake; the Quincy Mining Co. smelter, on the north shore of Portage lake, just across from Houghton: the Lake Superior Smelting Co. plant, owned by the Calumet & Hecla, at Dollar Bay; and the new smelting plant of the Calumet & Hecla Mining Co. at Hubbell, which includes an electrolytic refinery that was completed early this year. It must be admitted in the beginning that smelting is the least advanced of the operations of the district. The best work I consider that at the Michigan smelter, which was designed by Frank Klepetko and built by F. I. Cairns in 1903. The copper concentrate is brought from the mills to the smelter in 40-ton cars and is dumped into bins where the 15% or more of moisture which it contains drains away and dries out. Provision for drying it by means of the heat of the waste gases was first made, but this proved unnecessary. All the concentrate, some of it containing as little as 22% copper, is smelted in 35 by 16-ft. reverberatory furnaces. These are fired with soft coal, using Traylor stokers, and smelt 95 tons per day each, or 4 tons of charge for each ton of fuel. The copper is drawn

out of two furnaces and into a third, placed between them and at lower level, in front. Here it is oxidized and poled in the well known way, and is then cast, into the various shapes required, upon a Walker casting machine. The arsenic content of this copper is such as to make it suitable for the rolling of sheets and the drawing of seamless tubing, so that some of it is cast into cakes 5 ft. square and other into enormous wire bars for these uses.

The slag from the reverberatory furnaces, averaging 80-tons per day in amount, is so high in copper (8%) as to require re-treatment. This is run into molds, cooled, and crushed and elevated to the bins above the blast furnace by a link-belt elevator. Here it is mixed with 20% (by weight) of limestone, 6½% coke, and 6½% soft coal. All the coarse or 'mass' copper is charged into the blast-furnace, for a variety of reasons. (1) It makes a good deal of slag, which if made in the reverberatories would have to be resmelted; (2) it gives a large fall of copper, which is necessary to dissolve the metallic iron formed by the strong reducing action of the furnace, which would otherwise accumulate and form a sow; (3) it is cheaper to remelt the copper thus produced than it is to resmelt the slag. The copper drawn off from the blast-furnace is cast into sows weighing about 6000 lb. each. These are lowered by a crane through an opening in the roof of the refining reverberatory which is ordinarily covered by a lid. The slag from the blast-furnace contains 0.9% copper and is run to waste, but has been impounded so that if it is ever found feasible to re-treat it, by leaching or otherwise, it can easily be recovered. The copper from this plant is not further refined, and finds a ready market for the making of hard copper articles, wire for screens, copper sheets for such uses as locomotive fireboxes, and for the making of seamless copper tubes.

Practice at the other smelters is different because most of their material is free enough from arsenic so that it can be sold as Lake copper, which commands a premium for its purity. The coarser copper is purer than the fine, and all the material which is over 60% copper is smelted in reverberatory furnaces, refined in the same furnace, and cast into commercial shapes. The fine concentrate, containing from 60% copper down to 22% copper, is melted down in a reverberatory in order to agglomerate it. The agglomerate, together with the slag from the reverberatory furnaces, is then smelted in a blast-furnace, together with some limestone, yielding a slag which contains about 35% Fe and 31% SiO_2. It is interesting to note here that one of the principal constituents of the fine concentrate is epidote, the green silicate of lime and alumina. The easy basal cleavage of this mineral causes it to form small polyhedra when crushed, and although it has only a specific gravity of 3.4, it tends to come off the tables along with the heavier but leaf-like copper. Recent changes in milling practice result in the saving of more of the magnetite, which is present in the ore, but in a fine state of division, and this is a welcome constituent, as it yields iron to the slag. To the casual observer this method of smelting seems unsatisfactory, since the copper is in large part converted into a silicate by the fusion in the reverberatory, and the subsequent reduction of this silicate in the blast-furnace necessitates the use of 20% of anthracite as fuel, thus producing a degree of heat at which some of the copper must be lost by volatilization since the furnace flame is distinctly green. At one of the smelters the fine concentrate is briquetted, but it would seem as though there should be no difficulty in sintering it, following the practice used elsewhere of handling flue dust.

The copper made by blast-furnace smelting requires refining, and is remelted, cast into anodes, and refined electrolytically. Some of the coarser copper contains enough silver to make it worth while to refine it, and it is therefore smelted separately and sent to the electrolytic refinery. The only electrolytic refinery in the district is the newly built one of the Calumet & Hecla Mining Co. at Hubbell, to which operations have been transferred from the old plant at Black Rock, near Buffalo, New York. This handles so much of the copper of that Company as is high enough in arsenic or silver to need refining, and also treats the same product of the other companies of the district. The plant is an interesting one, and deserves description in detail, but its technical operation has no bearing on our present theme, and therefore cannot be gone into here. The reason for the transfer of the plant from the East to the Lake Superior district is also interesting, but may not at once be obvious. The chief cost of refining is the electric energy required, and by placing the plant near the mills and smelter it gets the benefit of the central electric generating station, while its steady electric load helps to produce a better power factor. In other words, increasing the total electric load decreases the disturbing effect of those departments in which the load is fluctuating. Fuel costs but little more at Lake Linden than at Lake Erie ports, since the ore-carrying boats return up the lake in ballast and are glad to carry cargoes of coal at a low figure, coal on the dock at Lake Linden only costing 30c. more per ton than at Cleveland. The cost for smelting, refining, freight to the East, and marketing, in the case of those companies which report it, averages 20c. per ton of ore milled, ranging from 13c. to 31c. This variation probably indicates that there is room for improvement in the methods pursued in some cases, but I have not sufficient data on this point to speak more definitely, and, as already indicated, the variations in methods of account-keeping make it necessary to use comparative figures of cost with caution. Generalizing from the few companies which report details, it may be said that the cost of coarse crushing ranges from 1½ to 8.6c. per ton; transportation from mine to mill, 3 to 17.5.; stamp-milling, 18.7 to 40c.; smelting, freight on copper, and selling costs, 13.9 to 31c. per ton of ore milled. Progress will consist in the cutting down of costs everywhere to the lower level.

Mineral Resources of Jujuy Province, Argentine Republic

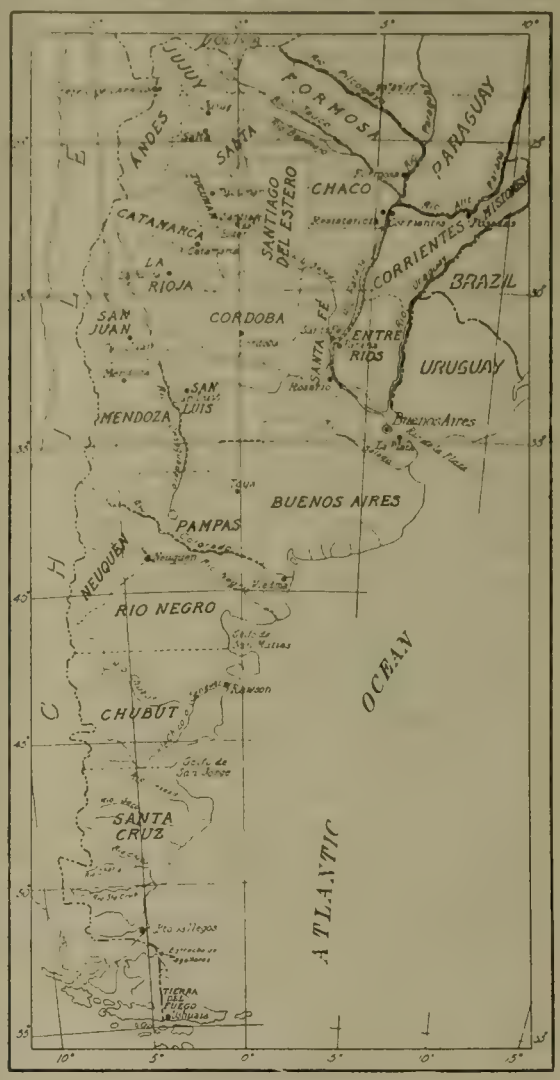
By ARTHUR W. JENKS

This province is situated in the northwestern corner of the Argentine, and is bounded by Bolivia both on the north and on the west. The production of gold from placers has been considerable in the past, and when the government of the province desired me to make a detailed examination of the mineral resources last year, I accepted with pleasure, because the scattered data regarding that region that had reached me had predisposed me in its favor. There would be no utility in giving a detailed description of all the properties visited. It will suffice to say that the principal placers and borate deposits, and all the other important mining districts, were reached, and that abundant samples were taken.

There are innumerable quartz veins, the strike in the majority of cases being north and south, parallel to the slates and shales that form the mountain ranges of most of that region. Almost all the veins are interstratified with the slates; a few strike north and south, but dip differently from the slates. Generally, the quartz is white, with little iron pyrite and with slight stains of oxide of iron. The very rich quartz formerly mined evidently was extracted either from rich veinlets of quartz, very narrow, or from nodules of rich quartz included in the masses of barren vein matter. The distribution of these nodules in the quartz unfortunately has no regularity; that is, a uniform mineralization in the veins of the province does not appear to exist, and the wide quartz veins do not have commercial value, showing only traces of gold. However, I shall mention the mine in Rinconada, called the Veta Blanca, and the mine El Torno, 13 kilometres northeast of Santa Catalina, both of which are worthy of investigation. Due to the fact that the workings are full of water, no positive statement can be made as to the richness of the quartz now exposed in the veins; but considering the large amount of work done, and the unanimous testimony as to the previous richness of the quartz extracted, it would be a legitimate mining risk to unwater those mines, in view of the fact that the quantity of water to be pumped is not likely to be large in either case.

In reference to the placers, these have been very rich, and there is little doubt that much gold still remains in them. None of them is being exploited on a commercial scale at present. In many of the valleys of that region, in the rainy season, when for a short time there is sufficient water, the natives wash the gravel and gain a precarious livelihood. There still remain several areas that are worthy of being explored systematically, despite the fact that in the most of the placers the richest portions have been worked out. Locally it is considered that the presence of these placers, which yielded so much gold, proves the existence of rich quartz veins. This opinion does not take into account the great erosion and consequent concentration of the wide veins of low grade quartz and veinlets of rich quartz which jointly have furnished the material of the placers.

In reference to the placers of the river Orosmayo, it is not my intention to enter into the details of the notorious fiasco of the Orosmayo dredging companies



MAP OF THE PROVINCES OF THE ARGENTINE.

some years ago; but from the gulch of Uriuri opposite the mountain peak Cabalonga northward to the point where the Orosmayo river joins the Granadas, the gravel in the valley is without doubt auriferous. In this distance there are forty kilometres that are worth exploring with the hope of finding a quantity of gold such that a dredge could extract it profitably. Among in-

vestors, no one now would place reliance on the results of the former prospecting work done along the river; besides, the number of prospecting pits sunk was apparently entirely insufficient. From the dredging of 2.5 km. of the river, 140 kg. of gold is said to have been produced. The dredge with which this extraction was effected is still in fair condition, and would need relatively few repairs and no large expense to put it into working condition again. The depth of the dredged gravel was 10 to 15 ft.; dredging stopped at a stratum of hard clay, but the bedrock should be prospected. The boulders encountered were not too large to be handled easily. It probably would be practicable to dig a large number of prospecting pits by hand, but in many cases the amount of water would compel the use of drills. The freight by burro or mule to Abra Pampa, the nearest station of the government railway, is $15 U. S. cy. per metric ton. The distance is 110 km. The cart road to Abra Pampa is partly destroyed by floods, but could be repaired provisionally at small expense, sufficiently to bring any heavy pieces of machinery. But in the plateau region of the province of Jujuy it is cheaper to carry small pieces by burro, mule, or llama than by cart, because the fodder for cart animals is expensive. The dredge formerly employed *yareta*, a resinous moss, for fuel; this *yareta* now is only to be found at some distance from the valley, is not very abundant in any case, and would cost $6 to $8 U. S. cy. per metric ton delivered at the dredge. The railway having been built through Abra Pampa, gasoline or crude petroleum can be brought in tank cars from Buenos Aires, and would form the cheapest fuel at present. In the month of April the quantity of water in the Orosmayo river was found to be 1.5 cu. m. per second. During the rainy season (December, January, and February) the quantity is much greater. Pasture and fodder of all kinds are scarce, and there are rather extended areas where poisonous grass is found that injures or kills mules and horses, especially those that have been raised at a distance and have not become accustomed to this grass. This valley appears to be worthy of a systematic and properly conducted prospecting, in spite of the unsavory failure of the former dredging companies in Orosmayo, which have injured Argentine mining so much. The collapse of the dredging companies of San Juan del Oro, in Bolivia, just north of the Argentine boundary, increased the aversion to mining so strongly felt by Argentine capitalists. The Orosmayo river runs northerly into Bolivia, where it is known as the San Juan river; but there the gravel is very deep, and the gold, if it exists in profitable quantity, is at such a depth that it is likely to remain unmined.

Another placer that may be mentioned is situated 20 km. west of the town of Santa Catalina, and is called La Eureka. It occupies a narrow plateau that forms the divide between the river San Juan and the river Santa Catalina. There are no quartz veins visible, but the deposit is an old channel of the San Juan river, in spite of the great difference in level between the mine and the present stream. Numerous working pits, 30 to 45 m. deep, were made by the miners of long ago, from the surface of the plateau down to the gravel of the old channel. More recently certain Englishmen drove an adit 500 m. from the eastern slope of the ridge to drain the gravel; it passed first through red clay and then entered the conglomerate; unfortunately, the adit was started at too high a level, the ancient bed of the stream remains still flooded with water, and the miners were not able to reach the bedrock, though all accounts agree that the small quantity of gravel they did extract below the level of the adit proved to be rich. It would be necessary to use drills from the surface of the small plateau above in order to prove this ground. In a few places in the adit the conglomerate is copper bearing, the maximum thickness of this ore being 50 cm.; a selected sample yielded 19% copper.

No Lead or Antimony Mines

As to the lead ores of the province of Jujuy, they do not contain gold, and with the exception of certain narrow veins do not assay well in silver. From these considerations, and from the fact that the most of the lead veins are distant from the railway, I consider that at present there is little opportunity for a profitable business in working the galena ores of the province. Farther north, in Bolivia, I visited important lead mines, the ores of which, while low in silver, occurred in sufficient purity and width to be profitable.

Antimony does not occur in commercial quantity in Jujuy, though across the line in southern Bolivia veins of stibnite are found, but were not being exploited when I was in Bolivia, because of the low price of antimony last year.

The double borate of lime and soda occurs in two districts, in Coyaguaima and in the department of Cochinoca. The former is a small deposit, but interesting as showing the probable origin of all the borate deposits of the province. It is an excellent example of the formation of borate from the waters of springs. The water that issues at present is insignificant in quantity, and cold, but the apertures through which the mineralized water formerly issued are very numerous, and the borate and carbonate of lime that have been deposited around them prove the origin of the deposit. The borate is not covered by a layer of earth or sand, but the white silky mineral is either at the very surface or beneath a layer of the carbonate of lime that was also precipitated from the water. The deposit slopes away from the central portion where the apertures are most numerous, becomes thinner, and within 150 m. disappears entirely. A selected sample of borate from it gave the following analysis:

	Per cent.		Per cent.
B_2O_3	39.66	Na_2O	7.59
SO_3	Trace	Total water	37.00
SiO_2	0.70	Loss and undetermined	2.87
CaO	12.18		
MgO	None		100.00

In the locality called Guayatáyoc, in the department

of Cochinoca, the 'Borax Trust' has an important holding in what is really the nearly dry bed of an extensive ancient lake at an altitude of over 11,000 ft. The borate bearing ground at this point is irregular in its boundaries, but is roughly 20 km. long by 1.5 to 7 km. wide. Everywhere in the neighborhood of this property, prospecting pits were sunk 1 m. deep by the 'Borax Trust,' and a few pits were continued to greater depths; but these latter did not show additional strata of borate of commercial importance. Guayatáyoc is 75 km. from Purmamarca, the nearest railway station. The thickness of the stratum of borate varies between 20 and 75 cm., with a probable average of 30 cm. It is found entirely in a continuous layer, not in rounded balls as at Tres Morros farther south. The borate is usually covered by a layer of earth or sand that in places attains a thickness of 50 cm.; but sometimes the borate is found at the very surface.

Methods of Mining Borate

To extract the borate the capping of earth is shoveled off and the tough borate cut with picks, breaking it thus into large pieces which are left in the sun to dry. The borate fields are not worked in the rainy season. It is necessary that the mineral should be well air-dried before it can be cleaned from the adhering sand and earth. The large pieces are broken into smaller ones of about 10 cm. diameter, placed in a screen with 1.5 cm. openings, and shaken rapidly by hand. Thus the earth, sand, and a large amount of borate rubbed off the large pieces pass through the screen, while the cleaned pieces of borate remain in the screen and are ready to sack, weigh, and ship to Purmamarca. The fine that passes the screen is not utilized, despite its high content of borate; probably 25% of the original boracic acid content of the stratum of borate is thus lost. The workmen are paid by contract $2.60 U. S. cy. per metric ton of sacked borate. The burro freight thence to Purmamarca is $12 U. S. cy. per metric ton. The Company makes no effort to exploit these deposits on a large scale; it only aims to do the assessment work required by the Argentine law, and the present production is only incidental to that work. The cost of production in the Company's borate fields in Chile and in Peru is much less than in Jujuy; therefore, it is prudent for them to save the Argentine deposits for future use, when the more cheaply worked deposits shall have been exhausted. The production in 1913 was approximately 750 tons of borate from the Guayatáyoc field. A sample of sun-dried borate gave:

	Per cent.		Per cent.
B_2O_3	31.20	MgO	Trace
SO_3	Trace	Na_2O	12.48
SiO_2	7.70	Total water	30.64
CaO	12.60		

The valley in which the borate and salt deposits of Jujuy are situated is 200 km. long and from 20 to 40 wide, with an altitude of 11,000 to 12,000 ft. The valley forms an interior basin without present outlet, and the evaporation of the ancient lake has caused the extensive deposits of borate and of rock salt. In the dry season it is possible to ride horseback over the larger part of the borate ground, if one knows the safe roads; otherwise the animals may mire in the sticky sand that never becomes entirely dry. The area covered by salt is safe, because the hard surface of this sustains the horses perfectly. In the rainy season, from the end of November to the beginning of March, the salt deposit and the greater portion of the borate field are changed temporarily into a large shallow lake. It is necessary to wait a couple of months each year after the evaporation of this lake before the extraction of the borate can be re-commenced. The working season is about seven months, extraction being impossible the remainder of the year on account of the wetness of the ground.

The principal Argentine office of the Compañía Internacional de Borax, or the 'Borax Trust,' is in Buenos Aires, but the local office is at Tres Morros, department of Tumbaya, province of Jujuy. The area owned by the Company near Tres Morros is more important than that in Guayatáyoc, and the tonnage of borate that has been proved is undoubtedly large. Here, as in Guayatáyoc, the Company does as little as is possible, simply endeavoring to perform the required amount of annual work. The whole valley has been prospected for borate, and it is unlikely that other profitable areas exist, aside from the properties of the 'Trust' and apart from the smaller holdings of two neighboring, independent companies. From Tres Morros to Purmamarca the distance is 60 km., and the burro freight $11 U. S. cy. per metric ton. The borate of Tres Morros is found sometimes at the very surface, and sometimes beneath as much as 30 cm. of earth, and the thickness and quality of the strata of borate vary much. The mineral occurs both in a solid stratum and also in rounded balls; the latter are usually purer than the former, and have apparently been formed by the erosion of the solid strata of borate, the resultant pieces having been rounded and purified by the action of water. The average thickness of the layer of borate at Tres Morros may be given as 25 cm. The methods of extraction are the same as at Guayatáyoc. The sun-dried borate shipped runs from 37 to 38% boracic acid. In air drying, the mineral loses half of its weight. The production in 1913 at Tres Morros was 1800 metric tons.

Roasting to Reduce Weight

The Company has experimented on a limited scale with the roasting of the air-dried borate in order to reduce the freight bill by lessening the weight. The cost of wood fuel is excessive at Tres Morros, being $13 U. S. cy. per metric ton; as 25% of the fuel is used for the motor and for the cylindrical roaster, there is little advantage in roasting in the present plant, despite the fact that between moisture and flue dust escaping, the reduction attained in weight is one-third.

The deposit of rock salt in the province is extensive; it is little worked owing to high transportation costs. The salt beds lie to the west of Tres Morros and extend

in a northeasterly-southwesterly direction for 40 km., with a workable width of from four to seven kilometres. In the central portion, the salt attains a depth of half a metre, and is purer than near the edges, where the salt is at present being cut. But the thick blocks that would result from cutting the salt from the central portions would yield blocks that would not be so convenient for transportation by burros and llamas. The blocks are chopped with axes and weigh from 15 to 17 kg. each. In the rainy season, the salt beds are flooded, and the water attains a maximum depth of 1½ m.; but the depth at any one point varies greatly according to the wind; the temporary lake is so shallow that the water is often forced by the wind to flow from the northeast to the southwest or vice versa, the force of the waves being such as to destroy the monuments that mark the mining claims, unless they are carefully constructed. The extraction of salt in Jujuy in the year 1913 was 1500 metric tons. The freight paid to Purmamarca, the nearest station of the government railway, is $13 U. S. cy. per ton. The following is an analysis of the salt:

	Per cent.		Per cent.
Insoluble	1.12	Magnesia	Trace
Water	1.60	Loss and undetermined.	0.22
Sodium chloride	95.33		
Potassium chloride	1.07		100.00
Calcium sulphate	0.66		

As far as known, the only extensive deposits of profitable mineral in the province of Jujuy are the above mentioned beds of borate and of salt. The working of these on a large scale is impossible under the present conditions of transportation. The construction of a cart road that shall be permanent even in the rainy season would be very expensive, and freights will always remain high even with a cart road, for pasture and hay are scarce at all seasons in the valley that is followed by the road, and always will be scarce because of the lack of cultivable land in the valley. In the winter and early spring, July to October, there is practically no pasture, and the burros make the round trip from Purmamarca to Tres Morros and back with almost nothing to eat. With a cart road it would be necessary to haul much hay to Tres Morros from Purmamarca for the use of the cart mules. An extensive system of wire rope tramways would solve the problem, and a cheaper solution would be a narrow-gage railway northward 110 km. from Tres Morros to Abra Pampa, a station of the government railway. Both solutions of the transportation difficulty are expensive, but would be justified by the tonnage in sight, if the Borax company were well disposed to the project. But, even with the facilities afforded by a narrow-gage railway, it is probable that it could still place borate in the European markets more cheaply from the Peruvian and Chilean properties than from the holdings in the province of Jujuy.

Petroleum has been sought in the northern Argentine at several periods and, it must be admitted, with no commercial results as yet. The localities that show the most favorable indications in the province of Jujuy are the one to the west of the railway station El Quemado, and the other at the side of the small lake of salt water called Laguna de la Brea at the northern extremity of the Santa Barbara range. None of the wells drilled in the provinces of Salta or Jujuy have as yet found oil in profitable quantities. The strata that are oil-bearing form an almost continuous district from Tucumán northward through the Argentine provinces of Salta and Jujuy to Santa Cruz in Bolivia, a town 600 km. north of the Argentine boundary. The geological characteristics of this entire region are closely similar. There are anticlinals that are promising, which have not been explored, or have not been explored properly; and there are numerous seepages of oil. Possibly the seepages in this case indicate that the greater part of the oil has already escaped; but it would seem that up to the present, those who have prospected the oil-bearing area of Jujuy have not taken into sufficient account the geological study necessary before beginning to drill their wells.

Petroleum Probabilities

In my opinion it has not been proved as yet whether the provinces of Jujuy and Salta have oil deposits of commercial importance or not. West of El Quemado a depth of 500 m. was reached, and near the Laguna de la Brea, 705 m. The latter well penetrated hot water with a strong odor of sulphuretted hydrogen; another well put down by the same company obtained a flow of two or three barrels per day. The oil from the seepages of El Quemado is very thick and the quantity is small. The following is an analysis of a sample taken by me:

	Per cent.
Coke and ash	18.31
Hard asphalt	23.35
Oil distilled below 315°C.	50.82
Oil volatile above 315°C.	7.52
Specific gravity	0.9529

The fractional distillation of the oil volatile below 315°C. is as follows:

C.°	Grams.	Density.
Up to 100	2.0 water	
260 to 300	35.5 oil	0.8449
300 to 315	12.7 oil	0.8477

From an abandoned well near the Laguna de la Brea a small amount of thin oil flows, of which a sample was taken that gave the following analysis:

	Per cent.
Coke and ash	8.20
Hard asphalt	9.90
Oil distilled below 300°C.	29.00
Oil distilled above 300°C.	52.90
Specific gravity	0.8777

The fractional distillation of the oil volatile below 300°C. is as follows:

C.°	Grams.	Density.
Up to 100	1.00 water	
220 to 240	8.25 oil	0.7912
240 to 260	5.25 oil	0.8094
260 to 280	7.00 oil	0.8200
280 to 300	7.50 oil	0.8301

But without considering the exact percentage of light oil in the petroleums, it is certain that an abundant de-

posit of oil would have great value in the northern Argentine, and the continuation of prospecting work is justifiable if the corresponding geological data are properly taken into account.

More interesting perhaps than commercially important are the numerous occurrences of mineral waters in the province. The only hot springs that have been utilized are those at Reyes 13 km. northwest of the city of Jujuy. The conveniences for guests are fairly good and the water appears to possess decided curative properties in cases of rheumatism. There are other hot springs in widely scattered localities, and several springs of cold water with strong odor of sulphuretted hydrogen. As the province is so far north of the large cities of the Argentine, the utilization of these springs as the basis of health resorts has not been seriously undertaken as yet; but with the growth of the country these mineral waters will have decided value.

With the exception of the southeastern portion of the province, fuel is scarce in the mining districts. *Yareta* and the brush called *tola* answer fairly well for cooking purposes, but are not abundant; that is, they would not suffice as fuel for a company operating on a large scale. For the operation of such a mining property, I should prefer gasoline or crude petroleum with the appropriate engines for furnishing motive power, in any part of the plateau of the province, despite the cost of transportation from the railway to the mines.

At these high altitudes the provision of drinking water is always important. In traveling, especially in the dry season, it is necessary to have a guide who knows the springs. With a knowledge of the country there is no great difficulty in obtaining the fresh water necessary for personal use and for the saddle mules and pack animals. But in some localities it would be costly to secure water sufficient for the various needs of a mining company operating on a fairly large scale. In this region also there are few cattle, because of the poor pasture. Sheep are numerous, selling at $1.30 to $1.70 U. S. cy. each. Goats are worth a little less, while llamas sell at $7. The meat of the llama is good, and that of the vicuna is still better. Often there is difficulty in buying these animals, for although they are numerous almost everywhere, the owners, for some inexplicable reason are averse to parting with them, and sometimes it is necessary to kill the animal desired and pay for it afterward. Alfalfa or other hay must be freighted in from the railway, or from the San Juan valley in Bolivia. In the winter, pasture is very scarce in the elevated portions of the province; therefore the best season to go there is shortly after the rains, which cease in February or early in March.

Due to the fact that many Bolivians make their sales and purchases in the northern part of Jujuy, the use of Bolivian money in the departments of Rinconada, Santa Catalina, Yavi, and Cochinoca is almost universal, it being difficult to use Argentine money in those departments except at the post-offices and at the railway stations. The peones who freight goods from the railway to the westward are always paid in Bolivian money, and charge at the rate of 12 to 20c. U. S. cy. per ton-kilometre.

The results of my investigations, though not as encouraging as I had hoped when undertaking the work, at least showed that there exist various opportunities for legitimate mining development operations in the province of Jujuy, operations from which one can reasonably hope for success.

Profits and Holdings of Guggenheim Exploration Company

The net income for 1914 was $3,383,622, equal to 16.27% on the outstanding capital stock. At the end of the first quarter the dividend was increased from 12% to 14% per annum, which is the present rate. The surplus shows an increase of $160,660.

Assets at December 31, 1914:

American Smelters Securities Co. 'A', 33,656 shares	$ 3,029,040
*Utah Copper Co., 404,504 shares	9,161,767
*Yukon Gold Co., 2,842,625 shares	10,114,564
*Chino Copper Co., 97,750 shares	2,534,803
*American Smelting & Refining Co., com., 69,500 shares	4,767,265
*Ray Consolidated Copper Co., 154,300 shares	3,245,850
*Miscellaneous investments	56,439
*Alaska Yukon properties and equipment	1,047,262
Furniture, fixtures, and equipment	1,630
Accounts collectable	1,407
Cash and demand loans	11,837,273
Total	$45,797,300

*Carried at cost.

Liabilities:

Capital stock	$20,793,300
Authorized $22,000,000	
Unissued 1,206,700	
Unpaid taxes (estimated)	32,000
Surplus	24,972,000
Total	$45,797,300

AUSTRALIAN comment on the metal situation is varied, but the following remarks by *The Bulletin*, Sydney, are of especial interest: "Last month Great Britain imported 20,185 tons of lead, only 1698 tons of which came from Australia. The remainder, 18,487 tons, was from Spain and America, which can dump lead at low freights into the English market. Much has been written about the supremacy of German metal firms in Australia. Now the plain fact is that Great Britain imports most of its copper from the United States, lead from Spain, and spelter from Belgium. That being so, what else can Australia do but sell to the foreigner?"

Twenty-three mines of Bendigo, Victoria, produced 102,649 oz. gold from 272,420 tons of ore in 1914. Dividends totaled £126,879, and assessments £61,842. The total yield of the district was 163,601 oz., a slight decrease.

Revival of the Meadow Lake District, California

By W. PRINCE CATLIN

The first discovery of gold in the Meadow Lake district, Nevada county, California, was made by Harry Hartley in 1863. Other discoveries soon followed, and during 1864 and 1865 a town, named Summit City, of 3000 to 4000 inhabitants, sprang up on the shore of Meadow lake. A stock exchange was established, mining companies were incorporated, mills were built, and a general mining boom was on. It was soon found that the oxidized ores went down but a few feet, and that the gold could not be recovered from the iron sulphide by amalgamation. This coupled with the hard winter of 1865-1866 caused a general exodus which resulted in the almost total desertion of the town and district. Since then the buildings of the old town have either been removed, crushed to the ground by snow, or burned, until at the present time only three remain standing to mark the spot. The mills suffered the same fate. In more recent years, one property and then another has been worked in a desultory manner and without success. Metallurgical difficulties have been held to be the chief cause of failure, but with the improvements in processes for the treatment of sulphide ores containing gold, capital is being attracted here and a new life is beginning to stir.

Most of the properties of the Meadow Lake district lie from four to nine miles northerly from Cisco on the main line of the Southern Pacific railroad, and it is from this point that the larger part of the mining supplies are packed in over trails. The northern part of the district can also be reached by wagon road from Truckee, a distance of 38 miles. Being situated in one of the belts of deepest snow in the United States, operators are required to make extensive preparations for each winter. The elevation ranges from 7000 to 7800 ft. At this altitude the warm rains of the coast are replaced by snow which accumulates from November to April, and 15 ft. is common. A depth of 35 ft. has been recorded.

The topography of the country is precipitous. Bare granitic rocks, with only here and there a patch of soil with trees and underbrush, characterize the landscape. The predominating formation is granodiorite, while large masses of more basic rock, probably a gabbro, exist in the northeastern, and metamorphic rocks in the southern part of the district. The veins run from one formation into the other without any perceptible change in character or value. They are of the 'fissure-replacement' type, and cut the formations almost at right angles. In some instances the diorite along the vein walls is altered to a schist. This metamorphism undoubtedly took place along the fracture prior to vein formation.

There are two vein systems in the district, one having a southeast-northwest strike and the other an east-west; dips varying from 60 to 80° toward the southwest and south, respectively. The veins of both systems are alike in content with the exception that the ores of the east-west veins carry a small percentage of copper and occasionally of lead. These metals have not yet been found in the other series. The veins are numerous, but irregular in width, being really lenticular masses (some of which reach a maximum width of 30 ft.) occurring at intervals along continuous fractures. The more important ore-shoots are usually found at vein intersections.

HIGH-GRADE MINE.

EXCELSIOR CON. MINES CO. BUILDINGS.

The principal vein minerals are quartz, tourmaline, hematite, magnetite, pyrite, marcasite, chalcopyrite, pyrrhotite, and rarely galena and sphalerite.

The old Excelsior group of patented claims, upon which the first discovery of gold was made in the district, and which has produced considerable bullion from the oxide ores near the surface, was bonded to Worcester, Massachusetts, people last spring, and will be worked under the name of the Excelsior Consolidated Mining Co. During the past five months this Company has had a force of men at work erecting camp buildings, placing machinery, constructing a water-power line from Meadow lake to the mine, and getting ready generally for a heavy development campaign. The property is now equipped so that operations can be carried on during the winter months regardless of weather. In the meantime the metallurgical details will be worked out, and a mill will be erected as soon as ore reserves justify. Maurice M. Johnson, representing Samuel Newhouse, recently secured a bond on the High Grade property from the owners, John P. Clark and Harry D. Ramsay. A small force of men will be worked on this property until spring, when, it is understood, machinery will be installed and development on a large scale commenced. Among other promising claims in the district are the Oro Grandes, Cash In Sight, Gray Eagle, Three Johns, and the Freeman.

The development work done in the district has been limited. Although properties have been held and attempts at mining have been made here for over 50 years, it is safe to say that 2000 ft. would cover all the work done on all the claims combined. And this work, done by the early operators in quest of the oxidized or free-milling ores, is of a superficial character. Work was always stopped when sulphide ore was reached. Frequently, trenches from two to six feet deep along the outcrop of a vein were evidently enough to satisfy the owner that he had reached the bottom of the free-milling ore. The deepest shaft in the district is 115 ft. At this depth a good grade of sulphide ore is exposed; this is also true in the deepest workings of other properties in the near vicinity. The district, therefore, is not without inducements for deeper explorations of its lodes.

With the advent of new operators, combined with the growing tendency of the claim-owners to offer more attractive terms to capital, it is to be hoped that the district is entering upon a period of development which will result in proving the worth and merit of the claims to full satisfaction of the owners who have held on so tenaciously all these years, as well as to those who invest their money in them, and that prosperity will spring anew from the ashes and ruins of former efforts.

VALUE of all the gold produced in the United States from 1792 to January 1, 1914, is estimated by the U. S. Geological Survey at $3,549,799,400; the value of the silver at $1,709,517,600.

BANK CLEARINGS in New York in 1914 totaled $83,018,580,015, compared with $94,634,281,984 in 1913.

The Boss Mine, Good Springs, Nevada

By SEELEY W. MUDD

*Both daily and technical press have erroneously stated that I had purchased this property. I have never been in the district, but I can, however, give some facts with regard to the property, based on a statement by an engineer who is familiar with it.

The Boss claim was located about 30 years ago. The property was originally opened as a copper mine, the gold value at that time not being considered of great importance. Some years later an unsuccessful leaching plant was built to treat the copper ores from this and other properties.

The country rock in the immediate vicinity is a thick-bedded limestone, probably of Carboniferous age, dipping approximately south 60° west at an angle of 10 to 20°. A fault zone, having a direction approximately north 30° east, passes through the main workings on the Boss claim. This fault zone is from 20 to 30 ft. wide, and in it the known orebodies of the Boss mine occur. About 600 ft. northwest of the mine workings a large intrusion of quartz monzonite appears. No igneous rocks have been identified in the mine proper.

The orebody of chief interest may be called a pipe, which outcrops at the surface. Its axis dips to the northeast at an angle of from 5 to 10° from the horizontal. Several cross-faults have caused slight lateral and vertical displacements.

Part of the orebody is quartz, which is generally thoroughly disintegrated and of a light gray color. In places the quartz is nearly black, sometimes vesicular and sometimes rather compact, but nowhere does it occur in large unfractured masses. The quartz body is surrounded by an irregular shell composed principally of hard and soft hematite, although limonite is present, especially near the surface. This shell of hematite is from a few inches to 6 or 7 ft. in thickness. The hematite shell, in turn, is enclosed by malachite, usually about 4 in. thick, but varying from a thin seam to 10 or 20 inches.

The black or greenish yellow talcy material accompanying the quartz core is said to be the richest ore, and the gold content is said to be somewhat higher, in ounces, than the combined platinum and palladium contents. The light-gray quartz ore is considered richer than the compact black quartz ore. It is only in this black quartz ore that metallic gold is noted in hand specimens, although the black ore does not horn so well as the ore previously referred to. The hematite varies greatly in its content of precious metals, but gold predominates in value; the silver varies from an ounce or two upward, and the quantity of platinum and palladium is small, usually negligible. The outer shell of

*Remarks to the San Francisco section of the Min. and Met. Soc. of America.

malachite usually carries from 20 to 30% of copper.

At some points near the orebody the limestone is heavily stained and in part replaced by the oxides and carbonates of copper mixed with iron oxides. A little chrysocolla and chalcocite were noted. The hematite shell sends out little streaks or fingers into the surrounding fractured limestone. The limestone is usually rather coarsely crystalline, light colored, and, while broken by the faulting, has not been brecciated. The orebody is very irregular in size, but one point was noted where a cross-section of the quartz included in the hematite showed an area as great as 70 ft. square. Detached lenses of hematite were noted in several of the adits, and, as a general rule, those of larger diameter than 3 ft. contained a core of disintegrated quartz similar to the main ore pipe.

It is claimed that at one point, a mile or more distant, some ore has been discovered in limestone, which contains platinum and palladium. It may be of interest to note that the discovery of platinum and palladium was made by an assayer who was at first puzzled by the fact that his assay buttons were ragged and irregular rather than round and smooth.

H. F. Bain has referred to a European platinum mine where the ore was reported to occur in graywacke. In the literature on the subject, other than that concerning placers, I have been unable to find any reference to an occurrence of platinum except in connection with rocks of igneous origin, usually peridotite or serpentine. The occurrence of these ores in limestone is exceedingly interesting.

Prospecting Dredging Ground at Pato, Colombia

*Where gravel deposits extend several feet below the permanent water-level, as those of the dredging areas of Pato, there is no means commercially available for accurately determining their gold content. Drilling, which under these circumstances is the most accurate, gives only approximate results, which are subject to wide variations owing to the personal variation of method, carelessness in drilling and panning, varying physical properties of the deposit, and to the economic impracticability of drilling holes sufficiently close together. Having driven a tube and pumped the gravel out of it foot by foot to bedrock, and panned the gravel so extracted, and weighed its gold content, it is desirable to know just what proportion of the displaced gravel and gold entered the tube and subsequently the pump, and what proportion was pushed aside by the tube in entering the ground, and how much was pushed out of the tube in pumping. This proportion varies in different parts of the hole, and also in the different holes, more especially where the physical character of the deposit is different. Many other variable quantities common to all types of drills enter into the process, but suffice it to say that one can only assume an average factor or proportion which is reliable to within perhaps 50% of the true average figure on any individual drill-hole.

In the early drilling of the Pato property, a theoretical factor arrived at in an entirely different field was necessarily used.* For this examination, we had the advantage of a dredge in operation and under our own direction, dredged over an area where we had previously drilled 17 holes. Carefully calculating the area and cubic yards represented by each hole, and knowing the actual yardage and gold yield by the dredge, we determined mathematically the factor for the drill-holes which would give the actual value recovered by the dredge. This factor works out at 387 ft. of hole for one cubic yard of gravel removed. This factor or proportion was then used for all of the holes drilled under my supervision on the Pato property.

Six drill-holes were further checked by sinking shafts alongside. In this checking, the dry weight of the gravel from the shaft and drill-holes was compared, and the drill factor for each case was determined on that basis. In those shafts where there were no water difficulties, the factor obtained in this way checked up closely with the factor obtained by dredging. In consequence, the drill results that have been obtained on the Pato ground during this examination are figured more scientifically than is usually possible or considered necessary.

In calculating the present dredging area of Pato, I have used the results of 89 holes drilled under my supervision, 38 drilled under C. H. Munro, six drilled by A. P. Rogers, and one drilled by E. B. Kimball. In estimating the yardage, a circle of uniform size was drawn on the map about each hole, and the area included in the polygon, formed by joining the points of intersection of the circles, was taken as the area corresponding to that hole. That area and the depth and value of that hole were used for determining the cubic yardage and gross value corresponding to the hole. These figures thus obtained separately for each hole were then summed up to obtain the total area, yardage, and value. In this manner, errors of calculating results are not introduced by varying distances between drill-holes of widely different values and depths. The examination showed a total of 22,419,490 cu. yd., worth $7,092,100.

By assay of the gold recovered from the drill-holes it was found that the bullion fineness varied from 848 to 937.

*Abstract of report of W. A. Prichard to Oroville Dredging Co., December 24, 1914.

TRANSACTIONS on the New York Stock Exchange in January totaled 5,028,113 shares and bonds valued at $56,967,500. In December and January of 1914 the business was 1,847,982 shares and $35,327,000 bonds, and 10,012,404 shares and $88,823,600 bonds respectively.

TRANSACTIONS at the New York Assay Office in January amounted to $3,795,795, against $8,957,563 in that month of 1914.

DISCUSSION

Readers of the MINING PRESS *are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.*

The Copper Beds of the Coeur d'Alene

The Editor:

Sir—I have read the article entitled 'The Copper Beds of the Coeur d'Alene,' by George Huston, appearing in the January 23, 1915, issue of the *Mining Press*. It seems to me that certain points of importance in any geological discussion, and especially in a discussion of mining geology, have been grossly ignored in the presentation of the above mentioned article; namely, the correct use of technical terms, and the careful presentation of the data under discussion by the use of maps and drawings. Economic geology is progressing towards an exact science and articles dealing with it should be clearly expressed by careful phrasing and the use of exact terms. A relapse into the limbo of terminology from which geologists are gradually emerging should not escape criticism.

On page 145, first column, fourth line from the bottom, in the above mentioned article, the word *trend* is used, and the reader is told that "* * * the trend may be divided into two divisions according to the *strike* * * *." *Trend* is apparently used as a nickname for the general area occupied by the Granite Peak syncline; there is no statement of to what geologic body the *strike* applies. *Trend* implies direction and a direction can not be divided into two or any other number of parts. A careful study of the map accompanying the article which purports to be 'Map of Syncline Showing Principal Faults and Area of the Revett Formation' yields no enlightenment on the matter. There is no syncline indicated on the map, and the reader may only conjecture whether the dotted area or the white one is meant for the Revett formation.

The use of the word *filled* in the seventh line, second column, page 145 implies that the Revett, St. Regis, and Wallace formations were laid down in a pre-existing trough. As applied to the Granite Peak syncline this, of course, is not true. The syncline was produced by a folding of the beds after their deposition in a shallow basin of wide extent and with possibly a slight eastward dip at this locality.*

Four lines below is the statement that "Side pressure against the limbs has fractured a *plane line* down about the centre of the *trend* * * *." In vain I look on the map for the "centre of the trend"; further, a *line* has but one dimension, length, and a *plane* line is any line in a plane.

In the third sentence of the first paragraph under the heading 'Revett Formation,' page 145, it is stated that "These beds lie in the *first* or top 350 ft. of the formation * * *." The first 350 ft. of a sedimentary formation lie at the base unless the beds have been completely overturned. This is not the position of the Revett formation on the east limb of the Granite Peak syncline, but is the case at certain localities on the west limb.

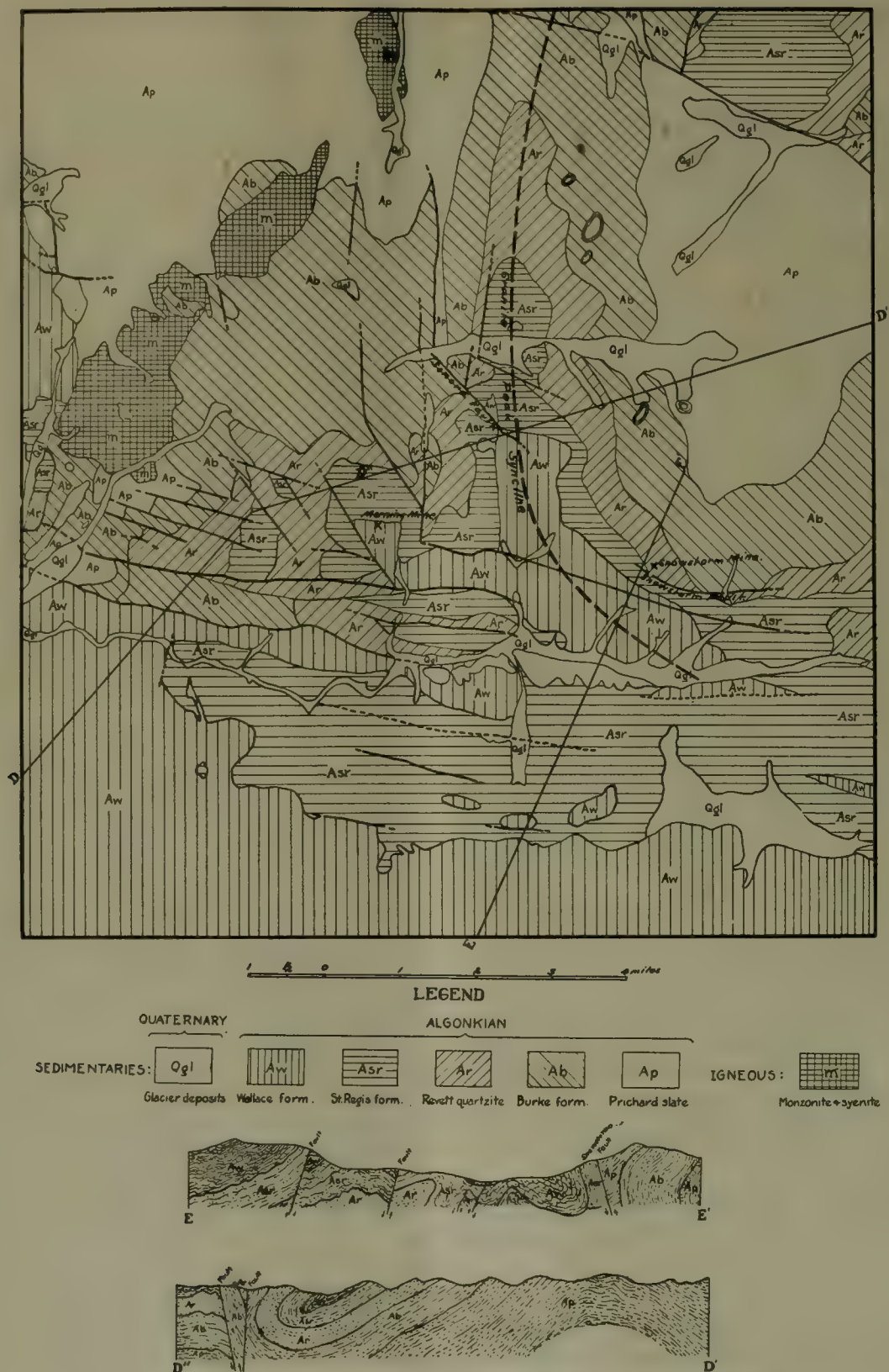
In the second sentence of the following paragraph it is stated that "The faulting, as noted, follows about the centre line of the trough, the Sonora fault on the Canyon Creek slope connecting through with the Snowstorm fault on the Mullan side." I here introduce a copy of a part of the United States Geological Survey map and two sections across the Granite Peak syncline. I have added the heavy dotted line to show the approximate position of the axis of the syncline. A line connecting the Sonora and Snowstorm faults would cut diagonally across this axis or "the centre line of the trough." Neither the syncline, its axis, nor a line connecting the two faults under discussion are shown on the author's map, yet he states that he has studied this small area for seven years.

The succeeding paragraphs are equally vague and misleading. Under the heading, 'Copper Impregnation,' page 146, we see "The deposits are unique in that the nearest igneous rocks are miles away, and there are none whatever in the syncline." A glance at the geological map shows the monzonitic intrusions of the Coeur d'Alene district to be exposed within seven miles of the Snowstorm mine. In the U. S. Geological Survey *Bulletin* 540, page 175, the statement is made that igneous dikes have been cut in the workings of the Morning mine and near-by prospects. The Morning mine is less than four miles distant from the Snowstorm mine and some of the igneous dikes are considered offshoots of the monzonitic masses mentioned above.

The author's discussion of the processes of mineralization suggests a lack of understanding of the metamorphism to which the Algonkian sediments were subjected before the introduction of the metallic sulphides. A complete discussion of this subject is found in *Professional Paper* 62 of the U. S. Geological Survey, and *Bulletin* 540. Under the heading, 'Enrichment Evidence,' is said "Enrichment in this case may be defined as a change in minerals, resulting in a higher copper content *with the casting aside of others.*" It is hard to understand how this escaped the editorial blue pencil.

A. F. Rogers of Stanford University has kindly lent me a specimen of the mineralized quartzite from the Snowstorm mine. This is a typical specimen of the low-grade ore described by Calkins in *Bulletin* 540,

**Prof. Paper* 62, U. S. Geol. Survey, p. 74.



GEOLOGICAL MAP OF GRANITE PEAK SYNCLINE AND MONZONITE INTRUSIVES (IN PART).

(After Ransome and Calkins, U. S. Geol. Surv., *Prof. Paper* 62, Pl. 2.)

U. S. Geological Survey, page 204. The rock is a clean light grayish quartzite impregnated with copper minerals showing no evidence of oxidation. Some time ago Rogers discovered that the dark gray copper mineral heretofore called chalcocite is in reality tetrahedrite.

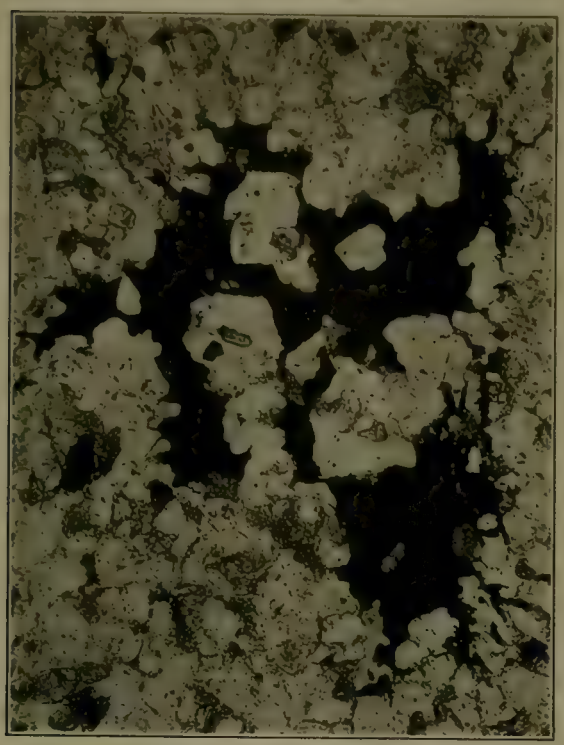


FIG. 1. SPECIMEN FROM SNOWSTORM MINE, MULLAN, IDAHO. BLACK AREAS, PRINCIPALLY TETRAHEDRITE; WHITE AREAS, QUARTZ AND MICROCLINE PLAGIOCLASE; GRAY, FINELY FELTED AREAS SERICITE; × 44 DIAM.; TRANSMITTED LIGHT.

Fig. 1 is a microphotograph of a thin section from the above mentioned specimen. There is no 'silicious' cement proper surrounding the grains of quartz, microcline, and plagioclase. Secondary enlargement of the quartz grains of the original sandstone is visible in places (not shown in the photograph). Sericite is often developed along the contacts of the enlarged grains and also partly, and in places completely, replacing the grains. There is little doubt that this phase of the alteration is the result of metamorphism which altered the sandstone to a quartzite over large areas long before the copper mineralization took place. There is also little evidence of the existence of interstitial spaces at the time of the introduction of the copper-bearing solutions. F. L. Ransome has shown that these solutions were introduced through tiny fractures in the quartzite from which they replaced the sericite and grains of quartz, microcline, and plagioclase. The replacement of sericite and the grains of the quartzite is clearly shown in Fig. 1. The dark areas in Fig. 1 are principally tetrahedrite with a little bornite and chalcopyrite, the white areas are principally quartz with a few grains of microcline and plagioclase. The grayish, finely felted areas are sericite.

Fig. 2 is a microphotograph of a polished section from the above mentioned specimen. The enlargement is 100 diameters and shows the border of one of the larger areas of the copper minerals. In this photograph tetrahedrite is the principal copper mineral, with bornite and

FIG. 2. SPECIMEN FROM SNOWSTORM MINE, MULLAN, IDAHO. T, TETRAHEDRITE; Cp, CHALCOPYRITE; Bo, BORNITE. THE BLACK AREAS ARE QUARTZ AND SERICITE.

chalcopyrite occurring, usually, around the border. There is little evidence of oxidation, the tetrahedrite apparently replacing both the grains of the quartzite and the sericite. Bornite and chalcopyrite usually occur together with the chalcopyrite cutting the bornite. No chalcocite whatever was found in this specimen, but tiny veinlets of covellite were observed, under the high power objective, to be cutting the tetrahedrite and replacing the bornite and chalcopyrite. Covellite occurs only in very minute amounts. It is hard to conceive that this type of ore from the Snowstorm mine is the result of downward secondary enrichment.

JAMES C. RAY.

Palo Alto, California, January 28.

[The Editor must divide blame with the author for the faults criticized by Mr. Ray. The original manuscript was materially condensed before publication, possibly not altogether wisely. Mr. Huston submitted with his article a part of the Geological Survey map of the area involved. Being printed in colors, it could not be directly reproduced, and so a sketch map was prepared indicating especially the position of the faults and the mines discussed by Mr. Huston. It was expected that

this would be used in connection with the original map, to which reference was made on p. 146. While the title was, possibly, a bit indefinite, we cannot believe that anyone was otherwise than wilfully in doubt as to which areas indicated represent the Revett formation. These, however, are minor matters and of relative unimportance. Mr. Huston presented an explanation of the occurrence of copper in the Revett formation, and stated briefly his evidence. Publication of his article has called out from Mr. Ray statement of the evidence for a contrary view, and Mr. Ray has been good enough to prepare a map satisfactory for use with both papers. The whole subject is one of much interest, and we will be glad to hear from others familiar with the field.—EDITOR.]

Electric Smelting in 1914

The Editor:

Sir—Commenting on Mr. Keeney's interesting article on electric smelting in the *Press*, January 2, I am moved to correct an erroneous impression which he has formed from statements made concerning the use of coke as a reducing material at Heroult.

On page 25, at the top of the first column, Mr. Crawford states that coke "if finely ground can be used as a reducing agent with satisfactory results." As a matter of fact, in none of our experiments did we use finely "ground" coke. We did find, however, that to obtain satisfactory electrical efficiency when using coke as a reducing material it was necessary to crush it. The degree of crushing found necessary depended principally on the density and crushing strength of the coke used, and varied, with the different cokes tried, from one inch to three inches maximum size.

Our decision to use half coke and half charcoal in making ferromanganese has no bearing on the subject, as this was done to reduce the volume of slag and hence loss of manganese in the slag.

JOHN CRAWFORD, Jr.

San Francisco, January 15.

The Uwarra Mill

The Editor:

Sir—My attention has been called to Andrew Walz's communication in your issue of December 12. I was inclined to overlook this, but several letters to me on the subject have decided me to reply. I shall not attempt to correct all the errors and misstatements in his communication, but will touch on some of the more glaring ones.

He is absolutely wrong when he says that the pulp storage tank had "no provision made to keep the pulp in suspension." A compressed-air connection was called for in the specifications and was provided by the manufacturers. He says further: "Since the plant was readjusted, the filter discharge has consistently averaged less than 30c. per ton." This must be gratifying to all concerned, because the tailing was averaging less than 30c. and had been for a long time when the plant was turned over to him, although it jumped to $3.10 immediately thereafter.

In speaking of the "overloaded belt-conveyors" he doubtless means the bucket-elevator, because the belt-conveyor had a capacity far in excess of the capacity of the mill. The embarrassment of the bucket-elevator was only temporary, and the change in the trommel screen to relieve it was advised long before he arrived and was mentioned in my article which he quotes.

Mr. Walz finds that his quasi-improvements in the mill result in a saving of 6½ tons of coal per day. Inasmuch as the mill only required 7½ tons before, his figures are certainly wrong unless he is milling 50 tons of ore per day at a total expenditure of one ton of coal. A saving of 6½ tons of coal represents about 70 hp. The mill engine at maximum load showed only 94 indicated horse-power. If 70 hp. was saved, there remains only 24 hp., and the tube-mill alone takes more than that. It would be interesting, since one single steam plant supplies all units, to know how much coal was saved by the new hoist over the little old overloaded worn-out steam-eating hoist which it was replacing when he took over the authority. He may have overlooked the fact, also, that the comparative number of drills and the comparative amount of development done account to a large extent for the steam economy stated.

The complaint that the rolls do not assist the tube-mill in "making slime" overlooks the fact that the rolls were installed *to crush* and the *tube-mill to make slime*. He adds: "I am not prepared to state definitely if stamps would have been better than rolls." Then why mention it? In *The Engineering and Mining Journal*, January 9, 1915, one of their "contributors * * * of national reputation as experts in their specialties" says of this very installation it "is an important step toward the elimination of stamps as primary crushing machines," and continues: "Upon ores of a character suitable to such work it is cheaper, both in installation and operation, to use rolls rather than stamps." Also, I might add as pertinent evidence on this point, that the Alaska Gastineau is now building the largest (20,000 tons per day) gold mill in the world along the most advanced metallurgical and mechanical lines and is installing rolls rather than stamps.

PERCY E. BARBOUR.

Bath, Maine, January 30.

Milling Gold Ores in Cyanide

The Editor:

Sir—Noel Cunningham's statements in your October 17 issue seem so strangely at variance with the facts of the case that perhaps I may be permitted to explain why I quoted figures by which, in Mr. Cunningham's opinion, "no experienced metallurgist should have been misled." In contrast to Mr. Cunningham's statement that "It was specifically stated that the Hollinger was just starting up at the time of writing, and milling data were only vaguely indicative," I would refer to the article itself, in which it is stated: "The mill start-

ed operations in June of this year [. . . *six months before the publication of the article*] and the greater part of the elapsed time has been taken up in systematizing the operation * * * The mill is now running well * * * but the management desires to establish the costs firmly before publishing any data." The recovery of gold was stated to be "thoroughly satisfactory" and extraction figures were given without reservation. I fail to see anything to justify the remark that the latter were only vaguely indicative.

Mr. Cunningham misquotes me in dealing with precipitation ratio. Other things being absolutely identical, the figure is often, doubtless, a factor of grade of ore. In the six instances quoted, the ratio is certainly in proportion; but with regard to one of these, the Esperanza, I have already stated* that "The milling dilution, with Huntington mills, is only 4 to 1, against 10 to 1 in most other [Mexican] mills; and the amount of solution precipitated amounts to only 3 tons per ton of ore, as against two or three times that amount in cases where ordinary stamp-milling is practised." Design of plant is only one of many factors affecting precipitation ratio, which, as I stated, is by no means *invariably* proportional to the grade of the ore being milled.

The feasibility of milling in water and the avoidance of discharge of waste solution other than as residue moisture are almost entirely questions of the efficiency of the dewatering apparatus used. For a leaching product a combination of Caldecott cone and sand table is used on the Rand with excellent results. In other cases drag or screw classifiers may be made to act as efficient dewaterers. By such means it is possible to obtain a low moisture product which even permits of the use of a water wash without increasing the bulk of the solution in circuit.

Similar results may be obtained with slime by a variety of means. I have been able to avoid the necessity for discharging waste solution by the use of an intermittent type of settler which I described in *The Mining Magazine* late in 1911. A system described by C. A. Banks in the *Press* of July 26, 1913, is also applicable; and I look for some such addition to the modern Dorr-type thickener which would bring its dewatering efficiency up to what has been my experience with intermittent machines.

In other cases where rapid cyanide treatment is feasible as a result of efficient amalgamation, the slime pulp may be dewatered in the same presses in which it is subsequently cyanided. Evaporative losses during ordinary slime and sand treatment are by no means insignificant and frequently permit of a water wash being used. In the majority of cases, however, the time may be more advantageously employed by a further solution wash. The use of water can only result in mechanical displacement. The use of barren solution may result in a further recovery of gold in addition to displacing that which has been already dissolved.

On the Rand, where milling in cyanide is usual, and where the discharging of waste solution is prohibited by law, the moisture water in the slime residue carries about 0.005% KCN. The total cost of cyanide used in treatment averages about 9 cents per ton milled.

In a postscript Mr. Cunningham quotes a case where improvements resulted from a change from "stamping in water and amalgamation to stamping in solution *followed by continuous decantation and filtration.*" The italics are mine, but the sentence embraces all the available information as to the precise nature of the change. Excellent results have been obtained elsewhere from continuous decantation, and I feel sure that Mr. Cunningham would be the first to question the judgment of a metallurgist who, upon such uncertain evidence, interpreted the results as conclusive evidence in favor of milling in cyanide, *per se*.

In conclusion, and to prevent misconceptions, I would restate the fact that my arguments with reference to the advantages of milling in water are not meant to apply to silver or silver-gold ores where, on account of low amalgamation efficiency and for other obvious reasons, milling in cyanide has been proved to be the more effective method.

A. W. ALLEN.

London, December 23, 1914.

**Mining and Scientific Press*, May 14, 1914.

U. S. Geological Survey Exhibit at the Exposition

The central feature of the Survey's exhibit at the Panama-Pacific Exposition, San Francisco, will be two stagelike settings—partly model and partly painted—representing a district in the arid West both before and after development. In the before-development scene, topographic engineers are at work with their instruments on the headlands, geologists have stripped a bed of coal and are taking samples for analysis, and other geologists are studying rock formations. In the foreground is an automatic river gage; farther back a hydrographer is measuring the flow of the stream as it races by. In the background is a camp and pack train.

The second scene shows the same district after development. The results of the stream-gaging have been utilized in planning a power plant that shows in the distance an irrigation project that covers the valley floor. The coal bed is being mined, an oilfield with derricks is under development, a sandstone bed is being quarried, and mining and milling are in progress in the mountains. A town has also sprung up, and roads, railroads, and other evidences of civilization abound.

The scenes are illustrative of the basic work of the Survey and also explain why this organization is not even better known than it is. It carries on the pioneer work and prepares the way for the engineer and the constructor; but when these men appear on the ground to erect permanent monuments to their professions, the Survey disappears from the scene and moves on to new fields.

CONCENTRATES

Readers of the MINING PRESS *are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.*

WIRE ROPE consumption in the Transvaal amounts to nearly $700,000 in value per year.

DREDGE EXCAVATION at Panama in December totaled 1,227,675 cubic yards.

SINKING the North Butte Mining Co.'s Granite Mountain shaft to 3100 ft. from the surface, cutting stations, and driving cross-cuts to connect up mine workings, cost $227,604, or $71.80 per foot. The shaft-house, electric hoist, and other construction will cost $251,540 by the time the plant has been tested and accepted from the manufacturers.

MINING AREAS in many foreign countries are dependent on other capital than their own for their exploitation, yet the laws are not always to the investors' liking. The Colombian government, Central America, both state and national, is making a laudable effort to promote and foster the development of its natural resources by foreign capital. However, a peculiarity in its laws gives almost sovereign power to the municipalities in the matter of local administration and taxation. Much of the good intent of the government is thereby undone through the tendency of each municipality to fatten on the industry that is unfortunate enough to become established within its jurisdiction. According to W. A. Prichard, the Pato property is continually persecuted by the municipality of Zaragoza, by the levy of exorbitant duties both legal and illegal, so that it is necessary to keep a salaried native lawyer on the property, another at Remedios, the head of the district, and another at Medellin, the state capital.

MINERS' LIENS.—According to California law, a miner who has worked for six months for the lessees of a pile of tailing and has not been paid his wages, may, if the lease is assignable, take an assignment from the lessees and work the tailing subject to its provisions, but in such event would be subject to the terms of the lease in the same manner as the original lessee. He should also protect his right to recover wages for past services by filing a miner's lien on the claim and machinery thereon within 30 days after stopping work as an employee of the lessee, and within 90 days after filing the same should commence suit to foreclose said lien. He would acquire no right to the possession and proceeds of the claim under his lien until after judgment of foreclosure and sale of the claim and improvements thereunder to himself. A notice of non-responsibility posted by the lessor, in order to be effective, must be posted conspicuously on the claim within 10 days from the time when he has notice that work is being done on the claim, and recorded in the county recorder's office, and then becomes effective as to all labor performed. If the owner of the claim knowingly permits work to go on for six months before posting the notice, it is of no effect whatever as to work already performed, but would probably be valid as to future work. Machinery placed on the claim and owned by the lessee would be subject to the miner's lien for the wages due him during his entire period of employment.

The mining district of Mogollon, New Mexico, has obtained a permanent highway outlet to Silver City and other points by means of a novel aerial ferry which was recently constructed across the Gila river at Gila. This overhead tram is of the wire cable type of construction, and is operated by a small power plant. It is 90 miles from Mogollon to Silver City, and at certain periods of the year, before the aerial ferry was built, the line of communication was frequently interrupted for days by floods in the Gila river, which made fording of that stream impossible. It occurred to Thomas Lyons, who owns a farm near the treacherous crossing, that it would be a feasible plan to build a cableway across the river, by which means mine motor-trucks and other vehicles could cross at all times. The platform which is suspended from the cables easily transports loads of as much as 16,000 lb. across the stream. The establishment of this crossing is of great benefit to the mining industry of the Mogollon district.

AERIAL FERRY FOR THE MOGOLLON DISTRICT, NEW MEXICO. BOTTOM PICTURE SHOWS TAKING ON A LOAD, AND TOP ONE CROSSING THE GILA RIVER.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

BOSTON

Lake Superior Coppers.—Convertible Mining Bonds.—Butte & Superior Dividends.—Nevada Douglas Affairs.—O'Reilly Company.—Calumet & Corbin.—Colorado Minerals Separation Company.

Recovery of the Lake Superior coppers on the Stock Exchange and Curb is easily the leading feature of the Boston mining-share market. At present the Stanton stocks, Mohawk and Wolverine, occupy the strongest position. Wolverine interests claim the mine has a life of 15 to 20 years, or about 150,000,000 lb. of copper, making the Company worth about $6,000,000, or $100 per share. In August 1911 J. R. Finlay stated that Wolverine then had but nine years of life, of which 3½ years of this have already passed away. Calumet & Hecla, which has also been played up or down as a played-out mine, has been accumulating stamp-mill sand for the past 60 years which it will take a period of 30 years to treat. Tamarack has accumulated likewise 12,000,000 tons which will occupy it 30 or 40 years. Metallurgy is giving a new lease of life to Calumet and Tamarack, as well as other Lake producers. The stories of the death or depletion of these old mines are turning out to be very much exaggerated.

The strength of Alaska Gold Mines Co.'s 6% convertible debenture bonds, selling around $115, has directed attention to the excellent records made by the convertible bonds of the porphyry group likewise floated by the banking house of Hayden, Stone & Co. Nevada Consolidated, Ray Consolidated, Chino, and Utah Copper all issued 6% convertible bonds. Nevada bonds cost $106 and sold as high as $300; the first issue of Ray bonds cost $105 and sold up to $200; Chino cost $110 and sold up to $200; Utah cost $110 and sold up to $220. Among the several achievements of the porphyry coppers should be noted the fact that they have made the convertible mining bond a popular security, combining investment and speculative attractions. Jay Gould made the convertible bond popular originally, a generation or more ago, in the days of his Erie campaign, but it has been left for the low-grade copper and gold mining companies, with their large ore reserves, to popularize that form of investment in the mining world.

Boston is talking about an increased dividend for Butte & Superior, which is now earning its dividend requirement of $3 per year four times over, and has nearly $1,000,000 in the treasury. However, the conservatism which resisted the pressure to increase the Utah Copper dividend a year or so ago, when that Company was earning the $3 annual dividend requirement twice over, may prevail again, as the dominating influences are the same in both companies.

The Nevada-Douglas Consolidated Copper Co., stock assessable, is to succeed the Nevada-Douglas Copper Co., stock, non-assessable. Capitalization is to remain the same, 1,000,000 shares, par $5. A special meeting has been called for March 4 at the Company's offices at Salt Lake City to effect this reorganization, and the official notice intimates that it is either a reorganization or a receivership. There are 888,100 shares of Nevada-Douglas stock outstanding, and holders of this stock will receive new shares *pro rata* on the payment of an assessment of 10c. per share. The assessment is a necessary one, as the Company is in financial stress, but it is announced that with the reorganization the Company is to take over the Moore Mining Co., with debts amounting to $57,000 included, in which is the money due on the bond and lease of the Western Nevada mine in the Yerington district. On the news of reorganization the stock dropped to 35c., its lowest price. The criticism is made here that an assessment of 10c. per share will not suffice for the Company's needs, and that if a dead company is to be revamped, it should be made into a live one. The assessment will yield $88,810, and there are floating debts of the present Company, bond interest payments, and reorganization expenses to be taken care of, in addition to the $57,000 indebtedness of the Moore Mining Co. Besides, the management has not yet completed the new leaching plant, which represents considerable obligated expense. However, by making the stock assessable, the Company will be in position to make fresh levies from time to time as money is needed.

A meeting of the stockholders of the O'Reilly Gold Mining Co. has been called at Phoenix, Arizona, for February 20 to reorganize the Company into the Marie Mining Co., reducing the capitalization from $2,500,000 to $1,500,000. Haverhill, Massachusetts, capitalists are largely interested in this Company, which owns about 51 acres of mining ground on the northern slope of the North Star mountain, 10 miles south of Breckenridge, Colorado. The mine has an adit 763 ft. into the mountain, and the management expects to reach the main Witch Hazel vein in another 300 ft., at a depth of over 1000 ft. from the apex.

Various stories have been afloat here concerning the status of the Calumet & Corbin Mining Co., stock of which has been manipulated on the Curb heavily for the past three months. In November 1913 the Company acquired under option the New Era gold mine in the Freeland district, Colorado, near Idaho Springs. An official notice was sent out then stating that this property had been "purchased and taken over," but the facts seem at variance with that statement. It seems the New Era was acquired under option for $150,000, with $10,000 paid down and $7500 payable every six months until the property was paid for. Last year a $7500 payment was defaulted, and it is stated that there are about $10,000 local debts unpaid. The property thus passed out of the hands of Calumet & Corbin, although sponsors for the stock here on the Curb protested that such was not the fact. It was naively stated that the option had not necessarily been parted with, and the Company could, if it so desired, exercise it still, but had decided not to do so, and was looking up a property in Alaska instead to purchase. In the search for the Senegambian ensconced in the woodpile it appears that there has been a period in which Calumet & Corbin's hold upon anything in the shape of a mining property was, to say the least, very slender, although there has been nothing at any time to indicate any suspended animation in the stock's activity on the Curb.

Philadelphia capitalists have recently formed, under the laws of Delaware, a corporation called the Colorado Minerals Separation Co., with a capitalization of $500,000, and announce that they will build and install a battery of 20 machines to operate on the dump material at Leadville, Colorado. It is claimed that a recovery of 97 to 98% in zinc concentrate can be made through these machines by a mechanical and electrical process. Boston experts not connected with the Company in any way have testified to the efficiency of the machines, several of which have been built and tried out, with a capacity of treating six tons of ore per day.

BUTTE, MONTANA

PRICE OF SPELTER AND BUTTE'S ZINC DEPOSITS.—COPPER FROM BUTTE TO NEW YORK *via* PANAMA.—EAST BUTTE AND NORTH BUTTE CONSOLIDATION.—MONTANA BRANCH OF A. I. M. E. —BARNES-KING DIVIDEND PROBABLE.

The present high price of spelter is causing Butte's two productive zinc mines to operate at their maximum capacity. There is no curtailment or working part time here. The only limitation placed on the mines is the tonnage capacity of the mills. The manifest success and prosperity of these mines has resulted in mining men considering the opening of other zinc orebodies in the district. The great detriment up to the present has been the fact that so much of the zinc ore is burdened with large quantities of pyrite which has not been successfully eliminated so far by any known process of concentration. Many attempts have been made in the past to make a satisfactory zinc product from the ores of the Lexington and Alice mines. At present the Anaconda company is said to be making experiments with the hope of devising a process of treating these iron-zinc ores. Should these tests be successful, a great impetus will be given the Butte district. It is not unreasonable to predict that before many years this centre will be producing as many pounds of commercial zinc as of copper.

A large expense in connection with getting Butte's copper product to market has been the railroad freight on bars to New York. Arrangements have now been made to reduce this freight cost by shipping the copper over the Chicago, Milwaukee & St. Paul railway to Tacoma, Washington, where it will be loaded on steamers and carried direct to New York by way of the Panama canal. Now that the Anaconda company is arranging to have most of its copper refining done at Great Falls, rather than on the Atlantic coast, the amount of copper which will be shipped by this route to New York will be large. Theoretically it might seem that the additional length of time for delivery would mean a considerable interest loss on refined copper tied up in transit, but practically a company like the Anaconda usually has a considerable store of copper on hand, and it might as well be stored in transit as in warehouses at the selling point.

The mines of the East Butte reduction works have been closed since August 5, and, according to the management, there is no likelihood of the property being reopened in the near future or at least not until the copper market is considerably more stable than it seems to be at present. The Company is making good use of the shut-down in carrying out extensive changes and repairs at its metallurgical plant, and also in doing development and making repairs at its mines.

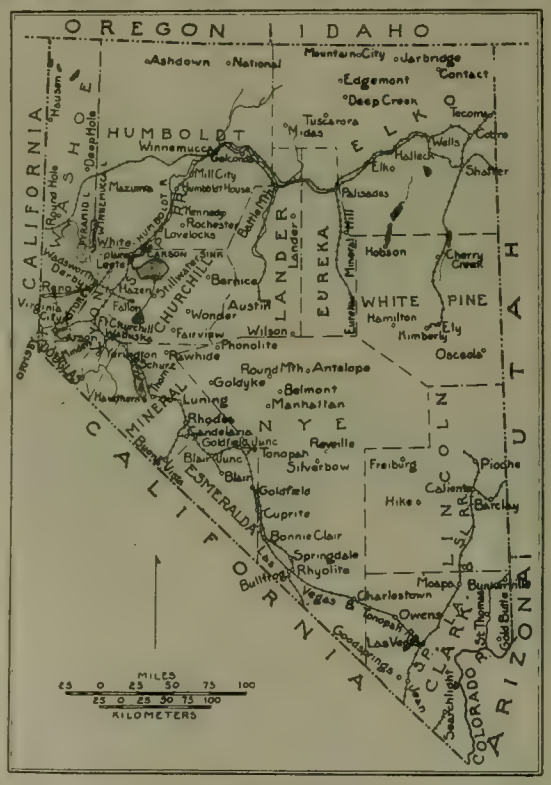
The rumor ceases to be downed that the North Butte is considering a business consolidation with the East Butte Mining Co. If this consolidation could be worked out on a basis satisfactory to the interests of each company, it would undoubtedly be of value in operation of the properties. There is no question but what the North Butte is considering seriously the matter of providing some treatment method for its ores other than the present one of shipping to the Washoe reduction works of the Anaconda company. The North Butte apparently considers that it should be able to treat its own ores at less cost than that charged it by the Anaconda. In this connection the fact has recently come to light that the North Butte company has bought some land and water rights near Silver Bow, six miles west of Butte. These water rights could supply sufficient water for concentrating at least 1000 tons of ore per day.

The Barnes-King Development Co. is nearly ready to surprise its stockholders by considering the question of dividends. This concern is one that the mining engineering profession can point to with considerable pride. As the Company was originally launched by its promoters it was a notorious affair, and the original investors lost heavily; but after the collapse, a few of the braver stockholders, among whom were some experienced mining men of Butte, got together and made an inventory of the assets of the Company. They found as its most important asset about $250,000 in cash. Instead of rushing madly into some other mining venture with this money, they put it out at interest and used the interest in a careful, systematic, and conservative search for a suitable mining investment for it. This search covered several years, and was finally rewarded in the securing of a property which has netted over $200,000 during the past year, and in the securing of another property, the development of which has proved very encouraging. This second property promises to be in the dividend class within a year. The Barnes-King shares, which were originally unloaded on the public at the ridiculous price of $5, dropped during the time of storm to below 50c. per share. Under conservative management, the property has been brought to its present promising stage, and the stock is now selling at close to $2 per share, and the prospects of the Company seem to fully warrant this price.

RENO, NEVADA

NEVADA WELFARE AND DEVELOPMENT CONFERENCE.—NOTES ON PAPERS AND DISCUSSIONS OF INTEREST TO MINERS AND ENGINEERS.

A largely attended and interesting conference was held under the auspices of the University of Nevada and state government at Reno on February 5 and 6. The meeting was



MAP OF NEVADA.

attended by mining men, engineers, railroad officials, farmers, and business men from the whole state, and many from California. In addition, the State Legislature adjourned and attended the conference. The meetings were held in the University buildings, the conference being called by A. W. Hendrick, president of the institution, who was ably assisted in

his work by James G. Scrugham, dean of the engineering departments.

One of the most valuable and interesting meetings of the conference was that of Friday morning, the 5th. This session was opened with a paper by Maxwell Adams of the University, on 'The Manufacture of Nitrates by Electrical Methods.' He discussed the history of plants in this country and abroad which produce nitrates by the atmospheric fixation method, and called attention to the great possibilities in Nevada for the manufacture of nitrates with the aid of electrical power from water-power plants. This paper was followed by several on irrigation pumping, the titles and authors being as follows: 'Electric Irrigation Pumping,' by H. A. Lemmon, of the Truckee River General Electric Co.; 'Irrigation Pumping in Central Nevada,' by James Edmunds, of Winnemucca; 'Irrigation Pumping Opportunities in Elko County,' by B. G. McBride, manager of the Elko Lamoille Power Co.; 'Development of Underground Water Supplies in Southern Nevada,' by Hon. Peter Buol, senator from Clark county; and 'Costs of Electrical Irrigation Pumping,' by F. B. Mechling, manager of the Nevada-California Power Co. There was also a formal discussion by L. W. Crehore, city engineer of Fallon. Each of these papers pointed out different conditions and problems which have to be considered and solved in various parts of the state in connection with irrigation pumping. One of the most striking points brought out was the diversity of conditions. In Washoe county considerable difficulty is found in sinking the wells, to prevent them from caving; near Winnemucca the gravel formation makes well-sinking an easier problem; in Elko county conditions are ideal for electric pumping; while in southern Nevada the artesian belt renders it unnecessary to use pumps.

On Friday afternoon the conference meeting was devoted to a series of papers on the safety movement and welfare work throughout the state, the session constituting an interesting continuation of the 'Safety First' work started at the University of Nevada in January 1914. One of the subjects under discussion was 'Electric Headlights,' by Mr. Booth, attorney for the Southern Pacific, and Frank Ingram, president of the Brotherhood of Locomotive Firemen and Engineers, in which it was brought out that the nitrogen lamp, which was tested a year ago, has now proved generally satisfactory and meets the requirements of the employees as well as the railroad company.

Other interesting papers read during the conference were the following: 'Reclamation Problems,' by E. P. Hobson, of the U. S. Reclamation Service, and discussion by E. P. Osgood, of this department; 'The Adjudication of Water Rights,' by William Kearney, state engineer; 'The Commission Form of Government,' by C. L. Harwood; and 'The Control of Public Utilities,' by W. H. Simmons, state railroad commissioner; also an interesting and valuable discussion on the subject of 'Rural Credits,' by Dean Hunt, of the Agricultural Department of the University of California; Frank Drum, president of the San Francisco Savings Union Bank & Trust Co.; and Wm. Sproule, president of the Southern Pacific Company.

The conference closed with a banquet to 400 guests in the gymnasium of the University on Saturday evening, at which the president of the University presided, the guests including governor E. D. Noyle, the members of the Legislature, state officials, and the delegates to the conference.

Safety First of the Nevada Consolidated company for January states that at Copper Flat there was only one accident resulting in a loss of time, two at the concentrator, and one at the smelter.

This monthly publication has started its third year, and the Company has hopes of increasing its usefulness. It was one of the first magazines of its kind in the field to "herald the slogan and champion the cause of industrial safety," and it has persevered in its policy of publicity, in calling the attention of foremen and employees to the number, nature, cause, and effects of works accidents.

LEADVILLE, COLORADO

Important Gold Discoveries in Three Mines — Leadville Mill Busy — Down Town and Big Five Companies — Zinc Producers.

The past month has brought to the front several features in the mining activities of the district which have aroused great interest throughout the state. Three important discoveries of high-grade ore were made soon after one another. The first was made in the Garbutt property, adjoining the famous Little Jonny on Jonny hill. John Cortellini, who operates the Garbutt, has a lease on a great number of Ibex blocks along the boundary, and on several claims to the south which have not been prospected at all. A large vein was cut in the ground leased from the Ibex late last year, and shipping has been carried on steadily from the orebody here uncovered. This discovery led to development from the Garbutt side, and the same vein has been found in that property and continues into the Nonie claim to the south. Taking the development as a whole, it is the largest orebody that has been opened in this district in many years, and is the source of one of Leadville's greatest productions. The ore will average about 2 oz. gold per ton, and contains little other value.

The Gordon-Tiger property, in the Twin Lakes district, was the scene of the second excitement. This old property has been one of the greatest gold producers and has been idle for years. Recently George W. Boyce took charge of the mine, and under his management another of the old-time shoots of 'picture rock' has been opened, which assays between $200 and $300 per ton. The exact size of the deposit has not been ascertained, but a good number of men are employed sacking the ore, which is being held for shipment as soon as the roads permit.

Mining circles throughout the state received a happy surprise early this month when it was made known that George Campion, a brother of John F. Campion, owner of the Ibex property, had cut a body of rich ore in the Little Bob mine, which adjoins the Ibex on the northern brow of Breece hill. Mr. Campion has operated this property several different times, and on each occasion failed to open anything that was profitable. Undismayed by past reverses, he interested a number of Colorado Springs capitalists in another attempt to prospect for rich deposits which he felt sure existed in the formations. After several weeks of fruitless searching, ore was found and proved up to the expectations of the promoter. A large vein of ore running from $320 to over $500 per ton has been opened, and preparations are now being made to drive under the ore and mine it through a rise. This property will soon be added to the list of money makers that have been recovered out of what were considered 'gutted' properties.

The old Leadville district mill is again operating successfully. A new oil-flotation process has been installed in the old plant, and has been found to treat the low-grade ores with good results. Samples from several of the properties have been tested, and a number of the low-grade properties are preparing to resume work as a result. Horrigan Bros. closed a contract with the milling company to ship the immense tonnage of tailing from the old Adams mill in Stray Horse. The deposit has been carefully sampled, and it is estimated that there is $60,000 worth of ore in the dam. Shipment of this material will start at once.

The Down Town Pumping Co. is going steadily ahead with the work at the Penrose. Jesse F. McDonald, manager, stated recently that he had received word from the Providence Machine Manufacturing Co. stating that the pumps were shipped on February 4. They are expected to arrive any day now, and they will be installed immediately upon arrival.

The Big Five Operating Co., which has been successfully

working the Big Four property on Breece hill for some time, has decided to rebuild the surface plant which was destroyed by fire several weeks ago. The Company is planning an extensive campaign on the Big Four, Gold Basin, and 25 blocks of ground leased from the Ibex Mining Co. adjoining. A lateral will be driven from the Yak tunnel through this Ibex ground to the Big Four shaft, and rise connection made with the bottom of the shaft. This work will open a territory 1060 ft. long and at a depth that heretofore has not been reached in this district. The Big Four property, up to the time of the fire, was one of the biggest producers in the Evans district, and now that the work will be taken up on a large scale, greater results are expected. The same Company will also operate the Fanny Rawlins mine, which has been idle for some time.

The greatest tone of Leadville's prosperity at this time comes from its zinc production. In the Wolftone mine of the Western Mining Co., Leadville has one of the greatest producers of zinc carbonate in the world. With the metal market offering over 8c. for spelter, this mine is making a fine output of 500 tons per day. Several other properties are producing a heavy tonnage of zinc, among them being the Yak tunnel, Iron-Silver Mining Co., Colonel Sellers, and Dome. Predictions that zinc will go to 10c. has caused a great revival of prospecting for this valuable ore, and several smaller properties, supposedly in the zinc belt, have resumed operations, but as yet no discoveries have been made.

KALGOORLIE, WESTERN AUSTRALIA

Great Fingall New Shoot.—Chaffers' Fiasco.—Yuanmi Company's New Property.—Zinc Shavings Manufacture.—Great Boulder Developments.

Since the Great Fingall mill at Day Dawn started treating ore from the new shoot below No. 14 level, in June 1914, 28,800 tons has yielded $228,100, or nearly $8 per ton, resulting in a loss of $25,800. Owing to the extra handling required, costs totaled $7, or nearly double what they used to be. The Company has, during the year, examined under option several properties in various parts of the Murchison field, but has abandoned them all. Recently the manager staked out a block of 450 acres at Rothsay, 100 miles southwest of the Great Fingall mine. This ground was abandoned by an English company nearly 20 years ago, and was taken up by the Great Boulder company 18 months ago, and abandoned after a short examination. The district has never been properly prospected, though it has produced $70,000 from 8900 tons of ore from shallow ground.

After erecting a new plant, and spending $380,000 since the last reconstruction of the Company in July 1913, the Chaffers mine has been closed down, and all employees paid off. The new cash capital found by shareholders amounted to $230,000, while $50,000 came from gold won, and $100,000 is due to creditors. In spite of being told by John Morgan, late manager of the South Kalgurli, and who examined the property, that there were no inducements to spend money above the 2260-ft. level, and that deeper sinking to try to catch the continuation of the rich shoots being worked in the Great Boulder and Golden Horse-Shoe was advisable, the money was wasted at No. 15, 16, and 17 levels. One ore-shoot, at No. 16 level, in No. 3 west branch lode, was stated by Boyd Aarons, the manager, to average $25.80 per ton for a width of 7 ft. It now appears this was incorrect. The 6000 tons of ore raised during development was valued at $9.60 per ton, but, when treated, yielded $4.30 only. Nothing is known as to what will be done with the mine or what the creditors will receive. Six weeks' wages are due the office staff and miners, and as the mortgagees have foreclosed on the mine and machinery, the men's chances of being paid are not bright. *The Kalgoorlie Miner* has been quite outspoken on the debacle.

An option, on behalf of the Yuanmi company, over the group of claims, consisting of 136 acres, known as the Warriedars in the Yalgoo district, has been taken by Bewick, Moreing & Co. There is a regular network of veins in the property, the main bodies running north and south, being crossed by smaller leaders striking east and west. The firm's manager, G. C. Klug, states that pan prospects made by him gave high results from the surface ore. H. P. Woodward, a government geologist, whose opinion carries considerable weight, thinks that the gold will not be found at depth. However, as the terms of purchase are reasonable, Mr. Klug thought it safe to recommend the property to the directors of the Yuanmi company.

The Broken Hill Proprietary Co., which has taken over the Hoskins foundry at Lithgow, New South Wales, has been experimenting with rolling zinc sheets for making zinc shaving for cyanide precipitation. This has proved to be a success, and the Company expects shortly to be in a position to supply the demand of all the mines in Australia. The Zinc Corporation has also been experimenting for the same purpose.

The eastern area of the Great Boulder leases is at present being tested from the Perseverance workings. At depth of 1300 ft. a horizontal bore, at 4 ft. inside the Great Boulder, passed through 12 in. of mineralized greenstone assaying $18.36 per ton. At 78½ to 85½ ft. a lode 7 ft. wide, worth $10.20 per ton, was passed through, and at 117 to 124 ft. another lode assaying $11.22 was penetrated. A second bore passed through a lode 30 in. wide assaying $24.48, a distance of 163 ft. inside the Great Boulder boundary, some 500 ft. south of the previous bore. In 1910 a borehole at 1800 ft. passed through a lode 147 ft. west of the Perseverance boundary, assaying $8.64 over a width of 4 ft. Diamond drilling is still proceeding.

The *Monthly Journal* of the Chamber of Mines for November contains an article on 'The Importance of Efficiency in Mine Sampling,' by Leslie B. Williams. He says, "if sampling results are looked on as approximations only, their value is great. * * * No hard and fast rule can be set down for the amount of sampling to be done." This publication also contains some interesting notes on a new industry in Australia resulting from the war, the rolling of zinc sheets suitable for cutting into shaving for cyanide plants.

NEW YORK

Institute Meeting Well Attended.—Amendments Carried.—New Officers Elected.—Butte.—Duluth and Inspiration.

(By telegraph.)—The attendance at the meeting of the American Institute of Mining Engineers this week numbered about 300. The sessions were quiet but much good fellowship prevailed, and it was evident that members are beginning to feel better acquainted with each other. The sessions devoted to safety and to speculation brought out lively discussions which will be reported later. There was much interest in the announcement of the vote on the amendments to the constitution. All those proposed carried by good majorities. For the two removing restrictions to expressions of opinion by the Institute, the votes were: No. 2, 822 for, 250 against; No. 3, 844 for, 237 against. The regular ticket for officers was duly elected, the vote being: W. L. Saunders, president, 1118; vice-presidents, S. J. Jennings, 1124, and P. N. Moore, 1114; directors, S. A. Taylor, 1120, R. W. Hunt, 1129, Hennen Jennings, 1123, George C. Stone, 1123, and W. H. Aldridge, 1126.

The Anaconda company will exercise its option on the Butte-Duluth Copper Co.'s mine and mill, paying $1,500,000 cash and a share arrangement. Diamond drilling to 160 ft. shows 1.8% copper ore. An immense tonnage of ore amenable to leaching is opened.

The Inspiration Consolidated Copper Co.'s balance sheet on November 30, 1914, showed assets consisting of material and supplies, $581,433, and cash and current assets, $3,064,377; while current liabilities were $244,482.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press.

ALASKA

Cordova

The mine inspector for the second and fourth judicial divisions of Alaska, W. J. Maloney, arrived in Cordova at the end of January, having covered the 307 miles between Fairbanks and Chitina in 5½ days by a dog-team with 10 in harness. In one day he covered 76 miles in nine hours, with one passenger and 300 lb. of freight. These animals were left at Chitina, but they will be returned to Nome later on to enter the All-Alaska Sweepstakes race. In a race at Nome, about the beginning of the year, 17 teams participated, the inspector's team broke trail and covered 2½ miles in 17 minutes and 40 seconds in a heavy storm, finishing third. The three teams with the best time had the advantage of the broken trail.

A DOG-TEAM ON THE MARCH.

A Keystone drill and Ingersoll-Rand air-compressor, three machine-drills, and a jackhamer are to be installed at the Valdez Creek Placer Mines property. A 58-hp. Pelton wheel will drive the plant. These drills are necessary to break up boulders encountered in sluicing. The Keystone machine is for prospecting. Hydraulicking is expected to start early in May, giving four full months' run before cleaning up. The output should be over $200,000, according to the president, George W. Sias. A. H. Bryant is superintendent, and W. T. Soule, transport manager. During 1914 and 1915 a total of $228,044 was spent on property purchase, development, and equipment. Cash at Cordova on January 30 was $15,000.

Fairbanks

The mine inspector for the second and fourth judicial divisions of Alaska, W. J. Maloney, arrived in Fairbanks early in January after a tour of several districts. He stated that in the lower river there is some activity all along the Yukon and Tanana, but conditions are far from booming. At Nome, from where the inspector started, there is more prospecting this winter than for several years. Ruby is also active, and on Long creek three big 'outfits' are in operation. On Mascot creek, Deitz, Sech, and Walker have very rich gravel. The district's output for the past season is estimated at $780,000. A little work is under way in the Hot Springs district, and the yield was about $675,000. The trail from Nome to Ruby was bad, but on to Fairbanks it was good. At No. 4 Below Goldstream, Gleason and Sawyer have 20,000 ft. of bedrock blocked out. They have installed a gasoline engine and hoist underground, and by an automatic arrangement need no man on top of the shaft for dumping.

Iditarod

Mail to Iditarod is badly arranged, and between October 1 and November 25 there was nothing received. Sending it by way of Seward works badly, and the route from Fairbanks is preferred. Ophir is worse off, as it has had no mail since the latter part of last summer, the sacks being at Tacotna. Lower river points are in a like condition, and everybody is dissatisfied with the service, or, to quote the *Fairbanks Weekly Times*, "Iditarod is up in the air over the mail service."

Ruby

Wolf, Zuber & Shropshire, mining on Poorman creek, tributary to the north fork of the Innoko river, employed six men during the summer. The claim is known as the Poorman bench. Coyle Brothers & O'Donnell have a plant ready on their bench holdings and plan to spend the winter prospecting. Nelson & Co., also prospecting, are said to have uncovered 'pay' running $1.50 per square foot of bedrock. McLeod & Co. made several clean-ups late in the summer, soon after they started operations. The first one yielded $1200 for four men's work in six days.

Flat creek is a tributary of Timber creek, which, in turn, flows into the Poorman. T. Tousley and E. G. Morton found 'pay' reported to average $3 per square foot, but have not defined the streak as yet. D. A. Sutherland and George Roberts, working on the upper end of Flat creek, is said to have made a good discovery under the creek bed. G. W. Herman is working in good ground on Duncan creek, a tributary to Poorman. George Beetle is prospecting on Poorman.

Pahlke, Trafolet & Co., recently made a new find of 'pay' on Birch creek, tributary to Flint. They have three feet of pay-gravel 90 ft. wide, and said to average $1.40 per square foot. Charles Strite is prospecting below them on his own holdings, looking for a continuation of the same streak.

RUBY DREDGE.

ARIZONA

Cochise County

The Shattuck Arizona Copper Co.'s total revenue in 1914 was $1,660,573. The net profit was $587,497, of which $525,000

was paid in dividends, leaving a surplus of $62,497. Ore shipments were stopped on October 23 on account of the copper market. Cash and metal on hand is valued at $1,045,315.

GILA COUNTY

There has been further heavy rain in the Globe district, and instead of pumping 3,500,000 gal., the Old Dominion mine is yielding 9,000,000 gal. per day, but the pumps are not yet at capacity.

The Old Dominion output in January was 1,745,000 lb. of copper, compared with 2,797,000 lb. in that month of 1914.

GREENLEE COUNTY

The Arizona, Detroit, and Shannon copper companies have adopted a sliding scale for wages, and an increase was posted on February 6.

MOHAVE COUNTY

The Lexington-Arizona company, of Oatman, is to sink a shaft to 600 ft.——The Oatman Gold Mining & Milling Co. is to sink to 500 ft.——A good tonnage of ore has been developed in the Copper Giant property.——Considerable work is being done by the Arizona Venture Corporation in the Big Sandy district.——Molybdenite ore sent by R. C. Jacobson to the Henry E. Wood company, of Denver, returned 18% metal. Other claims in the district are forwarding similar ore to Denver.

PINAL COUNTY

The Ray Consolidated Copper Co. reports as follows for the last quarter of 1914. Floods interfered with work in December. Development totaled 3288 ft. Mining cost 49.722c. per ton. The mill treated 402,917 tons of ore averaging 1.74% copper, with 68.2% recovery, at a cost of 54.56c. per ton, an increase of 8.71c. The concentrate yielded 9,638,586 lb. of metal, against 12,636,185 lb. in the third term. The year's output was 59,044,700 lb. Net costs, including credits, totaled 8.645c. per pound, a reduction of 0.093c. After paying bond interest the surplus was $174,945.

A good deposit of zinc ore has been developed at 300 ft. in the old Reward mine, 27 miles southwest of Casa Grande, according to V. H. Brooks. Shipments are to be made when the roads are passable.

ARKANSAS

BOONE COUNTY

During January four cars of zinc ore was shipped from Zinc. On account of the price of spelter, every effort is being made to produce ore, and several old properties will be restarted. One of the most important of these is the Madison.

CALIFORNIA

AMADOR COUNTY

Many people have tried to secure options on the old Eureka mine, at Sutter Creek, owned by Hetty Green and her son, without success, but it is now reported that a Scotch syndicate has made an offer for the purchase of the property.

CALAVERAS COUNTY

Thirty-five suits have been filed in the court at San Francisco by farmers and orchardists against the Penn Mining Co., operating a smelter near Campo Seco on the Mokelumne river. The total damages asked are about $350,000, the plaintiffs alleging that fume had damaged their properties.

KERN COUNTY

A good shoot of tungsten ore has been opened in the Stringer district, near Atolia, by D. E. Thompson.

NEVADA COUNTY

San Francisco people have acquired the Montana and other claims in the Willow Valley district. This property is opened to 830 ft. on the incline, has a good past record, and is equipped with a 5-stamp mill, compressor, and other plant. R. R. Moore is in charge.

PLACER COUNTY

Development in the Glover and Hanniman mines, near Auburn, continues satisfactory.——The Little Valley gold mine, at Brandon station, was sold at the Placerville court-house last week, for $338.

SHASTA COUNTY

The Noble electric smelter at Heroult is to resume production of ferromanganese in March. The Thomas mine in Mendocino county will supply manganese ore.—Forty-four asbestos claims of E. H. Hayden, on Mears creek, west of Sims, have been sold to H. L. Smith.

SIERRA COUNTY

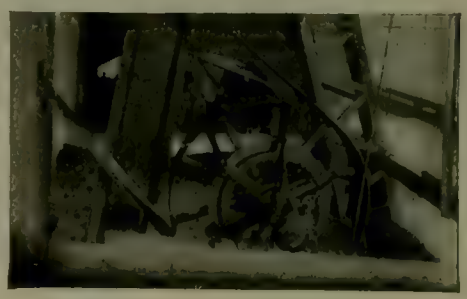
Bad weather in this county has interfered with mining, but the rain and snow insure plenty of water for the coming season.——At the Lightner, near Alleghany, sinking is still under way.——A stamp-mill may be erected on the Rainbow.——The Plumbago mill is crushing ore.——Several promising discoveries have been made in other mines.

TRINITY COUNTY

About a half-mile of flume of the Lagrange company was carried away in a recent storm, and no water will be available for two weeks for sluicing. Last year a siphon collapsed and curtailed work.

YUBA COUNTY

A dredge costing $25,000 is to be constructed for James M. McIntyre, of Sacramento, to be placed on Bulls bar near Copley, on the Sacramento river. P. Lockhart will be in charge of the boat.



SCREEN DRIVE YUBA NO. 14 DREDGE.

The man who attempted to hold up one of the Yuba Consolidated dredges last November was sentenced to five years' imprisonment recently.

COLORADO

LAKE COUNTY (LEADVILLE)

Work at the Penrose shaft of the Down Town pumping scheme is making fair progress. Nothing is known of the whereabouts of the pumps from the Providence Machine Manufacturing Co.——The Star Consolidated, on Carbonate hill, has contracted for the supply of a large tonnage of manganese ore.——To drain the Big Four mine, it is proposed to make connection between the shaft and the Yak tunnel, by driving a cross-cut and then rising to the shaft.

SAN JUAN COUNTY

Silverton and other Colorado people favor the erection of one of the United States government mining experiment stations in that town. They argue that Silverton is in the centre of the San Juan region of over 3000 square miles, producing a variety of ores, and supplied with water, electric power, coal, and railroads.

San Miguel County

The Tomboy mill treated 12,585 tons of ore in January, yielding bullion worth $41,000 and concentrate valued at $48,500. The net profit was $28,000.

Teller County (Cripple Creek)

The Cresson has shipped a car of ore worth $60,000.——Lessees in the C. K. & N. mine are working a new phonolite dike, which is about 20 ft. wide. In it are streaks of rich ore. ——The Golden Cycle company has acquired the Keener company's property of 30 acres adjoining the Elkton for $100,000, and 700 acres of coal land near Colorado Springs for $50,000.

IDAHO

Shoshone County (Coeur d'Alene)

Underground haulage by storage-battery locomotives in the Bunker Hill & Sullivan is discussed by J. W. Gwinn, of Kellogg, in the *Transactions* of the A. I. M. E., February meeting at New York. There is a total of 35,000 ft. of drifts, adits, and cross-cuts where the locomotives are used, the Kellogg tunnel being 10,000 ft. long from the portal to the main working shaft, and then about 4500 ft. farther in each of two directions.

Logging operations along the North Fork river this season have reached large proportions, and the cut is estimated at about 40,000,000 ft. The Pine Creek cut will add to this total, but work has been slack there. From 800 to 1000 men have been employed this winter. The lumber industry in the Coeur d'Alene is of great importance, yet many do not realize it.

Butte people, headed by W. H. Nichols, have taken an option on the Keating lead-silver claims at Wardner, and have organized the East Caledonia Mines Co. to develop the property. ——The Golden Curry has a shaft 416 ft. deep, equipped with a hoist, compressor, and other plant. The shaft is to be unwatered for a start.

MICHIGAN

Houghton County (The Copper Country)

Wages at the Centennial and Osceola mines have been raised to the rate prevailing on September 1, 1914. Other companies are said to be about to follow suit.

Two more companies, the Wolverine and Mohawk, have increased wages to the old scale. Miners using Leyner drills will get not less than $2.75 per shift, and other underground employees will receive a 5% advance. The Wolverine is producing 33,000 tons of 'rock' per month.

MISSOURI

Jasper County

The Texas Mining Co., three miles northwest of Joplin, will probably rebuild its mill which was destroyed by fire early in February. A new shaft has been sunk through hard limestone and a southerly drift was nearing the old workings where zinc ore had been encountered. The need of a new shaft was caused by poor ventilation.

The Fortune Teller Mining Co.'s plant of 150-ton capacity at Granby was destroyed by fire the latter part of January. The Company was working in an extensive body of blende and calamine. The plant will probably be rebuilt. Another mining plant that burned was that of the Weaver Mining Co., four miles north of Carl Junction, Missouri.

The Red Top Mining Co., at Webb City, operated by T. C. Coyne & Co., has opened rich lead ore, but is forced to timber its ground every inch of the way. A novel method of timbering is being tried, drill holes being sunk from the surface to the roof of the drift and iron rods being run through them. To the bottom of the rods are fixed the supporting timbers, while the rods are held securely on the surface by heavy beams.

MONTANA

Cascade County

Construction is to start at Great Falls on a 125 by 200 ft. furnace building, and a 25 by 300 ft. electrolytic refinery of steel, concrete, and brick, for the Anaconda company.

Granite County

A number of properties in this county are showing improvement, according to W. W. Williams, who recently visited Butte. At the Mandarin the shaft is down below 100 ft. on a silver-bearing vein. A gasoline hoist is used in this work. An electric motor will be put in later when the power-line is completed from Philipsburg.

Madison County

The mining camps of Bear gulch, Goodrich gulch, Rochester, and Silver Star have one or more mines shipping ore, and developments are considered encouraging for employment of more men and machinery. The crushing plant of the Florida Giant will soon be finished, and the 40-ton cyanide plant will be enlarged from 40 to 100-ton capacity in the spring. Numbers of lessees are meeting with fair results.

Silverbow County

An amended complaint was filed last week in the district court by the Western Federation of Miners and Charles H. Moyer, against Martin Scahill and other officers of Butte Miners' Union No. 1. The national organization wishes to assert temporary control over the local. It is claimed that charges have been preferred against the Butte officers by more than 10% of the membership. This, according to the constitution and by-laws, gives the national president the control.

A mine guard named T. Mondoe was shot and fatally wounded in a street in Butte by H. Robinson, a unionist and leader of the I. W. W., on February 12. It appears that an automobile containing four men drove up to where the victim was standing, and the accused shot him.

The second number of *The Anode*, published by the Anaconda company, contains notes on improvements at the reduction works by Frederick Laist, recent appointments and accidents in the Butte mines. A chart shows the accidents per 10,000 shifts worked during 1914, fatalities being 1.49%, serious 12.62%, and slight 85.89% of the total. Moving pictures have been taken of the surface and underground of the Tramway mine.

The Butte & Superior company has started excavating for extensions to the flotation plant of the mill. Rich ore is being opened at 1200 ft. In January the mill treated 36,840 tons of ore with 91.92% recovery. Concentrate produced was 11,730 tons assaying 53.76% zinc, containing a total of 12,612,000 lb. In this month of 1914 the figures were 33,520 tons, 91.76%, 11,124 tons, 51.61%, and 11,482,483 lb. zinc.

NEVADA

Esmeralda County

A new map, 39 by 52 in., of the Goldfield district has just been published by Lee W. Davis and E. A. Byler, surveyors, of Goldfield. It is complete in every respect, and shows all mining claims clearly.

Development in the Jumbo Extension continues satisfactory, and a daily shipment of one carload of $50 ore is being made.

White Pine County

The report of the Nevada Consolidated Copper Co. for the last quarter of 1914 gives the following information. The property is being worked at 50% capacity. Overburden stripped amounted to 245,969 cu. yd., and the mines produced 416,825 tons of ore, 98% coming from the pits at Copper Flat. The output of copper was 8,065,236 lb., compared with 11,258,421 lb. in the previous quarter. The profit and loss account shows a total profit of $370,847, and after paying a dividend of $749,-

796, there was a deficit for the term of $378,949. Undivided profits amount to $2,290,626. The total charges, save ore extinguishment, were 8.42c., while earnings were 11.504c. per pound of metal. Copper on hand and in transit at the end of the period was 22,378,133 lb., and metals are valued at $3,114,862. The year's output was 49,244,056 lb., against 64,972,829 in 1913.

NEW MEXICO

Grant County

The Chino Copper Co. reports as follows for the last quarter of 1914: The mill treated 347,200 tons of ore averaging 1.862% copper, with 69.14% recovery. Concentrate smelted yielded 8,935,585 lb., compared with 11,491,120 lb. in the third quarter. The outputs for 1914 were 1,907,300 tons of ore and 56,841,977 lb. of metal, against 53,170,145 lb. in 1913. The net cost of production was 7.71c., against 7.37c. per pound in the previous term. The net profit was $285,933, about half of the September quarter.

OKLAHOMA

In *Bulletin* 22 (142 pages) of the State Geological Survey is the director's biennial report, and mineral resources of the state and statistics of production from 1901 to 1914. All subjects connected with the mining industry of the state are discussed. The output of all mineral products in 1913 was valued at $80,031,630, against $4,907,543 in 1902. Of the 1913 production, oil contributed $59,581,948; natural gas, $7,436,389; coal, $8,542,748; and zinc, $1,306,368.

OREGON

Jackson County

(Special Correspondence.)—At the Braden mine at Gold Hill a motor-driven sawmill has been erected, resulting in lower charges for lumber, which is cut on the property.——The Beaver Portland Cement Co.'s quarries are being arranged for a large output this year. A great deal of the cement used in the southern Oregon highways was made in this Company's plant.——The placer mining season at Gold Hill has been satisfactory to date. The old Sterling mine is still producing gold. More prospecting has been done in the Trail creek, Jump-off-Joe, and Elkhorn districts this season than for many years. The area is rather remote from transport, but gold, copper, cinnabar, and asbestos deposits have been found. A motor-driven mill and concentrating plant have been erected at the Nellie Wright mine near Gold Hill. The mine is opened to 150 ft.——The Lucky Bait continues to make regular gold returns. The mill is on Sardine creek.

Gold Hill, February 6.

SOUTH DAKOTA

Lawrence County

The Hidden Treasure shaft, in Deadwood gulch, is 275 ft. deep in mineralized formation. Jackhamer drills are being used.——The Echo company is also sinking, and an electric pump is being installed.

UTAH

The itinerary of U. S. Bureau of Mines rescue-car No. 2 is as follows: Bingham, January 27 to February 11; Murray, 12th to 18th; Tooele, 19th to 26th; and Park City, 27th to March 14.

Juab County

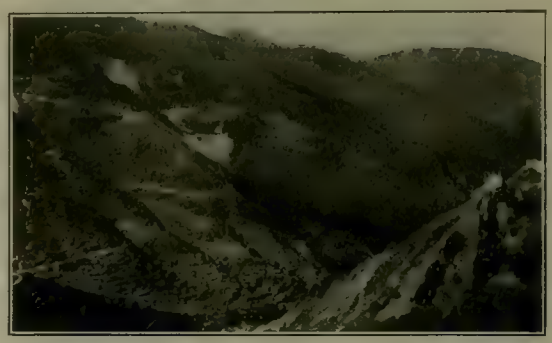
The heaviest snowstorm for many years visited Tintic on February 10. Power and telephone lines were blown over. Ore shipments were considerably reduced, the week's total being only 79 cars.——Owing to the price of spelter, buyers of zinc ore have announced that they will accept ore containing 24% and up. This will be good news for the East Tintic Development, Gemini, Lower Mammoth, May Day, and Yankee mines.

The Chief Consolidated Mining Co.'s report for 1914, Walter Fitch, manager, and Cecil Fitch, superintendent, contains the following: Development totaled 7054 ft. This included a cross-cut at 800 ft. connecting the workings at 1000 ft. with the shaft. Ore will soon be mined from the 800-ft. level. Some zinc ore occurs at 900 and between 1000 and 1200 ft. At 1600 ft., good silver-lead-gold ore was developed. A drift is under way at 1800 ft., and will connect with the ore at 1700 ft. in a few months. Diamond drilling was done to prove certain ground, and showed great economy over driving drifts. Poor metal prices reduced profits considerably. From 39,629 tons of ore there was a net profit of $76,522. Eleven blocks of zinc ground in the May Day has been leased to 22 miners.——The Gemini will resume work during the month. ——Rich lead-silver ore has been opened at 1700 ft. in the Eagle & Blue Bell.——The new 100-ton mill of the Utah Minerals Concentrating Co. will soon be started. A large supply of ore has been arranged for.

Salt Lake County

The report of the Utah Copper Co. for the last quarter of 1914 contains the following data: Stripping removed amounted to 955,675 cu. yd. The Magna mill treated 1,035,303 tons of ore averaging 1.5062% copper, with 64.86% extraction. This recovery was 3.27% lower than the previous term, due to some carbonate getting mixed with the sulphide ore. It is impossible to keep the two ores separate. The yield of metal was 20,229,012 lb., compared with 28,686,672 lb. in the September quarter. With certain credits the net cost of production was 6.688c. per pound. The net profit was $673,590, about half the previous amount, and with the Nevada Consolidated dividend and sundry income, the amount available was $1,076,073. A dividend of $1,218,367 left a deficit of $142,293. Copper on hand amounted to 40,546,627 lb. The year's output was 121,779,401 lb., compared with 119,939,809 lb. in 1913.

The Alta Consolidated, in the Alta district, has a good tonnage of ore awaiting shipment, but weather conditions



HIGHLAND BOY MINE, BINGHAM CANYON, UTAH.

have interfered with work.——In the Columbus Extension, miners have driven along a quartzite and limestone contact 20 ft. beyond where the vein was first cut. The ore is 5 ft. wide. An air pipe for ventilation is being installed. This is to be 4000 ft. long, and will have an exhaust fan on the end. Ore shipments will commence in a week or two.

Summit County

Suit has been started against the Silver King Consolidated Mining Co. and its president, Solon Spiro, for stock worth $8500 and participation in dividends amounting to $64,963, by James D. Murdoch. The plaintiff alleges fraud was practised on shareholders in the Company when it was reorganized under the laws of Utah, previously being incorporated in Wyoming. The case is involved, and many other points are the subject of dispute.

WASHINGTON

Stevens County

At Chewelah, the United Copper Co. has diamond drills at work. Above 1000 ft. there is estimated to be 395,000 tons of ore. The mill is being increased to 200-ton capacity per day. Oil is needed to start the flotation process.

The Security Copper Co., which has a large area of ground two miles south of the United Copper at Chewelah, held its meeting at Spokane recently. L. K. Armstrong is manager. Six parallel veins of good width have been opened. It is proposed to purchase a hoist and air-compressor, and sink to 500 ft.——Copper claims in the Loon Lake district, about 10 miles south of the United Copper, which have been idle for about 18 years, are to be reopened in the spring. They are owned by J. C. Haas and H. H. Shallenberger, of Spokane, and C. E. Agnew, of Sharpsville, Pennsylvania. Previous shipments to Tacoma returned 25 to 30% copper. — Some high-grade silver ore has been cut in the Double Eagle mine in the Chewelah area.

CANADA

British Columbia

Diamond drilling has proved a large tonnage of ore at Princess, and the British Columbia Copper Co. has decided to erect a concentrator there. A railway is to be constructed from Princeton to Princess and Voigt.——Development is to be resumed at Voigt, and New York interests will erect a smelter.

Ontario

During January the Nipissing high and low-grade mills treated 166 and 6291 tons of ore, respectively. The refinery shipped 709,174 oz. of refined silver, part of which was from custom ore. At vein 64 the winze below 900 ft. is down 101 ft., where the vein is from 1 to 8 in. wide, of low value. Work at shaft 73 was very encouraging.

The third annual meeting of the Dome Lake Mining & Milling Co. was held at New Liskeard on February 8. The main shaft is down 400 ft., and a great deal of work was done at 180 and 300 ft. The mill started in October, and to the end of 1914 yielded bullion worth $8850 and concentrate valued at $1566. The January output was $11,000. A. H. Brown is manager.

KOREA

The Oriental Consolidated mills and cyanide plants treated 28,688 tons of ore in December, yielding $148,216. On the 23rd the Maibong mill was destroyed by fire which started in the adjoining auxiliary electric power plant. The Kuk San Dong 40-stamp mill will be re-erected in its place. The January clean-up was $135,485.

MEXICO

Hidalgo

The length of the new shoot on No. 16 level of the Santa Gertrudis is 85 ft. This will average 7 ft. wide, and $4 gold and 45 oz. silver per ton. The mill is now treating 600 tons per day, cyanide supplies coming to hand. There is no trouble in the district.

Sonora

In spite of a shortage of food at Nacozari, the Moctezuma Copper Co. has resumed operations. There is enough fuel on hand for a month or so. General Calles will not allow food to go south, but has consented to the burned bridges being cribbed up between Nacozari and Douglas, only for the passenger automobile.

PHILIPPINE ISLANDS

The Philippine Dredges, Ltd., had the following output during the half-year ended October 31, 1914: No. 1 boat, 117,767; No. 2, 141,195; and No. 3, 344,758, a total of 603,720 cu. yd. of gravel with 5580 oz. gold, equal to 9.5c. per yard.

PERSONAL

J. E. Spurr was in San Francisco.

Arthur W. Jenks has gone to Bakersfield.

Charles Janin has returned from the East.

W. H. Ganst has returned to San Francisco.

Fred Searles was down from Goldfield, Tuesday.

C. H. Munro is leaving for Columbia, South America.

J. W. Finch passed through San Francisco on his way to Butte.

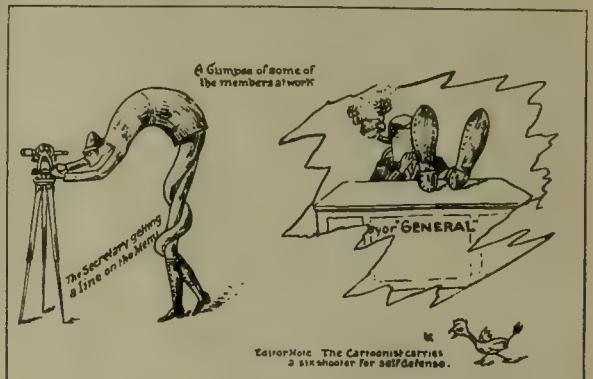
C. Willard Hayes is now at Washington, D. C., and is improving in health.

C. W. Purington was in New York last week and has returned to London.

R. M. Catlin laid the cornerstone of the new vocational school at Franklin Furnace, New Jersey, lately.

Arthur H. Adams has resigned his position as cyanide superintendent for the Easton-Pacific Co. and hereafter his address will be 975 E. 4th street, Long Beach, California.

The Alaska Mining and Engineering Society of Juneau, Alaska, was organized recently, and seems to be one which may do a great amount of good in this district, and give the numerous local engineers an opportunity to meet and discuss the problems of this low-grade area. While it is non-political, the Society should exercise a strong influence on the Territorial Legislature in its deliberations on mining and engineering problems. A banquet was held on January 30, and evidence of the brotherly spirit prevailing is shown in the accompanying cartoon. The speakers' initials are correct, but we cannot vouch for the Christian names.


A Glimpse of some of the members at work
The Secretary taking a line on the Menu
Pyor GENERAL
Editor Note. The Cartoonist carries a six shooter for self defense.

SPEAKER	SUBJECT
BULLION LAND **THANE**	The possibilities of Alaska's mineral treasure
PAY ROCK **BRADLEY**	Low grade mining
DIDACTIC DISCOURSER **MUIR**	The comparative effects of water and other liquors and solids in developing energy
ANGULAR **MACKAY**	New mills and old
GOOD TIMES **JACKSON**	Stoping of large orebodies
EARLY VANNER **DAVELER**	Metallurgy
WATER POWER **LASS**	Hydro electric development
CHRISTIAN ENDEAVORER **BRUFF**	Condensed conceptions concerning concrete construction is it all con ?
BILATERAL DECLIVITY **STEWART**	Troubles of a Mineral Surveyor
ENLIGHTENER **TASCHEK**	Photo Lithography
HIS LORDSHIP **WOLLENBERG**	Salmon Creek dam
F BELEMNITE **HYDER**	Local Geology
ACETYLENE NEXT **NADEAU**	"How doth the little Diesel do"

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, February 17.

Antimony	20 —20¾
Electrolytic copper	15½ 15¾
Pig lead	4.10— 5.05
Quicksilver (flask)	$62.50
Spelter	9 — 9¼
Tin	38 39½
Zinc-dust, 100-kg. zinc-lined cases	11½—15

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, February 17.—Copper is firm, and lead and spelter are strong, spot metal being scarce. The Calumet & Hecla company will pay $5 per share on March 18, this being the first dividend in nine months.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.		Average week ending	
Feb. 11	48.37	Jan. 6	48.65
" 12 Holiday		" 13	48.98
" 13	48.25	" 20	48.98
" 14 Sunday		" 27	48.77
" 15	48.50	Feb. 3	48.52
" 16	48.37	" 10	48.20
" 17	48.62	" 17	48.42

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	....
Feb.	57.53	....	Aug.	54.35	....
Mch.	58.01	....	Sept.	53.75	....
Apr.	58.52	....	Oct.	51.12	....
May	58.21	....	Nov.	49.12	....
June	56.43	....	Dec.	49.27	....

A shipment of 150,000 oz. of silver went to the Orient from San Francisco on February 13. Exports of metal from London to the East to the end of January were worth £549,000 (1,100,000 oz.), compared with £446,000 (900,000 oz.) in the corresponding period of 1914.

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
Feb. 11	7.75	Jan. 6	5.50
" 12 Holiday		" 13	5.85
" 13	8.00	" 20	6.13
" 14 Sunday		" 27	6.88
" 15	8.25	Feb. 3	7.58
" 16	8.50	" 10	7.75
" 17	8.75	" 17	8.24

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	5.22	....	Aug.	4.45	....
Mch.	5.12	....	Sept.	5.16	....
Apr.	4.98	....	Oct.	4.75	....
May	4.91	....	Nov.	5.01	....
June	4.84	....	Dec.	5.40	....

On February 11 the highest price ever paid for zinc ore was reached at Joplin, Missouri, when one concern bought at $73 per ton. Buyers are active, and the market is from $1 to $2 stronger on all grades than in the previous week.

So much spelter is being sold for export that everyone is now beginning to study the figures, which showed that in the week ended January 16, France took 2,344,366 lb.; England, 5,147,503 lb.; Russia, 1,608,417 lb.; and miscellaneous, 369,831 lb., a total of 9,470,117 lb. The demand for spelter free from lead and iron, such as is required in making brass for cartridge cases, continues so strong that the New Jersey Zinc Co., which has an established reputation for spelter of this quality, is said to be receiving 16c. per pound for its Horsehead brand. The high price of spelter makes good business for the companies which sell the product of their own ores, but makes the custom smelters nervous, since they fear that the high price of the metal will only prevail long enough to fill their bins with ore settled for at the high price, but the product of this may have to be sold at the usual figure. The market statisticians at once set to work to figure out how much profit the Butte & Superior is making at the present price level, and the president of the Company has stated that the smelting contract provides for a smelting charge of $14 per ton on 50% concentrate when spelter is at 5c., with a $1.40 per ton increase for each cent of increase in the price of spelter. Thus with spelter at 8c. the Company pays a smelting charge of $18.20 per ton and makes a profit of $19, not including the silver content

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Feb. 11	14 25	Jan. 6	12.92
" 12 Holiday		" 13	13.30
" 13	14.25	" 20	13.53
" 14 Sunday		" 27	14.00
" 15	14.25	Feb. 3	14.50
" 16	14.38	" 10	14.29
" 17	14.38	" 17	14.30

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	....
Feb.	14.46	....	Aug.	12.34	....
Mch.	14.11	....	Sept.	12.02	....
Apr.	14.19	....	Oct.	11.10	....
May	13.97	....	Nov.	11.75	....
June	13.60	....	Dec.	12.75	....

Exports of copper during the week ended February 6 totaled 9,714,979 lb., worth $1,371,127. Of this, 4,311,732 lb. went to England, 1,613,099 lb. to Sweden, 1,526,627 lb. to Italy, 1,064,471 lb. to Scotland, and 560,188 lb. to France. The market continued firm last week despite the general report of increased output. There was not much large buying at the end of the week, but sellers seemed to expect a further slight advance in price. Operations are reported to be about to re-start at Cananea, Mexico.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Feb. 11	3.85	Jan. 6	3.80
" 12 Holiday		" 13	3.70
" 13	3.85	" 20	3.70
" 14 Sunday		" 27	3.70
" 15	3.85	Feb. 3	3.80
" 16	3.85	" 10	3.80
" 17	3.85	" 17	3.85

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	....
Feb.	4.02	....	Aug.	3.86	....
Mch.	3.94	....	Sept.	3.82	....
Apr.	3.86	....	Oct.	3.60	....
May	3.90	....	Nov.	3.68	....
June	3.90	....	Dec.	3.80	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Jan. 21	52.50	Feb. 4	55.00
" 28	52.50	" 11	60.00
		" 18	62.50

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	....	Aug.	80.00	....
Mar.	39.00	....	Sept.	76.25	....
Apr.	38.90	....	Oct.	53.00	....
May	39.00	....	Nov.	55.00	....
June	38.60	....	Dec.	53.10	....

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	....
Feb.	39.76	....	Aug.	50.20	....
Mch.	38.10	....	Sept.	33.10	....
Apr.	36.10	....	Oct.	30.40	....
May	33.29	....	Nov.	33.51	....
June	30.72	....	Dec.	33.60	....

ANTIMONY

A Chinese mining and smelting company has opened an office in New York for the sale of this metal in the United States. Imports in 1914 totaled 14,263,629 lb., worth $696,362, of which 4,300,892 lb., valued at $190,737, was from China.

BOOK REVIEWS

MINING COSTS OF THE WORLD. By E. N. Skinner and H. R. Plate. McGraw-Hill Book Co., New York, 1914. P. 400. Maps, index. Sold by the *Mining Press*, San Francisco. Price, $5.

This convenient handbook is a compilation of official data as to operating costs, capitalization, profits, and other statistics necessary to an appraisal of the value of the properties of the principal mining companies of the world. The compilers have made it more useful by calculating costs not given, and by the supplying of much additional information, as the situation of the properties, character and size of deposits, methods of working, depth of mines, water to be pumped, and general operating conditions. The mines are given alphabetically under countries and states, while an index aids in finding any desired property. Well executed maps of the principal mining districts of the world also aid in making clear the relative situation of the mines. The data given are the latest available for each property, some being as recent as the first half of 1914. It is the intention of the compilers to revise the volume from time to time, bring the data up to date, and supply new material as it becomes available. The drawbacks of the book are chiefly unavoidable; from those companies which do not give out data they naturally cannot be obtained, and for those companies which keep their accounts in such form that little useful information can be obtained from them, it is difficult to supply figures, though the compilers have added much from sources of private information with the co-operation of well known engineers. Thus, for example, operating costs given out by most of the South African companies are decidedly misleading, since they only include a part of the expenses properly chargeable to operation, the dividends declared in a year averaging about 30% less than the operating profit shown in the accounts. The form of the book forbids any exhibition of literary skill, but grammatical errors, as "layed" for laid, "Sidney" for Sydney, verbs without a subject, and such 'shirt-sleeve geology' as "ribs of lime occur in the orebodies" should be amended in subsequent editions. The book is durably bound in morocco, of convenient pocket size, and should prove a highly useful manual of reference to mining engineers in all countries.

NORTHERN PATAGONIA. By Bailey Willis, Vol. I, text. P. 464. Ill. Vol. II, maps. Scribner Press, New York, 1914. For sale by the *Mining Press*, San Francisco. Price, $8. Vol. II sold separately at $2.

Patagonia is a *terra incognita* to most people, and for many years its sovereignty was in dispute, being claimed by both Argentina and Chile. In 1902 the title was confirmed to Argentina by arbitration, and the authorities of that progressive country at once set about the intelligent development of its new territory. Argentina, if superimposed on the North American continent, would extend from Tampico, Mexico, to Hudson bay, and from El Paso to New Orleans, exhibiting a corresponding range of climate, topography, and general conditions. Patagonia roughly corresponds to the area between Denver and the Missouri river, prolonged to an apex near Hudson bay. Mountainous on the west, the eastern portion consists largely of arid or semi-arid plateaus and plains extending to near the sea coast. The Ministry of Public Works of Argentina in attempting to foster the development of this area wisely decided to avail itself of the experience gained in similar areas in the United States, and a Comisión de Estudios Hidrológicos was organized under the supervision of Bailey Willis, formerly of the United States Geological Survey, to carry on topographic, geologic, and economic surveys of the territory. The Comision was organized in 1911, and at first devoted its attention to the discovery, if possible, of an underground water supply in the area tributary to the eastern end of the railway then under construction from Puerto San Antonio on the Atlantic to Lago Nahuel Huapi, in the Andes, corresponding roughly to a line from Kansas City to Leadville. No sufficient supply of underground water could be obtained, but it was found feasible to conduct the flow of the Orroyo Volcheta in a canal some 60 miles along the railway line to the port. It was next necessary to determine whether it was practicable to cross the Andes with the proposed line. Work in the autumn of 1911 showed this to be the case, as well as demonstrating the resources of the Pampas and the Andes which, when developed, will be tributary to the railway. A survey was then undertaken along the entire railway line from the Atlantic to the Andes between latitudes 39° 40' and 43° 40', an area of about 12,000 square miles. The personnel at first was: Bailey Willis (geologist, U. S. Geological Survey), director; Emilio E. Frey (Argentina), assistant director and topographer; C. L. Nelson and W. B. Lewis (U. S. Geological Survey), topographer; J. R. Pemberton (Stanford University) and C. W. Washburn (U. S. Geological Survey), geologists; W. D. Jones (University of Chicago), economic geographer; Otto Luginbuehl, Walter Graenacher and Walter Eschmann (Switzerland), assistant topographers; in the course of the work Messrs. Eschmann and Graenacher resigned. J. S. Mercer (Chicago) and Otto Schneider (New Zealand) were appointed assistant topographers. D. L. Raeburn, civil engineer, and J. G. Morgan, assistant engineer, were added to the corps in 1912-13 to survey a railway location. Ricardo Dowall (Argentina), R. M. Rodriguez (Argentina) and R. M. Hatch (University of Wisconsin) served successively as secretaries in charge of administration and accounts.

As a result of the work of the commission excellent maps have been prepared and the topographic features, agricultural resources, grazing industry, forest and water resources of the area learned, all of which is interestingly set forth in this volume. The area proved to be ill adapted to the making of a geological section, which perhaps explains why no mention is made of mineral resources. An appendix gives the records of meteorological observations in the Andes and a report on numerous samples of wood collected. The book is an excellent example of modern bookmaking art and is illustrated with beautiful photogravures, and numerous maps both in the text and as inserts. It is a valuable contribution to a better and more exact knowledge of South America, especially of an area which has great future possibilities.

RECENT PUBLICATIONS

Bulletin of the Geological Society of America. Vol. 25, No. 4. December, 1914. Joseph Stanley-Brown, editor. P. 367. Ill., index. Washington, D. C.

BASE MAP OF MISSOURI. Scale, 1:500,000. 42 by 47 in. Missouri Bureau of Geology and Mines. Compiled in co-operation with the U. S. Geological Survey. Rolla, 1914.

MINERALS OF PENNSYLVANIA. By Amos P. Brown and Frederick Ehrenfeld. Report No. 9. P. 160. Ill., maps, index. Topographic and Geologic Survey of Pennsylvania. Harrisburg, 1913.

GYPSUM IN CANADA. By L. H. Cole. P. 256. Ill., maps, index. Department of Mines, Ottawa, 1913. This is an excellent treatise on the subject, and the illustrations show great care in reproduction. The work covers the origin of gypsum, its associated minerals, production (549,856 tons from Cana-

dian mines in 1912), occurrences in Canada, technology, and includes a bibliography.

Some Measuring Devices Used in the Delivery of Irrigation Water. By California agents of irrigation investigations. *Bulletin* 247. P. 68. Ill., chart. University of California, Berkeley, 1915.

The United States of Europe, and The Preparedness of America. By Nicholas Murray Butler of Columbia University. Reprints from *The New York Times* of October 18 and December 10, 1914, respectively. P. 17 and 18.

Report of Conference on the Mine Workers' Relief Fund. P. S. Chamber of Mines, Kalgoorlie, Western Australia, 1914. Editorial mention of the efforts in that state to relieve miners incapacitated by lung troubles was made in the *Press* of February 6.

First Biennial Report of the Department of Labor of Montana, 1913-1914. W. J. Swindlehurst, commissioner, and W. B. Orem, quartz mine inspector. P. 350. Index. Helena, Montana, 1914. An abstract of this report was published in the *Press* of February 6.

The Journal of Geography. November and December issues. Vol. XIII. Ray Hughes Whitbeck, editor, and Lawrence Martin, associate editor. P. 32. Illustrated. University of Wisconsin, Madison, 1914. This monthly contains a lot of interesting general geographical matter.

Metal Statistics, 1915. By C. S. J. French and B. E. V. Luty, editors of *The American Metal Market* and *Daily Iron and Steel Report*. P. 344. Index. The American Metal Market Co., 81 Fulton street, New York. This is the eighth annual edition of a valuable compilation of metal statistics, covering production, prices, exports, and consumption, and is published in a handy pocket form.

The Mining Congress Journal. P. 64. Illustrated. American Mining Congress, Munsey building, Washington, D. C. January, 1915. "As a means through which to further its work looking to safety, efficiency, and conservation, the American Mining Congress presents to you the first issue of *The Mining Congress Journal*," is the opening sentence on the first page of this new publication. The aims of the Congress are well known among mining men, and this initial issue of its 'mouthpiece' covers many subjects of interest.

Coal Mining Practice in District III, Illinois. By S. O. Andros. *Bulletin* 9. P. 30. Illustrated. University of Illinois, Urbana, 1915. The average room-and-pillar mine in Illinois extracts only about 50% of the coal in the bed. Improper dimensions of workings and fear of squeezes or surface subsidence prevent pillar drawing in most mines. In District III, however, two mines working on the room-and-pillar system obtain an extraction of coal almost equal to that obtained by long-wall mining. This district produces 512,178 tons of coal per year.

Official Year-Book of the Commonwealth of Australia. Statistics for period 1901-1913. Compiled by G. H. Knibbs. No. 7. P. 1098. Ill., maps, index. Commonwealth Bureau of Census and Statistics, Melbourne, Victoria, 1914. This interesting and valuable annual gives details of every phase of life and industry of the 5,000,000 people living in Australia and Tasmania. The total production of all industries in 1912 was equal to $213.64 per inhabitant; and the foreign trade per head is only beaten by Belgium, New Zealand, and Switzerland, and is nearly four times that of the United States on this basis.

Department of Mines, Mines Branch, Ottawa, Canada, 1914:

Mineral Production of Canada in 1913. General summary. Compiled by John McLeish. No. 319. P. 50.

Production of Copper, Gold, Lead, Nickel, Silver, Zinc, and other Metals in Canada in 1913. By Cosmo T. Cartwright. No. 317. P. 77.

Building and Ornamental Stones of Canada. Vol. III. Province of Quebec. By Wm. A. Parks. No. 279. P. 326. Ill., maps, index. Limestone of structural quality, granite, marble, and slate are produced to the value of $1,983,884 in this province. The stones and operation of the quarries is described.

Oklahoma Geological Survey publications, Norman, 1914:

Volcanic Dust in Oklahoma. By Frank Buttram. *Bulletin* 13. P. 49. Illustrated.

The Cushing Oil and Gas Field, Oklahoma. By Frank Buttram. *Bulletin* 18. P. 108. Maps. The daily output of this state exceeds 300,000 bbl. There is 11,000,000 bbl. of oil in storage about this field.

The Neva Limestone in Northern Oklahoma, with remarks on the correlation of the vertebrate fossil beds of the state. By J. W. Beede. *Bulletin* 21. P. 37. Ill., map.

Director of the State Geological Survey Biennial Report to the Governor of Oklahoma, 1914. Part I. Mineral resources of Oklahoma and statistics of production. Part II. By C. W. Shannon. *Bulletin* 22. P. 142. Illustrated. Further mention of this work will be made in another issue of the *Press*.

U. S. Geological Survey publications, Washington, D. C., 1914:

Thirty-fifth Annual Report of the Director (George Otis Smith) of the U. S. Geological Survey to the Secretary of the Interior for the fiscal year ended June 30, 1914. P. 163. Maps, index. Appropriations for the year under review totaled $1,517,920. Geologic investigations were conducted in 47, topographic surveys in 35, and stream measurements in 39 states and territories. The land classification work included reports on 45,000,000 acres. In connection with statistics of mineral production, the Survey co-operates with 16 states and corresponds with 90,000 producers. The work of the department is reflected chiefly in publication and distribution of reports and maps. The total of all books, folios, and maps received was 1,428,441, and of distributed 1,105,711, a large increase. Geologists of all grades employed totaled 146. Mail of all kinds received totaled 255,502 pieces.

Results of Spirit Leveling in Michigan. Work done in co-operation with the state of Michigan. *Bulletin* 559. P. 59. Ill., index.

Salines in the Owens, Searles, and Panamint Basins, Southeastern California. By Hoyt S. Gale. *Bulletin* 580-L. P. 73. Ill., map. This is a corrected report of the same bulletin already acknowledged in this journal.

Reconnaissance of the Geology and Oil Prospects of Northwestern Oregon. By Chester W. Washburne. *Bulletin* 590. P. 111. Map, index.

Water-Supply papers:

Surface Water Supply of the United States, 1912. Part X. 'The Great Basin.' By F. F. Henshaw, E. A. Porter, and G. C. Stevens. No. 330. P. 275. Ill., chart, index.

Geology and Underground Waters of the Southeastern Part of the Texas Coastal Plain. By Alexander Deussen. No. 335. P. 365. Ill., chart, maps, index.

Water Resources of Butte, Montana. By O. E. Meinzer. No. 345-G. P. 47. Ill., maps. This report was covered in the *Press* of February 13 under the head of Montana news.

Profile Surveys in Hood and Sandy River Basins, Oregon. Prepared under direction of R. B. Marshall. No. 348. P. 6 and 8 maps.

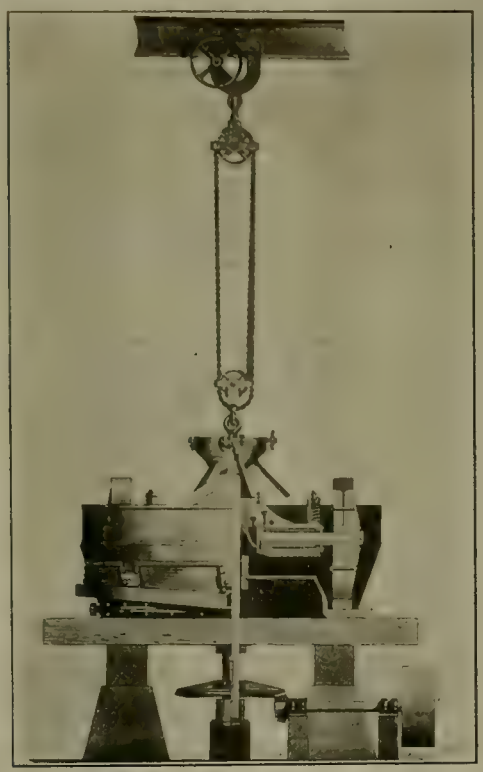
Profile Surveys of Snoqualmie, Sultan, and Skykomish Rivers, Washington. Prepared under direction of R. B. Marshall. P. 7 and 12 maps.

New Machines and Devices

The Mill That is Different

The above is the phrase used by the makers to describe the Sears 'Acme' mill, which is made for the Sears-Smith Engineering Co., of Oroville, by the Stockton Iron Works.

The Sears mill was designed by an experienced millman and practical amalgamator. This machine consists of a rolled-steel die and four crushing wheels equipped with rolled-steel tires. The axles are forged steel, keyed fast in the wheels and revolving in boxes which are secured in the hollow arms of the spider. These arms are open at the top to facilitate the removal of the boxes and also to permit the wheels to rise individually, preventing any undue strain on the central shaft.



SECTION OF AN ACME MILL, ALSO SHOWING CRUSHING APPARATUS LIFTED OUT FOR CLEANING.

The weight of the spider is supported on the wheels, thus increasing the crushing weight. The pan is cast in one piece with launder which extends half-way round, thus preventing the launder loading up with sand at the back of the mill and running over, as is the case with many styles of Chilean mills. The manufacturers recommend the Hamill ore-feeder as suitable for this mill. The feed hopper on the top of the spider is fitted with four feed pipes to convey the feed (both water and ore) directly to the die between the wheels. The hopper is also provided with means for operating the feeder arm which is entirely automatic and self-regulating. The mill may be run slowly and an overflow discharge used, dispensing with screens, but these are furnished with the machine. Dies last from 4000 to 6000, and tires from 6000 to 8000 hours. The following are details of the mills made. 3-ft., sectional for mule transport, when ordered, this and the ordinary having a crushing weight of 3500 lb., absorbing 3 to 5 hp., and crushing 5 to 20 tons to 30 mesh per 24 hours, and 6-ft., crushing weight 10,000 lb., 7 to 15 hp., and 20 to 60 tons per day. Special claims for this mill are good amalgamation and easy clean-ups, no trouble in starting with full load, automatic feed, wide range of adjustment, accessibility, and low cost of operation. An 'Acme' mill can be added to a stamp-mill to further reduce the ore. The Sears-Smith Engineering Co. has just issued its illustrated catalogue describing the new machine.

Improvements in Water-Wheel Generators and Mine Locomotives

Conspicuous among the improvements in the water-wheel type generator class of apparatus, is the suspension thrust-bearing designed for vertical shaft type sets, the bracket of which is rigidly supported by the generator stator, with the bearing carrying the entire weight imposed by the rotor, water-wheel, and water thrust. Among the larger machines for which these thrust bearings have been provided by the General Electric Co. may be mentioned: two 11,170-kva., 6600-volt, 60-cycle sets, operating at 180 r.p.m.; three 9000-kva., 12,000-volt, 40-cycle sets, operating at 185 r.p.m.; and four 10,000-kva., 6600-volt, 60-cycle sets, operating at 200 r.p.m. All of these generator sets are tested to withstand double normal speed, and the thrust bearings of the four groups referred to sustain respectively aggregate weights per unit of 75, 77, 100, and 175 tons. An indication of a recent tendency in hydro-electric development, brought about primarily through the improved efficiency in water-wheels, is the use of generators of relatively small capacity and low speed, which has rendered it possible to utilize effectively numerous low-head water-powers that heretofore could not be economically de-

5200-KW., 250-VOLT DIRECT-CURRENT GENERATOR FOR WATER-WHEEL DRIVE.

veloped. Several machines of this type have been constructed by the General Electric Co. during the past year.

All of the mine locomotives manufactured by the Company in 1914 were provided with commutating pole motors and ball bearings as standard equipment, and the operating records of those placed in service during the year show that these improvements have reduced the number of interruptions to

6250-KVA. WATER-WHEEL DRIVEN GENERATOR, SHOWING CONSTRUCTION OF SUSPENSION THRUST-BEARING BRACKET.

service and have resulted in decreased maintenance costs. The increasing output of many mines has rendered it necessary to equip with locomotives of relatively large capacity, capable of handling heavy trips over steep grades and for long hauls. For this class of service there have been built a number of 3-motor 15 and 20-ton locomotives. There has been a definite increased demand for the storage battery type of locomotive for gathering work, as it has been demonstrated that in this service each locomotive will effectively displace at least two or three mules. Heavy units are not, as a rule, required, and the locomotives of this class so far provided have been rated at from 3 to 7 tons. Most of these are of the straight storage battery type; but a limited number have, in addition, been equipped so that they can operate from a trolley wire when in the main headings of a mine. The advantages of this arrangement are obvious in that by means

COMBINATION STORAGE BATTERY AND TROLLEY MINE LOCOMOTIVE. PLATFORM REMOVED TO SHOW INTERNAL ARRANGEMENT.

of a small self-contained motor-generator set, the battery may be automatically charged while the locomotive is running on the trolley. When the locomotive is working in the rooms gathering the cars, a varying percentage of the battery charge will be consumed; but as soon as the locomotive is again operated on the trolley, these losses are automatically compensated for. With this dual system of operation, the battery need never be entirely discharged; and if space limitations are severe, it permits the use of a smaller battery than would otherwise be necessary.

An interesting discussion of the work of electric locomotives in mines is published in the February *Transactions* of the A. I. M. E., by J. W. Gwinn, of Kellogg, Idaho.

Commercial Paragraphs

The HOLT MANUFACTURING CO., of Stockton, California, *Caterpillar Times* for January described the work of a 'Cat' in hauling wood at Fairbanks, Alaska, the temperature being 40° below zero. Also some notes from Australia and Europe on the value of this machine.

The C. O. BARTLETT & SNOW CO., Cleveland, Ohio, has issued *Bulletin* 43, describing the 'Cobasco' system of handling material by means of skip hoists. Using an electrically-driven machine the apparatus is quite automatic in action, and unloading, crushing, and elevating is done at as low as 1.5c. per ton of coal. The hoist stands on one base and is very compact.

The GENERAL CEMENT-GUN CO., 914 South Michigan avenue, Chicago, sends a reprint from the *Journal* (March 1914) of the Western Society of Engineers, of a paper, 'The Cement-Gun and Its Work,' by Carl Weber, the construction manager of the firm. It covers 44 pages, with illustrations, and explains the use of this apparatus, in varied construction, and results.

The MINE & SMELTER SUPPLY CO., of Denver, describes the 'Massco' oil-burning assay furnace in a pamphlet. The walls are very refractory, and are enclosed between heavy iron plates. A hood carries fume from the room. The muffle is well supported and protected from the direct action of the flame. The burner tuyere makes less noise than usual; and three types of oil burners are supplied. Five sizes of furnaces are made.

A. LESCHEN & SONS ROPE CO.'s *Leschen's Hercules* for February contains short descriptions of the following construction in which its rope and gear is used. The Houston ship canal, connecting Houston, Texas, with the Gulf of Mexico; setting steel for bridge over Grand river, Michigan; Kansas City Twelfth Street trafficway; and placing statuary on the Grand Central terminal station, New York.

The WESTERN ELECTRIC CO. has distributed a short note entitled 'The Transcontinental Voice Highway.' This deals with the feat of telephoning from New York to San Francisco, 3400 miles apart, on January 25, 1915. This line consists of four copper wires of No. 8 B. W. G. gage, weighing a total of 5,920,000 lb., strung on 130,000 poles. All of this material was supplied by the Western Electric Co., as well as the telephone apparatus.

The BUCYRUS CO., of South Milwaukee, Wisconsin, states that it has received another order for a dipper dredge for Panama, similar, only larger, to those described on this page of last issue. The Fushun Collieries in Manchuria, China, also ordered two 60-C and one 150-B steam-shovels and a class 24 drag-line, the value of the machinery being about $425,000. Some results are given in the notes of the operations of a 225-B revolving shovel at Mulberry, Kansas, and a 14-B at Richmond, Virginia.

The CHAIN BELT CO., of Milwaukee, Wisconsin, has issued its general catalogue No. 56. It consists of 303 pages with an index, and is profusely illustrated with pictures of the varied machines manufactured by this Company. The text deals with elevating and conveying machinery, chain belt, sprocket wheels, transmission machinery, etc., for sawmills, cement mills, canning plants, power plants, sand and gravel plants, potteries, fertilizer plants, and practically every line of industry. Two chain belts particularly features are 'Griplock' (malleable), and 'Chabelco' (all-steel). These chain belts are very suitable for many drives in mining properties. A lot of useful information is given on gearing, shafting, and bearings.

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SAN FRANCISCO, FEBRUARY 27, 1915

Contents—Page 2
Buyers Directory—Page 28
Advertisers Index—Last Page

PLATINUM is one of the metals that the world rates high in value. Roughly it is twice as precious as gold. At times it brings even higher prices. It is an extremely useful metal, being essential to many chemical and industrial processes, so that its high rating is not due merely to the natural human desire to display as ornaments that which is scarce. Russia has almost a monopoly of platinum, yielding 300,000 of the 315,000 ounces annually produced. The metal is found in placers and for years has been mined by the simplest methods. Now dredges, similar to those used in gold mining, are being introduced, and in this issue Mr. R. S. Botsford tells the story of the erection of the modern, steel constructed, American dredge, whose hull is shown below.

New York Meeting of the A. I. M. E.—page 323

MINING PRESS

Established May 24, 1860, as **The Scientific Press**, name changed October 20 of the same year to **Mining and Scientific Press**, shortened January 2, 1915, to **Mining Press.** Controlled by T. A. Rickard.

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Price, 10 cents the copy. Annual subscription: United States and Mexico, $3; Canada, $4; other countries in postal union, 21s. or $5.

VOL. 110 SAN FRANCISCO, FEBRUARY 27, 1915 No. 9

TABLE OF CONTENTS

EDITORIAL Page.

Notes 319
Presidential Withdrawals Held Valid 320
The Federal Trade Commission 321

ARTICLES

LOOKING FORWARD 322

The problem of giving graduates of technical schools some first hand knowledge of the human element with which they are to work, is being solved by giving them the opportunity to serve as teachers to workmen, especially foreigners. The industrial department of the Y. M. C. A. is conducting the work and at the A. I. M. E. meeting in New York, J. Parke Channing told about it. His most interesting paper is abstracted here.

NEW YORK MEETING OF THE AMERICAN INSTITUTE OF MINING ENGINEERS 323

The annual meeting of the Institute held in New York last week was characterized by an excellent program and lively discussion. The sessions were held in sections devoted to 'Safety and Sanitation,' 'Non-Metallic Minerals,' 'Iron and Steel,' 'Petroleum,' and 'Metallurgy.' The annual dinner, presided over by the newly elected president, W. L. Saunders, was attended by over 300 and was greatly enjoyed.

DREDGING FOR PLATINUM IN THE KYTLIM VALLEY, RUSSIA.
By R. S. Botsford 327

Platinum has been mined for 15 years in the Kytlim valley in the Ural mountains by means of a bedrock tunnel. On the Lobva, into which the Kytlim river flows, failing to divert the river, dredging methods were introduced. A Putiloff 5½-cu. ft. dredge is now at work and a new 7½-cu. ft. Marion boat with steel hull, designed to dig 16 ft. above and 25 ft. below water-level, has just been built. Full construction details are given.

TESTING BURNED-OUT ARMATURES.
By Leonard V. Newton 329

A convenient and simple method of determining the locus of trouble.

MISFIRES IN BLASTING AND THEIR CAUSES.
By J. B. Burgess 330

Misfires are a common source of loss, trouble, and danger. Mr. Burgess determined to learn if possible what causes them and how they may be prevented, and with that in view he conducted a number of experiments with caps and fuse from which he deduces some rules worth knowing. Incidentally he describes an excellent form of fuse-cutting table.

WATER IN PENNSYLVANIA ANTHRACITE MINES 333

It is estimated that for every ton of coal mined, one ton of water must be raised per year until the ground is exhausted. The amount hoisted has increased nearly 10% in the past ten years.

Page.

MOVING A SHOVEL UP AND DOWN GRADES 333

A steam-shovel is a heavy awkward machine to move over rough ground, but if it be properly prepared for the move, it is easily handled. In this note the correct method is described.

IMPROVEMENTS AT THE REDUCTION WORKS OF THE ANACONDA COPPER COMPANY 334

It was announced last week that flotation had been adopted at Anaconda. In this present note further details are given as to this and other changes in process and construction recently determined. The cost of the changes will amount to about $5,750,000, and the scheme of work both at Anaconda and Great Falls will be materially altered.

PLACER MINING CLAIMS IN THE YUKON.
By J. A. MacDonald 335

A brief synopsis of the correct method of locating and marking Yukon placer claims, with some illustrations of anomalous locations.

STAMP-MILL DATA AT THE BRUNSWICK CONSOLIDATED 337

A summary of the work at an important Grass Valley, California, mine. The treatment cost per ton is 92 cents.

SPELTER PRODUCTION OF THE BUTTE & SUPERIOR MINE 337

Summary of recent production of this great zinc mine at Butte.

MINING COSTS AT THE PORTLAND MINE 337

The total cost at this great Colorado gold mine is $1.98 per ton.

DEPARTMENTS

DISCUSSION:
AMALGAMATION IN HARDINGE MILLS.
By J. W. Pinder 338

Mr. Pinder gives details of his experience at the Curaren and Rosario mills with amalgamating while grinding ore. He concludes that flouring of mercury is not a necessary result of such a system.

CONCENTRATES 340
REVIEW OF MINING: Special correspondence from New York; Washington, D. C.; Houghton, Michigan; Fairbanks, Alaska; Grants Pass, Oregon; Austin, Texas.. 341
THE MINING SUMMARY 344
PERSONAL 349
SCHOOLS AND SOCIETIES 349
THE MARKET PLACE:
Metal Prices 350
COMPANY REPORTS 351
Jim Butler Mining Co.; Shattuck-Arizona Copper Co.; Brunswick Consolidated Gold Mining Company.
MINERAL STATISTICS 351
NEW MACHINES AND DEVICES:
Water-Wheels and Accessories at the Exposition..... 352
Commercial Paragraphs 352

EDITORIAL

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MEXICAN affairs continue unsettled, and A. B. C. intervention is now proposed. In the meantime the mail comes on regular schedule from mines in Villa territory.

AN embargo has been placed on the shipment of manganese ore from Russia to the United States, but several special exceptions have already been made, and it is not likely to be strictly enforced.

RUMOR has it that the lower levels of the Bonanza mine at Kennicott, Alaska, show carbonate ores in place of the chalcocite found at the surface. If this proves true there must needs be revision of opinion among geologists who pointed to the Bonanza as an example of primary chalcocite.

ONE million dollars is the amount the Butte Miners' Union has paid to the Western Federation of Miners, according to allegations made in a suit to determine control of the property of the local. It is further maintained that the Butte Miners' Union never received any benefits in return, and that much of the money was improperly spent by Mr. Charles H. Moyer and his associates of the Western Federation. That was rather a heavy price to pay for benefits that have at least been small.

WILFUL embezzlement is the cause assigned for loss in 73 out of 205 claims paid in December 1914 by the American Surety Company. The next most important source of loss was liquor, gambling, and immorality. Contrary to general opinion, speculation was an unimportant cause of trouble, though it is to be remembered that there is little speculative trading these days by anyone. The figures none the less are disappointing, as they seem to show a lower average honesty than most of us have been willing to credit to our fellows.

GERMANY is admittedly suffering from a shortage of gasoline, though a substitute has been found which can be widely used. We suspect, however, that no country will be more interested in Mr. W. O. Snelling's synthetic crude oil from which he is able to make repeated distillations of gasoline. The exhibition of this material and explanation of the process of manufacture was one of the features of the meeting of the American Institute of Mining Engineers last week. The commercial possibilities of the discovery are yet to be determined, but with so brilliant an investigator as Mr. Snelling, backed by so aggressive a business man as Mr. John T. Milliken, the matter will be thoroughly tested.

MANUFACTURE of steel rails has so far been a small business in Australia, but the first evidence of a new order of things has been given in the securing by the Broken Hill Proprietary company, at Newcastle, of a contract to supply the New South Wales government with 2500 tons of rails for certain lines in the west of that state. The price to be paid, delivered at Port Pirie, South Australia, is £8 7s. 6d., or $40.20 per long ton. The price for rails in the United States remains fixed at $28 per ton. Orders in January totaled 275,000 tons.

ELECTION of Mr. James F. Kemp to honorary membership in the American Institute of Mining Engineers, announced at the annual meeting, does not so much put him in distinguished company as mark recognition of the fact that he was already there. The list of honorary members is not so long that it may not be repeated. Omitting titles and degrees in the interest of economy of space, it includes: Richard Akerman, Frank D. Adams, Richard Beck, Andrew Carnegie, James Douglas, Haton de la Goupilliere, Robert A. Hadfield, Hans Hoefer, Henri Louis Le Chatelier, Ezequiel Ordonez, Alexandre Pourcel, Rossiter W. Raymond, Robert H. Richards, H. C. Emil Schroedter, John E. Stead, James M. Swank, Dimitry Constantin Tschernoff, Tsunashiro Wada, Charles D. Walcott, and James F. Kemp. To have your professional associates concede to you position in such company is an honor indeed, and there will be no difference of opinion as to the honor having been well placed in Mr. Kemp's case.

AMALGAMATION in Hardinge mills was a subject of discussion in our issue of January 16, but mention was not made of the fact that this practice has been dispensed with at the Plymouth mill because of the losses inherent to such practice. With the present system of treatment the discharge from 30 stamps is classified and the coarse material ground in a Hardinge mill, a second mill being held in reserve for the same purpose. The discharge from the Hardinge mill passes over two five by eight-foot copper plates, at the top and bottom of which are traps or wells of about four inches in depth. The upper traps catch as much as 70 per cent of the gold without the use of quicksilver, it being used solely

on the plates, which are cleaned once a day. After passing this first pair of plates the ore passes over a second set of ten 6 by 12-foot plates, where a further recovery is made. The present system of amalgamation is proving both simple and efficient. The discussion of the subject has attracted wide attention, and we are glad to add this week a thoughtful letter by Mr. J. W. Pinder, who draws on his note-book for illuminating experience in amalgamating while crushing, in Central America. While his machinery differed, the principle involved was the same.

MONTANA phosphate fields are to be extensively developed, according to present outlook. It is announced that the Montana Phosphate Company has contracted to deliver 80,000 tons per year to Mitsui & Company for shipment to Japan. The rock is to contain a minimum of 62 per cent of tricalcium phosphate and is to be mined near Great Falls.

FURTHER details regarding the improvements about to be made at Anaconda are presented this week. Incidentally it may be mentioned that an error in copying caused us to report the capacity of the new Minerals Separation flotation plant too low. Each of the 24 units about to be installed will have a capacity of 600 tons per day in place of 100 tons as stated. It will be seen that the total, nearly 15,000 tons, makes the plant a large one for a 'first unit.'

TONOPAH, after years of peacefulness so marked as to suggest that ownership of its principal mines by Philadelphians had linked it with the 'City of Brotherly Love' in more ways than one, is in the thick of litigation over apex rights. It has probably puzzled many to know why these difficulties have become acute after years of peace. The reason lies in the fact that mining has extended down through the zone in which narrow vertical veins are dominant and into one in which broad flat veins are characteristic. If apex rights to these can be established, they will be immensely valuable to the ones holding them. They will also, it may be noted, greatly complicate the matter of ownership of properties; but that is usually the result of attempts to enforce apex rights. The matter is now before the courts, and will be decided in due time on the basis of the law and the evidence, ... no' with a view to what any of us may think as to the general value or utility of the apex law, but it is illuminating none the less and helps explain why revision of the mining law is desired.

BEFORE the Panama-Pacific Exposition opened and when things were still in the planning, the professional exposition men who have been so prominent in the conduct of affairs, professed grave doubts as to the feasibility of an exhibit in an actual mine. It "never had succeeded," "people could not be induced to go in," and various other objections were urged. All these proved unfounded Saturday when a continuous stream of visitors passed through 'The Mine' almost from the time it was opened. When the mine explosion occurred and the rescue corps dashed up in their ambulance, put on their breathing apparatus and went below to bring out the supposed mangled miners, it required a number of police to keep back the crowd, and needed only a few weeping widows to give a final touch of reality to the scene. The mine itself is well worth a visit and is certain to have a large and beneficial influence on the public attitude toward mining. Mr. H. M. Wilson, the energetic chairman of the committee in charge, with the various mining and machinery firms whose co-operation made the exhibit possible, deserve the hearty thanks of the profession.

LOCAL TREATMENT of concentrate in individual plants, or a central custom plant, was suggested by Mr. M. W. von Bernewitz for California Mother Lode mining companies, in the *Press* of January 3, 1914. With the exception of the Kennedy Mining & Milling Company, at Jackson, which roasts and chlorinates its concentrate, practically all these companies send their product to a smelter. The Plymouth Consolidated contemplates local treatment of its concentrate. The shipment of this material is expensive, and regarding this cost the report of the Brunswick Consolidated Gold Mining Company, of Grass Valley, for the year ended January 28, 1915, supplies some interesting figures. During the current year this Company will erect a cyanide plant to treat its concentrate, and a large reduction in costs should result. In 1914, the 20-stamp mill treated 16,237 tons of ore, yielding 288 tons of concentrate, averaging $63.89 per ton. The freight and refining charges amounted to $3312, and loss in treatment $1472, the cost, including loss of value of 8 per cent in treatment, being $16.611 per ton, leaving a net value of $47.28 per ton. This is a high charge, compared with under $5 per ton at Goldfield, Nevada, where a rather complex treatment is used. The Brunswick management is to be commended for its effort to reduce expenditure, and we hope to see others fall in line.

PRESIDENTIAL WITHDRAWALS HELD VALID

The decision of the United States Supreme Court in favor of the government in the Mid West oil case, appealed from the District Court of Wyoming, announced last Tuesday, came as a distinct surprise to most of those who had followed the trend of recent decisions of the lower courts. Pending receipt of the text of the decision itself, it is difficult to make sure as to what was the determining factor. The general facts are well known. The Mid West company, operating in Wyoming, was one of those claiming land covered by the so-called 'presidential withdrawals,' and the decision is to the effect that the withdrawal was valid, and accordingly that the title of the oil company to the land is void.

It will be recalled that when in 1908 the conservation movement attracted attention and enlisted the support of Mr. Roosevelt, the public lands were open to entry under numerous laws. The cry was raised that the public domain was passing into the hands, not of genuine

settlers and developers, but of speculators; and there was only too much basis for the statement. It was widely felt that the system of administration and alienation of the public lands was wrong, that however well it might have operated in the past, and whatever benefits it might have conferred in the development of the West, the time had come for a radical change of policy. This sentiment was widespread. Mr. Roosevelt did not create it, he expressed it. He gave it force and effect, but fundamentally it represented a real public opinion which had developed slowly as a result of years of observation and reading. It had been brought to a focus by the land frauds made public shortly before, and there was an earnest purpose to make a change, though no consensus of opinion as to what the change should be. Congress having no certain guide as to what public opinion demanded and being always adverse to act in the absence of clearly expressed demand, did nothing. To be exact, certain leaders in Congress did all they could to prevent any change.

The President, on the contrary, acted in accordance with his usual plan of "acting first and leaving to subsequent generations the debate as to his constitutional authority." The executive department was the custodian of the public lands and it was clearly its duty to act as custodian for the people as a whole. For many years it had been customary for the President by simple executive order to withdraw from sale or entry tracts or areas of land needed or expected to be needed for any use of the government. So far as we are aware this right had never been questioned nor had it been passed upon by the courts. Probably it would never have been disputed if it had continued to be used in the moderate fashion of years gone by to segregate small tracts of lands for distinctly government use. Mr. Roosevelt, however, used the right to withdraw from entry large tracts of mineral lands and others primarily valuable as water-power sites pending legislation which, it was hoped, would establish a new system of sale or lease of the public domain. Mr. Taft, though professing himself in doubt as to the legality of the act, followed Mr. Roosevelt's example. There was widespread protest from those who hoped to secure further holdings of mineral land under the old easy terms and, acting on the advice of attorneys, many continued to locate oil 'placer' claims. Among other lands so located were those held by the Mid West Oil Company and whose status has just been finally adjudicated. There are thousands of acres throughout the West that were similarly located in defiance of the presidential withdrawal order, though presumably in good faith, believing the order itself invalid. Upon these lands there has been extensive development and property worth many millions of dollars is concerned. Presumably the title reverts to the United States, and the most that the present holders can expect is a preferential right to lease or buy under whatever new system may be established. Probably the very acuteness of the situation will operate to compel enactment of the bill now before Congress establishing a general leasing system for the oil lands. This has been the inevitable conclusion of the matter for several years, and we believe now, as we have from the first, that our friends in the oil producing business would have done better to have accepted the situation in 1910 and helped frame a suitable leasing bill rather than to have fought the inevitable.

THE FEDERAL TRADE COMMISSION

Months ago, among others, we urged that when the new commission came to be appointed to regulate interstate trade, a mining man might fitly be included. The reasons for such an appointment seem to us fairly obvious. Mining is, and will always remain, one of the great basic industries. Men in other trades and industries work with materials furnished by the mines and the farms. They come at things second hand. Despite the variety and bulk of the farm products of the United States, 65 per cent of the freight handled by the railroads, according to the late E. H. Harriman, comes from the mines. On important roads the freight from the mines amounts to more than 80 per cent, and on few, even in the prairie country, does it fall below 20 per cent. The relations of mining to interstate commerce are numerous and intricate, and many of the questions that will come before the new commission can only be fairly settled through a first-hand knowledge of mining problems and conditions. We know of no problems in interstate commerce that more demand the attention of the new commission than those that relate to bituminous coal production, and that is only one instance. An almost equally good case could be made out for petroleum and other mineral products. Such problems cannot be, and will not be settled by a board which has only second hand information and none of the feeling of an industry that comes from participation in it. It was not necessary that the commission should consist of mining men, but not to include one, appeals to us as a serious error of judgment. Worse than that, however, we esteem the fact that the majority of the members of the new commission, organized to determine business matters, are men whose relation to business itself is secondary. Mr. J. E. Davis and Mr. George Rublee are lawyers. Mr. W. H. Parry is an editor. Mr. W. J. Harris was an insurance manager before he became director of the Census. Only Mr. E. N. Hurley, a manufacturer from Illinois, has been dealing with things themselves. With all due respect to lawyers and with a naturally high regard for editors, we feel that this country would be better managed if more of the men in high places in the government had had the experience of building bridges, operating mines, managing stores, and, in general, taking part at first hand in the development of the country. This, we think, especially important in such a delicate matter as trade regulation. Such men are not appointed to office because, usually they are too busy minding their own business to think of the matter. Then, too, there is rarely any organized effort to present the claims of a business man to office, and no insistent public demand that in making appointments, choice be made from their ranks. This we think a national danger.

LOOKING FORWARD

A movement which so experienced and hard headed a mining engineer as Mr. John Hays Hammond considers "one of the most promising things that I have seen in connection with modern industry," and which enlists the active interest of such men as Mr. Elbert H. Gary, Mr. J. A. Holmes, Mr. J. Parke Channing, and others of like standing, is one well worth investigating. At the recent New York meeting of the American Institute of Mining Engineers, Mr. Channing told briefly of the organization, methods, and results of the 'Industrial Service Movement' with which readers of the *Press* are already somewhat in touch through the article by Mr. Fred H. Rindge, Jr., in our issue of November 7. Mr. Channing, who is a member of the advisory committee in charge and who is much more directly responsible for the impetus the movement has attained than his modest paper would indicate, gave, among others, the following interesting details:

"These days of great industrial and social problems in America produce many suggested solutions and great changes. The practical engineer and employer of labor views these problems differently from the labor leader or the social reformer, but as never before he is sincerely interested in solving them in a way that will be just to all. The very centre of final success in improving conditions and increasing the efficiency of workingmen must be the spirit of fairness and a knowledge on the part of the employer of how to deal sympathetically and intelligently with his employees. Every progressive employer knows how greatly he desires foremen, superintendents, managers, and others who possess these qualities. On the other hand, all are familiar with serious mistakes made by young graduates of engineering schools who have had no opportunity to develop these qualities, and who have no real appreciation of the worth of the workers. Indeed, one wonders whether much ill-feeling, labor difficulties, and many strikes could not be avoided if such men had the right attitude.

"How can it be done? For seven years a movement has been making rapid progress in engineering schools with the purpose of helping to solve this very problem. It was started at Yale in 1907, by the Young Men's Christian Association, when some engineering students were led to get in touch with workingmen and boys in New Haven. The idea was to render service by teaching them English and other subjects and in turn learn their ways, ideas, customs, and how to deal with them intelligently. Friendly, mutually helpful personal contact was the basic principle. This was the beginning. Do not confuse it with 'social service'—it was this, and much more. The reaction on the engineer was the main object sought. The idea worked out so successfully that a number of men saw great possibilities in it, and the whole conception was greatly enlarged. During the past year 3500 students from 200 colleges have engaged regularly in industrial service. Experience proves that men interested in this work at college go out into the larger world with a new vision and a new attitude and sense of responsibility. It may seem surprising that 3500 engineering students, each carrying a heavy course of study and with many other interests, can find an evening or two each week to engage in some form of definite service, without any financial compensation. But such is the case, and on the whole a careful survey of their work reveals efficiency and permanency in a high degree. If industrial men are at first suspicious, their suspicion soon wears away in the face of frankness and friendliness. If the employer has any doubts, they do not last long.

"But what has this to do with engineering? Just this—that every one of these 3500 students would be willing to say that he has gained far more than he has given. Furthermore, a study of the situation proves that he has gained in a large measure the very qualities he needs—an appreciation of workingmen, adaptability, leadership, a knowledge of how to deal with men in a way to get results and to avoid harmful labor difficulties. In general, he learns that all men are men, regardless of race, nationality, color, or creed, but that men must be dealt with very differently; he learns that it pays to win the leaders of men if one desires to win the men themselves; that the work, home, and leisure life of industrial workers play a large part in determining efficiency; that a man's working associates may largely influence the quality of work he does; that helping men to concentrate on their work (though not at the expense of mental and physical welfare) increases output; that friendly competition (without driving men) helps break records; that reasonable relaxation and recreation pays both from the human and economic standpoints; that visitation of other plants and stimulation of new ideas in various ways may mean a money saving to the company; that the loyalty of the men is one of the employer's greatest assets; and that character counts most of all. More than this, he learns to understand men, he learns how to sympathize with the other fellow's point of view and how to handle men successfully. Is this not worth while? Who can foresee what the future will hold for these men in the way of opportunities and responsibilities?

"Let me illustrate. One engineering student apparently never took any interest in anyone but himself until he was enlisted in some of this work. Two evenings each week he walked two miles to teach a class of 20 coal miners. The miners learned a great deal, but they little realized how much they were teaching the college man. His whole viewpoint was gradually changed. He learned to appreciate that all men were men, and he graduated from college with a new vision and a new sense of responsibility. He had not become a sentimental idealist. He perhaps realized the weaknesses of workingmen better than ever, but he had come to know their good points as well, and he had developed a real point of contact. It was therefore not surprising to receive a letter from him recently, indicating his growing interest and telling enthusiastically of his success with a welfare clubhouse."

New York Meeting American Institute Mining Engineers

The annual meeting of the American Institute of Mining Engineers in New York was opened on Monday, February 15, by a discussion of papers on safety and sanitation, which was presided over by Arthur Williams, chairman of the committee on safety and sanitation. The first paper was on safeguarding the use of mining machinery, and was presented in abstract by its author, Frank H. Kneeland. Howard N. Eavenson then described the safety methods and organization of the United States Coal & Coke Co. in an extremely interesting manner. Several of those present joined in the discussion which followed. J. Parke Channing called attention to the improvement shown by the operating forces of Russian coal mines since the sale of vodka has been prohibited, 70% of the regular operating force now producing 130% of the normal output. C. W. Goodale described the gratifying progress which has been made in decreasing the number of accidents in the mines of the Anaconda C. M. Co. He also pointed out that the method of reporting accidents as one for so many tons mined is satisfactory for coal mining, where but little work is done except mining coal, but in metal mines, where much of the work underground is unproductive, a more satisfactory basis is that of reporting accidents as one for so many shifts worked. G. S. Rice also touched on this point, and B. F. Tillson drew attention to some points of interest in the safety work at Franklin Furnace, New Jersey. S. Le Fevre next presented a paper on housing and sanitation at the mines of Wetherbee, Sherman & Co., at Mineville, New York, which was illustrated by a moving picture film taken by the U. S. Bureau of Mines at Mineville. J. Parke Channing presented a discussion of possible methods of enlarging the worth of the worker and the perspective of the employer through utilizing the facilities of the International Young Men's Christian Association. F. H. Rindge, Jr., who is in charge of this branch of the Y. M. C. A. work, supplemented this paper with a brief account of the way in which the Y. M. C. A. organization, through its hold on undergraduate college men, is able to enlist their energies in work to benefit employees in industry. H. H. Stoek told how this work at the University of Illinois has grown until the University asked for an appropriation of $50,000 for 1915, hoping if the sum becomes available to put a night school in every important town in the state. S. A. Taylor told of his experience with schools for workers in which it was found that the men would not travel considerable distances to a central school on Saturday afternoon, even though the company paid them their regular wages. An effort was therefore made to take the schools to the miners, and this was found entirely successful. Any convenient hall where ten or a dozen workers could be gathered was used, and by the aid of a balopticon, advertisements cut from technical journals were thrown directly on the screen while the instructor explained the construction and use of the equipment. In this way much useful information was gained by the men, and in addition they were kept out of the saloons and bar-rooms. The morning session was concluded by a paper on some factors in the cost of coal mining, by Gregory. This was originally scheduled for presentation at a later session, but was introduced at this point because it bore in part on safety measures. This prolonged the session over an hour beyond the set time, and served to demonstrate the unwisdom of such a proceeding, for the author was put out of his stride by the restlessness of his audience, and the time which had been allotted for committee meetings and the safety exhibit on the sixth floor of the Engineering building was taken up by the session.

The annual meeting was scheduled for Tuesday, the date fixed by the constitution for the annual business session, but it proved that this would bring the annual dinner on Ash Wednesday, so the date was advanced. In spite of this the attendance at the first session was surprisingly large, and at the luncheon served at 1 o'clock so many more than had been provided for were present that many of the members had to adjourn to the Engineers' Club. The Chemists, Columbia University, Harvard, Machinery, Princeton, Rocky Mountain, Technology, Williams, and Yale Clubs had all extended their privileges to visiting members during the meeting, so that there was no lack of places to go. The ladies, who were present in good numbers at the luncheon, were taken after lunch to hear a demonstration of a new player piano, and afterward to a 'dansant' at the Biltmore hotel, to which only two of the men had the courage to venture.

During the afternoon, two sessions were held simultaneously, that on non-metallic minerals being presided over by Heinrich Ries, and that on iron and steel by Albert Sauveur.

In the non-metallic session, J. Sharshall Grasty presented a paper by himself and T. L. Watson, on the barite deposits of the Appalachian states. C. H. MacDowell, president of the Armour Fertilizer Co., discussed in detail the various sources of potash supply which have been suggested, concluding that none of them offered much promise except the brines of California and the feldspars of the eastern states, making the pertinent observation that no sources of potash can be developed without some one being willing to spend money in considerable amounts. W. B. Phillips described his investigations of possible sources of potash, concluding that only along the New Mexico border are there any of promise. N. B. Davis next discussed the plasticity of clays, and J. H. Watkins described the white-burning clays of the southern Appalachian states. J. H. Pratt discussed the minerals used in the manufacture of lighting apparatus, and E. G. Norton the origin of the Louisiana and east Texas salines.

The annual business session was held the following

morning at 10 o'clock, when it was announced that the regularly nominated officers had been elected, as announced last week. The officers and various committees made the usual reports, among them the committee on increase of membership which reported that 1006 men had been elected to membership in the Institute during the year, and that the organization now has over 5000 members in good standing for the first time in its history. It was also announced that all three of the amendments proposed had been carried by over 600 majority, and it is interesting to note that as many members voted on the amendments as for officers.

Of the papers the following session, the one which attracted the most interest was the description of the Boulder Batholith of Montana, by Paul Billingsley. H. V. Winchell, L. C. Graton, and others joined in the discussion of this, and it was the general impression of all present that R. H. Sales and his associated workers have set a new and higher standard of geological work. At noon the Michigan College of Mines alumni held a luncheon at the Engineers' Club, while the other members lunched in the Engineering building as before. Following luncheon the ladies departed for the Metropolitan Museum, and a session on coal and petroleum was held, over which A. F. Lucas presided. C. T. Malcolmson described recent developments in coal briquetting, and E. W. Parker so heartily commended the use of briquettes that he was subject to good natured inquiries as to whether Mr. Malcolmson had sent him a carload. W. S. Ayres pointed out that in eastern Pennsylvania the production already exceeds the market, ascribing this to the fact that the binder gives rise to a heavy acrid smoke that is a source of much annoyance to neighbors, no matter how satisfactory the user found them.

The annual dinner was held at Hotel Astor, Tuesday evening, February 16, and was unusually well attended. At 6:30 p.m. there was a reception to the newly elected president and the retiring president in the reception room of the hotel. At 7 p.m., following the reception, the subscription dinner was served in the banquet hall. At 9 p.m., at the close of the dinner, the retiring president, Mr. Thayer, introduced the newly elected president, Mr. W. L. Saunders.

Mr. Saunders remarks were as follows:

"It is such an easy thing to get a swelled head, that I am not at all concerned about my capacity to fill President Thayer's hat: but the thing that worries me is how shall I ever acquire a large enough understanding to even look respectable in his shoes? So that if there are any here who kick against the new administration, I trust they will bear in mind that even success should have its consolations.

"It is a great satisfaction to follow a great man; to have a big job passed over to you with the statement, 'We older men must make way for younger blood; my boy, I wish you the same happiness and success that I have always enjoyed, etc.' That satisfaction becomes a condition of calm content when, as in this case, it is found that the old ship has been refitted from topmast to keel; that all the barnacles have been removed; that she is now staunch and strong, a goodly vessel, and that the captain is in reality only a watch officer whose highest aim should be to keep off the rock and up to the standard.

"In paying to my distinguished predecessor the tribute of my admiration and my tears, I must differ from him only in one thing. Actuated, I have no doubt, by his natural modesty and kind heart, he has told those who have expressed sorrow at his going out of the presidency that they would get a better man. Ah, no, no Mr. Thayer, not at all, not at all. Why that is exactly what your predecessor Mr. Rand said. I repeat, even success needs its consolations, and if the measure of the volume of our consolation is to be the extent of success achieved, then Ben Thayer should be truly overwhelmed. His administration of the affairs of this Institute has been one continued success.

> Born for success he seemed,
> With grace to win, with heart to hold.

"I wish that we might have kept him in office indefinitely, for he is an inspiration. He has done many things for the Institute, but it will always be remembered that under President Thayer the membership passed beyond the five thousand mark and that every dollar of a large indebtedness was canceled.

"For my part, words are but idle thanks in expressing my feelings. I realize that it is no easy task to keep up the pace which has been set, but the confidence implied by your act in so greatly honoring me will, I trust, serve to strengthen and sustain me.

"With this as a staff, and through the valued aid which will be given by the Executive Committee and the Directors, let us hope that the Institute and the great mining industry which it represents will press onward in continued prosperity and usefulness."

The other speakers were Messrs. Benjamin B. Thayer, Gano Dunn, Job E. Hedges, Dr. Rossiter W. Raymond, and John C. Montgomery. Dr. Raymond spoke of Job the early miner, and various speakers called attention to the fact that Job, in the person of Mr. Hedges, was still active in mining. The whole affair was carried out in excellent style and the evening was thoroughly enjoyed. The members and guests present were as follows:

Atwater, R. M., Jr.
Atwater, Mrs. R. M., Jr.
Ayres, W. S.
Ayres, Mrs. W. S.

Barron, Geo. D.
Barron, Mrs. G. D.
Bassett, W. H.
Best, W. N.
Best, Mrs. W. N.
Billingsley, Paul
Billingsley, Mrs. Paul
Blair, John N.
Blair, Mrs. John N.
Blow, A. A.
Blow, Mrs. A. A.
Blow, George
Bowler, R. P.
Bradley, Linn
Bradley, Mrs. Linn
Browne, de Courcy
Brunton, Mrs. D. W.
Bryant, Albert D.
Bryden, C. L.
Buck, Stuart M.
Buck, Mrs. Stuart M.
Buell, L. T.
Buell, Mrs. L. T.
Burdick, C. A.
Burger, C. C.
Burger, Mrs. C. C.
Butfield, Marson I.
Butfield, Mrs. Marson I.

Callbreath, J. F.
Catlin, R. M.

Catlin, Miss Beaste
Catlin, Miss Helen
Chan, C. Y.
Chappell, H. F.
Clark, A. Clayton
Clark, Mrs. A. Clayton
Clark, Mrs. E. H.
Clark, J. M.
Clark, W. A.
Coggswell, W. B.
Coggswell, Mrs. W. B.
Conner, Ell T.
Conner, Mrs. Ell T.
Cook, Fahys
Corning, C. R.
Corning, F. G.
Corse, W. M.
Cottrell, F. G.
Cox, Rowland
Crankshaw, H. M.
Crankshaw, Mrs. H. M.
Cuntz, W. C.

Dana, R. T.
Day, D. T.
DeKomorowski, George
Dilks, A.
Dorrance, C.
Drinker, H. S.
Dunn, Gano
Dwight, Arthur S.
Dwight, Mrs. Arthur S.
Dwight, Theodore
Dwight, Mrs. Theodore
Dunham, L. A.
Dunham, Mrs. L. A.

Eilers, Karl
Eilers, Mrs. Karl
Enzian, Charles
Eustis, F. A.

Firmstone, Frank
Forbes, W. A.
Francis, L. W.
Francis, Mrs. L. W.
Freeman, S. S.

Garrison, F. L.
Gathmann, E.
Gibbons, Douglas
Gillette, H. P.
Goodale, C. W.
Graton, L. C.
Grubnau, V. Carl

Hamilton, William
Hardinge, H. W.
Hardinge, Mrs. H. W.
Hart, Edward
Hartman, F. S.
Hedges, Miss
Hedges, Job E.
Hess, Henry
Hickok, C. N.
Hinckley, E. R.
Holbrook, Levi
Holbrook, Mrs. Levi
Hope, Mrs. W.
Howells, G. A.
Humphrey, G. S.
Humphrey, Mrs. G. S.
Hunt, R. C.
Hunt, Mrs. R. C.
Huntoon, L. D.
Huntoon, Mrs. L. D.

Ihlseng, Mrs. Axel O.
Ingalls, W. R.
Iredell, F. W.
Iredell, Mrs. F. W.

Jennings, Hennen
Jennings, Sidney J.
Jennings, Mrs. S. J.
Johnson, J. E., Jr.
Johnson, Mrs. J. E.
Jones, E. S.
Jowett, J. H.
Jowett, Mrs. J. H.

Keller, Edward
Keller, Herman
Kelley, William
Kelley, Mrs. William
Kemp, James F.
Kemp, Mrs. J. F.
Kemp, James T.
Kinny, H. D.
Kirby, E. B.
Knowles, S. A.
Knowles, Mrs. S. A.
Kunz, Dr. G. F.

Lamb, H. Mortimer
Lane, Alfred C.
Lane, J. S.
Lang, Henry
Lang, Mrs. Henry
Langton, John
Lawrence, B. B.
Ledoux, A. R.
Ledoux, Mrs. A. R.
Ledoux, Louis V.
Ledoux, Mrs. L. V.
Ledoux, Miss
Ledoux, Augustus
Le Fevre, S.
Leggett, Thomas H.
Leggett, Mrs. Thomas H.
Lincoln, Paul M.
Lindgren, W.
Linton, Robert
Lucas, A. F.
Ludlow, Edwin
Ludlow, Mrs. Edwin
Lyman, Frank

McCay, L. W.
McComas, K. W.
McCrocken, Eugene
MacDowell, C. H.
Malcolmson, C. T.
Mallory, Philip R.
Mallory, Mrs. Philip R.
Manning, Van H.
Martin, F. M.
Mathews, J. A.
Mathewson, E. P.
Mein, W. W.
Mein, Mrs. W. W.
Montgomery E. A.
Montgomery, J. C.
Moore, P. N.
Moore, Mrs. P. N.
Moore, George
Morris, H. C.
Morris, Lewis R.
Morse, Willard S.
Morse, Mrs. Willard S.
Motter, W. D. B., Jr.

Newhouse, E. L.
Newhouse, Mrs. E. L.
Newton, F. C.
Nitecker, Karl
Norris, R. V.

Olcott, E. E.

Packard, G. A.
Page, W. K.
Palmer, I. A.
Parker, E. W.
Parsons, F. W.
Patterson, J. H.
Payne, C. Q.
Pechin, E. C.
Peters, Richard, Jr.
Pierce, F. E.
Pocock, C. W.
Polhemus, H. H.
Prosser, H. A.
Prosser, Mrs. H. A.
Purington, C. W.
Purington, Mrs. C. W.

Rand, Charles F.
Rand, Mrs. Charles F.
Raymond, Dr. R. W.
Raymond, Mrs. R. W.
Read, T. T.
Read, Mrs. T. T.
Reger, D. B.
Reger, Mrs. D. B.
Reinhardt, G. A.
Reno, J. W.
Rice, Calvin W.
Rice, George S.
Richards, J. W.
Richards, Robert H.
Richards, Miss
Robertson, F. Y.
Robertson, Mrs. F. Y.
Robinson, B. A.
Robinson, Mrs. B. A.
Rowand, L. G.
Rowand, Mrs. L. G.
Rowland, W. O.
Ruiloba, J. A.
Rushmore, D. B.
Rushmore, Edmund

Saunders, W. L.
Saunders, W. L. 2nd
Sauveur, Albert
Scholz, Carl
Schaler, R. A.
Sharpless, F. F.
Sharpless, Mrs. F. F.
Sheridan, R. B.
Shipp, E. Maltby
Shipp, Mrs. E. Maltby
Smith, George Otis
Smith, Jesse M.
Smyth, H. L.
Spilsbury, E. G.
Stafford, S.
Stearns, T. B.
Stone, Miss
Stone, George C.
Storrs, A. H.
Storrs, Mrs. A. H.
Stoughton, Bradley
Stoughton, Mrs. Bradley
Struthers, Joseph
Sturgis, E. B.
Sturgis, Lyman B.
Sturgis, Mrs. Lyman B.

Taylor, Knox
Taylor, L. H.
Taylor, S. A.
Taylor, Mrs. W. J.
Thayer, B. B.
Thayer, Mrs. B. B.
Thayer, Miss Marie
Thayer, Miss Tesson
Thompson, Mrs. A. W.
Tlach, Victor
Tweedy, A. M.
Tyrrell, J. B.
Tyrrell, Mrs. J. B.

Valentine, S. G.
Van Winkle, Edward
Van Winkle, Mrs. Edward
Von Lilienthal, A. W.
Von Lilienthal, Mrs. A. W.

Warriner, J. B.
Webb, H. H.
Webb, Mrs. H. H.
Welch, H. K.
Weld, C. M.
Wenstrom, Olaf
Whildin, W. G.
Whildin, Mrs. W. G.
Whittier, Charles C.
Wierum, H. F.
Wierum, Mrs. H. F.
Wilkens, H. A. J.
Williams, David
Wilson, A. W. G.
Wilson, W. A.
Winchell, H. V.
Winchell, Mrs. H. V.
Winsor, F. H., Jr.
Wolfard, M. R.
Wolfson, Tobias
Wolfson, Mrs. Tobias
Worth, John G.

The meeting was managed by the following committees, in addition to which was a ladies' reception committee under the chairmanship of Mrs. James F. Kemp, assisted by Mrs. H. A. Prosser as vice-chairman.

GENERAL COMMITTEE OF ARRANGEMENTS

L. W. Francis, chairman

Bradley Stoughton, vice-chairman

Louis D. Huntoon	George C. Stone
John H. Janeway	E. Maltby Shipp
Willard S. Morse	W. L. Saunders
P. A. Mosman	Charles F. Rand

ANNUAL DINNER COMMITTEE
W. L. Saunders, chairman

W. de L. Benedict	John C. Montgomery
Arthur S. Dwight	E. Maltby Shipp
Henry M. Howe	Edward B. Sturgis

LUNCHEONS COMMITTEE
E. Maltby Shipp, chairman

W. de L. Benedict	P. A. Mosman
C. A. Bohn	Lucius W. Mayer
Arthur S. Dwight	Carr B. Neel

PROGRAM COMMITTEE
George C. Stone, chairman

R. M. Catlin	James F. Kemp
John V. N. Dorr	Joseph W. Richards
L. C. Graton	Bradley Stoughton
J. E. Johnson, Jr.	

Among the papers read and discussed at the meeting were a number previously printed in the *Bulletin* of the Institute, several of which have been previously noted in the *Press*. Others were presented in pamphlet edition to those attending the meeting. Among these papers may be listed:

ENLARGING THE WORTH OF THE WORKER AND THE PERSPECTIVE OF THE EMPLOYER, by *J. Parke Channing.*

HOUSING AND SANITATION AT MINEVILLE, by *S. Le Fevre.*

SAFEGUARDING THE USE OF MINING MACHINERY, by *Frank H. Kneeland.*

SAFETY METHODS AND ORGANIZATION OF UNITED STATES COAL & COKE CO., by *Howard N. Eavenson.*

GERMAN AND OTHER SOURCES OF POTASH SUPPLY, by *Charles H. MacDowell.*

INVESTIGATION OF SOURCES OF POTASH IN TEXAS, by *William B. Phillips.*

THE PLASTICITY OF CLAY IN RELATION TO MODE OF ORIGIN, by *N. B. Davis.*

BARITE IN THE APPALACHIAN STATES, by *Thomas L. Watson* and *J. Skarshall Grasty.*

WHITE-BURNING CLAYS OF THE SOUTHERN APPALACHIAN STATES, by *Joel H. Watkins.*

COMPARATIVE COSTS OF ROTARY AND STANDARD DRILLING, by *M. L. Requa.*

IMPROVED METHODS OF DEEP DRILLING IN THE COALINGA OIL-FIELD, CALIFORNIA, by *M. E. Lombardi.*

THE PETROLEUM FIELDS OF ALASKA, by *Alfred H. Brooks.*

THE USE OF MUD-LADEN WATER IN DRILLING WELLS, by *I. N. Knapp.*

THE RÔLE AND FATE OF THE CONNATE WATER IN OIL AND GAS SANDS, by *Roswell H. Johnson.*

OIL AND GAS POSSIBILITIES, by *F. Julius Fohs.*

THE ESTIMATION OF OIL RESERVES, by *Chester W. Washburne.*

THE DEHYDRATING OIL PLANT OF NEVADA PETROLEUM CO., CALIFORNIA, by *S. J. Hardison.*

A MODERN ROTARY DRILL, by *Howard R. Hughes.*

RECENT DEVELOPMENTS IN COAL BRIQUETTING, by *Charles T. Malcolmson.*

THE MINING AND REDUCTION OF QUICKSILVER ORE AT THE OCEANIC MINE, CAMBRIA, CALIFORNIA, by *C. A. Heberlein.*

METALLURGICAL PRACTICE IN THE PORCUPINE DISTRICT, by *Noel Cunningham.*

METHODS FOR THE DETERMINATION OF GOLD AND SILVER IN CYANIDE SOLUTIONS, by *L. H. Bahney.*

The list includes, as indicated by the detailed account of the sessions, only a part of the papers presented, but it is none the less a notable one. Especially is this true of the papers on petroleum, not that these were especially fundamental or revolutionary, but they were broad in scope, sound in technology, and they afford striking evidence of the good effect of the organization of a special petroleum committee in the Institute. Gas and oil production have too long lagged behind other branches of mining in the development of good technology through the medium of free exchange of data among engineers.

Gold Mining in Victoria, Australia

The gold output for the year 1914 (413,288 oz.) shows a considerable falling off compared with the yield for the two preceding years. No one has to search far for the reason, according to *The Australasian*, the leading weekly. Dividends have shrunk largely, and as a consequence there is not the same flow of capital into the industry. The returns from Bendigo, for instance, furnish an explanation of the shrinkage. There deep mines

DISCHARGE FROM PUMPS AT A VICTORIAN DEEP-LEAD MINE.

have failed to respond to the expenditure, and they have had to be closed down, or work on a small scale was concentrated on the ore occurrence in the upper levels of the mines. No really extensive scheme of development is being carried on, either on the side lines or in the districts surrounding Bendigo. Of these, Castlemaine should provide a field for prospecting. As at Bendigo, gold was rich at the surface, or in the shallow lodes, but so far deeper work has failed to repeat the experience of Bendigo in sinking for new saddle formations. There are 'leads' near Bendigo, also, that deserve attention. At Ballarat, mining on the plateau seems practically to have come to a standstill, owing to several causes. Until some developments are made, either in new or known centres, or work on some of the partly opened or untouched deep leads proves attractive, Victoria must rely for its gold output on the old mines. The Langi Logan deep lead property is now supplying 'wash' for treatment.

Dredging for Platinum in the Kytlim Valley, Russia

By R. S. BOTSFORD

For more than 15 years, 2 of the 3½ miles of the Kytlim valley, in the Ural mountains, has been worked by means of a bedrock tunnel. Last year's production was 640 lb. of crude platinum from this part of the estate alone.

Horses and carts were used in the lower part of the valley for removing the overburden and delivering the gravel to the various central washing-plants conveniently situated.

When the ground was found to be deeper half-way up the valley, shafts were started and *starateli*, or tributers, were put to work, more than 100 different shafts being opened at one time, with a population of over 2000 working the alluvial diggings.

The tributers leave about half the ground, digging only that part which they consider the richest and sufficiently drained in proximity to the bedrock tunnels; in fact, what they can work economically at the price they receive for the platinum from the Company.

My investigation has shown that it is desirable to employ a dredge to dig all the deposit, including the considerable amount of platinum in the overburden.

The Kytlim river empties into the Lobva, and for three miles the latter also has proved to be good dredging ground. An unsuccessful attempt had been made to divert the river, but the water proved too much, and the Lobva still remained untouched. A Putiloff 5½-ft. steam dredge with steel pontoon is now operating at a profit on the Lobva, and a modern 7½-ft. Marion electric dredge is being completed in the Kytlim valley. There is room for two more dredges on the 25,000,000 yd. of tested ground on this part of the estate alone. Testing was done by shafts, drilling being entirely unsatisfactory on account of the character of the ground and distribution of the platinum. The source of the platinum is the Koswinski Carmen, a hill of pyroxenite enclosing a boss of dunite, the disintegration of which provides the platinum alluvium of the streams rising on it, and combining to flow down the Kytlim valley. This has been definitely proved by Professor Duparc of the Geneva University.

The ground allotted to the Marion dredge will require to be flooded, and the dredge has been constructed to dig 16 ft. above and 25 ft. below water-level. A monitor and sand-pump have been provided, as well as a long stacker, 145 ft. 6 in. over all, to deal with the high bank above water and the occasional shallow digging to be expected from the moderately steep creek-grade. In order to deal with the gritty clay in the gravel, high-pressure water is used in the revolving screen, the latter being of the retarding stepped type, 36 ft. long, with manganese steel longitudinal agitating bars. The platinum occurs in fine and medium rounded grains, permitting ¼-in. holes in the screen with the advantage of

PUTILOFF, 5½-FT. DREDGE, PAVDA ESTATE, STARTED JULY 1914.

ERECTING THE MARION 7½-CU. FT. DREDGE, SEPTEMBER 1914.

carrying more of the washed gravel over the elevator and much better recovery on the double bank of steel tables, provided with matting followed by carbon steel angle-riffles. The suction of the 8-in. Morris sand-pump is connected direct to the under side of the upper tail-sluices to avoid priming.

The heavy, 72 ft. long, digging-ladder is of the plate-girder type with a water-tight drip-trough under the

ERECTING THE MARION DREDGE.

ERECTION OF 25-TON STERN GANTRY.

buckets extending to the lower tumbler, and is supported on the heavy foundation-castings of the main drive, concentric with the upper tumbler shaft. The bucket-line consists of 62 manganese steel one piece buckets of 32-in. pitch. Each bucket weighs 2165 lb., and the manganese steel pins are 5½-in. diameter. The crane overhangs the deck 8 ft. on each side and covers a width of 22 ft. The whole dredge is controlled by one operator in the pilot-house.

The pontoon is of strong construction, 44 by 100 ft., 8½ ft. deep, with 3 ft. overhang on each side. The stern gantry is 77½ ft. above the deck, which consists of ¼-in. plate covered with 2-in. plank. The sides consist of ⅜ in. with ½-in. plate around the well-hole. The pontoon, frame, and gantries were built here, 50 miles from the end of the private railroad, material being cut and trimmed, bent, punched or drilled, and riveted on the spot. The workshop is run by an oil-engine. The excellent martin steel of the Ural mountains shows under test a breaking stress of 24 to 27½ tons per square inch.

The heating plant contains a 35-hp. boiler on the pontoon with pipes to radiators at various points and to the stacker, which is covered and steam-heated with pan under the total length of belt. The stacker-belt is 34 in. wide. The dredge-housing is constructed of double siding with tarred paper between, to keep the dredge warm in winter. The total displacement of the dredge is about 830 tons.

The electrical equipment consists of 11 motors working at 2000 volts, 50 phase, 25 cycles, supplied by the American General Electric Company.

	Hp.
Ladder-hoist, variable speed induction motor	75
Winch " " " "	25
Screen-drive " " " "	50
Stacker-drive " " " "	25
Stacker-hoist " " " "	15
Main drive	150

PUMPS

10-in. Worthington, to tables, 3000 gal. per minute (constant speed)	50
12-in. Worthington volute, to screen and bucket spray, 4000 gal. per minute	100
3-in. priming pump, Worthington (constant speed)	15
8-in. Morris sand pump, motor (constant speed)	50
Giant-monitor, motor (constant speed)	50

The power is supplied by a 500-kva. De Laval turbo-generator set with a 600-hp. boiler, the current being transmitted at 10,000 volts. The central station is favorably situated as regards firewood on the Katechoram river, 3½ miles from the Marion dredge. The other dredges will be much closer to the station, which can be supplied with an ample amount of firewood for all likely requirements within a radius of 2 to 3 miles, all roads leading downhill to the station, thereby securing cheap haulage over the snow in winter.

The surface of the ground freezes with a normal amount of snow to a depth of 12 to 20 inches. The dredge starts at the lower end of the underground workings and a proper manipulation of the water feeding the dredging pond through the extensive warm workings should maintain the pond comparatively free from ice.

Testing Burned-Out Armatures

By LEONARD V. NEWTON

Where many electric motors are used in and about a mine for haulage and various other purposes, the electrical engineer is often called upon to test a burned-out armature and determine the coil or coils which are destroyed. The following is a description of a test which I have found to work admirably. The armature to be tested should first be mounted on a frame, so that it may easily be revolved. A stout string should then be wrapped around the commutator segments and securely tied. The current necessary in carrying out this test is small; therefore, if eight or ten 16-cp. incandescent lamps be connected in series, and the lead from one side of the lamp band be slipped under the cord around the commutator, and the lead from the other side of the lamp bands connected to the power-line, and the other side of the power-line connected to the commutator segments, say twenty segments apart, a current will pass through this portion of the armature. If then all these coils are perfect, the reading should be the same on a mili-voltmeter as the terminals are placed on adjacent commutator segments. If the mili-voltmeter shows an average reading, and then a low one, the coil giving the low reading is the burned-out coil. After testing the 20 segments, the power or current leads should be shifted to the next twenty until the entire commutator has been tested.

In practice, I have found that a switchboard ammeter, which is in reality a mili-voltmeter, serves admirably for the test. The theory of the test is as follows: the drop in voltage across a short-circuited coil is much less than through a coil that is not short-circuited, in as much as the drop in voltage through a big piece of copper is smaller than through a fine wire. Therefore, if there is any short-circuit in the armature, it is readily shown by the accompanying drop in voltage. The connections for the test are shown in the accompanying diagram.

FLINT PEBBLES worth $300,000 are imported each year into this country. According to Frank J. Katz, of the U. S. Geological Survey, the principal American localities at which flint pebbles have been noted in particular abundance are in Texas, Mississippi, Arkansas, and Missouri. One of these which is considered especially worthy of investigation, is the area of flint-bearing Cretaceous limestone in central Texas. Other kinds of tough silicious pebbles which are abundant in some parts of the United States are agate, carnelian, chalcedony, and petrified wood. Stream beds or shore beaches containing pebbles of this character should be searched.

THE Dominion Coal Co., Canada, production in 1914 was 4,287,150 tons, compared with 4,741,391 tons in 1913.

Misfires in Blasting and Their Causes

By J. B. BURGESS

Wherever high explosives are used, misfires or missed holes are a constant source of danger, expense, and annoyance. Many horrible accidents are caused through their detonation by tools in the hands of workmen. Valuable time is lost in searching for missed holes and in re-priming and firing them, and in waiting for the smoke to clear away before resuming work in the heading; to say nothing of the failure of a battery of holes to break its proper footage through the misfire of a leading hole. The causes and prevention of this kind of trouble are common subjects for earnest thought and discussion, participated in by everyone concerned, from 'mucker' to superintendent.

The Controlling Factors

The numerous elements involved in the preparation and blasting of a round of holes give many possibilities for unfavorable conditions, or defects in workmanship, any one of which may lead to a misfire. These elements may be enumerated as follows: nature of the ground; presence of ground-water; quality and grade of powder, fuse, and caps; temperature and dryness of powder; preparation of the fuse and cap; preparation and position of the primer; method of loading the hole; arrangement of exposed part of the fuse; and unavoidable circumstances.

All of these factors have been studied and made the subject of helpful and enlightening reports by various writers in the technical press, by the U. S. Bureau of Mines, and by the powder manufacturers; but it is my belief that there is room for further emphasis on the subject of care in the preparation of the fuse and cap. In the course of ten years' close observation of blasting conditions, involving daily inspection of newly blasted working faces, I have come to the conclusion that a large porportion of missed holes is caused by the failure of the cap to explode; and that this is the chief cause of the avoidable class of misfires, those that can be prevented by care on the part of the workmen. In this paper, therefore, I shall confine my remarks chiefly to that part of the subject.

The following definitions will be useful:

To 'spit' a fuse.—To ignite it, a common miner's term.

Flash.—The flashing of fire from the end of the fuse, opposite to that at which it was 'spit.'

Moderate crimping.—Crimping with a moderately firm grasp of the hand, not hard enough to bend the handles of the crimpers.

Hard crimping.—Crimping as hard as the strength of the crimpers will permit.

In the majority of instances of misfires that have come under my observation, where the fuse or primer was not cut off by the explosion of an adjacent hole, I have noticed that the fuse had burned as far down the hole as could be seen; and when the powder was exposed to view, it could be seen that the fuse had burned down into it. My courage and regard for my personal welfare was only occasionally equal to digging out the powder to see if the cap had exploded, but I did this in certain favorable instances, and have had my foreman bring me unexploded caps from missed holes when he found them. In a missed hole of this kind, it is rarely that I have found the cap to have exploded; and I have never found an unmutilated piece of fuse that had failed to burn to the end, even though it had been bent back upon itself for the purpose of inverting the cap in the primer, according to the questionable custom so often practised by miners. Almost invariably the fuse is found to have burned into the cap without exploding it. This fact puzzled me for a long time, but while the reason for the failure of the cap to explode cannot always be known with certainty, it can often be explained as the result of carelessness, or a wrong method of attaching the cap. Three particular instances of this kind are fresh in my mind. In one of these the cap had been crimped with the sharp point of a knife, which had been thrust so far into the side of the cap that it had penetrated to the train of powder in the fuse. I should hardly expect this to cause a misfire, but it is probable that the knife-hole made a way for the escape of fire from the fuse, and so weakened the flash that it did not ignite the fulminate. This was one misfire in a round of 15 shots. In another instance the cap had been crimped with a California crimper in an astonishing manner. It had been crimped hard more than half the length of the cap from the open end, so that the crimping extended ¼ in. over the fulminate. It had been turned ¼ over and crimped again in the same way. The cap, as found, presented a rather crushed or chewed up appearance. It is hard to believe that crimping over the fulminate could be done in this was as a regular practice without causing an accident. There were four misfires in this round of 18 holes. The important point to observe in this incident is that the tip of the fuse had been subjected to hard crimping, and this had caused the misfire, even though the end of the fuse had been cut off square and pushed into contact with the fulminate. In the third case the fuse had been cut at an angle of 45°, thrust into the cap up to the fulminate, and had been properly crimped with a California crimper. The reason for its failure to explode is not readily given, as the cap exploded when tested with another piece of fuse.

Experimental Results

In order to confirm the conclusions that I had arrived at through observation of practice, I recently made a series of experiments with fuse and caps, with the particular object of ascertaining how far it was necessary

to depart from the principles of good practice in order to cause misfires of the cap. In other words, I tried to find out how to produce misfires. I give the experiments in detail.

Experiments with Fuse

1. Fourteen feet of Bear brand fuse was laid along a board. The fuse was cut half way through at intervals of 2 ft., and then spit at one end, and rate of burning was timed for each 2 ft. A sharp puff of flame and smoke shot out from the knife-cuts as the fire passed them, enabling the time to be noted accurately. The time in seconds for 2-ft. lengths was as follows: 108, 92, 101, 101, 101, 105, 100, 109, 95, 101, 99, 98, 101, and 102. A second piece from another coil gave 97, 83, 92, 90, 90, 89, and 90. This experiment was to determine whether the rate of burning was uniform in each coil. As far as the experiment went, there was no indication of serious irregularity, and as there had been no complaints from the mine on this score, nor any observations on my part suggesting such a defect, no further tests were made.

2. Fifty feet of Bear brand fuse was stretched out along a steep bank, supported at irregular intervals on rocks, and ignited. It burned through uniformly. The strength of the fabric after burning was sufficient so the fuse did not break apart of its own weight.

3. Pieces of Bear brand fuse when twisted, kinked, and pulled in the hands, did not open up so as to expose the powder. The same result was observed when the fuse was used as pack cord and tied in knots by miners.

4. Fifty feet of fuse of foreign manufacture was stretched along a rocky slope and ignited as in experiment 2. It burned through uniformly, but fell apart in several places by its own weight after burning.

5. Pieces of foreign made fuse were twisted and kinked. They usually opened up badly and exposed the powder.

6. The following tests were made to determine the effect of pressure on rate of burning, the fuse being all taken from the same coil: (*a*) three pieces 12 in. long ignited—the time of burning was 52, 49, and 44 seconds; (*b*) two pieces 12 in. long were placed between the jaws of a 6-in. vise, so that 6 in. of fuse was strongly compressed, and 5 in. protruded beyond the jaws in the direction of burning—the time of burning was 44 and 45 seconds; (*c*) one piece 12 in. long was compressed in a vise, taken out, turned one quarter over and compressed again—the time of burning was 47 seconds. No appreciable change in rate due to pressure was observed, but in each trial the fuse exploded with a sharp snap as the fire emerged from the jaws of the vise, and blew a hole through the side of the fuse.

7. A piece of fuse was strongly gripped in the vise between two blocks of wood, ½ in. wide. The fuse was allowed to protrude ½ in. beyond the blocks in the direction of fire. The flash was more vigorous than in the case of loose fuse.

8. A piece of fuse was strongly gripped in a vise as in No. 7, but between an iron block on one side and a piece of hard belting leather on the other. The flash was vigorous as in No. 7.

9. Two pieces of fuse were gripped as in No. 8, but the end of the fuse was flush with edge of blocks, so that none protruded. The flash was very weak—not over ⅛ or ¼ in. beyond end of fuse.

10. Several pieces of fuse were gripped firmly at their extreme ends in jaws of California crimpers, and ignited at the other end. The flash was noticeably weaker than when burned without pressure. When the end of the fuse was crushed twice on opposite sides with the edges of the crimping surface of the crimpers and then held firmly in the crimpers, the flash was extremely weak, only a few sparks getting through, and these being feeble.

11. Several pieces of fuse were gripped strongly in crimpers so that ½ in. of fuse protruded. The flash was strong.

12. A piece of cold glass was held ½ in. from the end of the burning fuse. When the flash occurred, a considerable quantity of moisture was condensed on the glass.

Experiments with Caps

All caps, with the exception noted, were No. 8, made by the California Cap Co. All were crimped with a California crimper.

13. Number tested, 20; fuse cut square; end of fuse placed in loose contact with fulminate; crimped with one moderate pressure at end of cap. All exploded.

14. Number tested, 20; fuse cut square; end of fuse in loose contact with fulminate; crimped hard two widths of crimper, revolved quarter turn and crimped again. All exploded.

15. Number tested, 20; fuse cut square; end of fuse in contact with fulminate; crimped hard with edges of crimper so as to bruise fuse, and then crimped hard in the regular way for two widths of crimper; cap had battered appearance. All exploded.

16. Number tested, 20; fuse cut square; end of fuse ¼ in. from fulminate; crimped with one moderate pressure at end of cap. All exploded.

17. Number tested, 20; fuse cut square; end of fuse ¼ in. from fulminate; crimped hard with pressure, two widths of crimper, so that crimping extended to tip of fuse, revolved half over and crimped again. Nine missed fire.

18. Number tested, 20; fuse cut square; end of fuse ½ in. from fulminate; crimped with one moderate pressure at end of cap. All exploded.

19. Number tested, 20; fuse cut with long slant and end pushed firmly against fulminate; crimped with one moderate pressure at end of cap. All exploded.

20. Number tested, 20; fuse cut square; end of fuse in contact with fulminate; crimped with fuse cutters, making deeply indented groove around cap. All exploded.

21. Three caps with end of fuse ½ in. from fulmi-

nate were placed in snow and left several minutes before spitting. All exploded.

22. No. 5 caps; number tested, 50; fuse cut square and placed in loose contact with fulminate; crimped with one moderate pressure at end of cap. All exploded.

The results of these tests point definitely to the squeezing and crushing of the extreme end of the fuse inside the cap as certain to cause misfires. Experiments 1 to 5 showed nothing wrong with the fuse, although they were not conducted on a large enough scale to be considered an adequate test where a large quantity of fuse is under consideration.

Experiment 6 showed that pressure did not alter the rate of burning to any appreciable extent, and did not extinguish the fuse. The explosion at the point where the fuse left the vise is explained as the result of the constriction in the bore of the fuse. The powder train, while burning between the vise-jaws, was compelled to do so under an unusual pressure from the resulting gases, in order to force them through the constricted opening; and this pressure was sufficient to rupture the walls of the fuse as soon as it was unsupported by the vise. In No. 7 and 8 this pressure exerted itself in forcing the fire through the remaining half inch of fuse, and thereby increased the strength of the flash. Experiments 9 and 10 showed that the explosive force of the burning powder was greatly decreased when the fuse was under pressure, although as seen in No. 6, the rate of burning was not affected. When the fuse was under pressure to its extreme end, the flash was very weak. Experiments 7, 8, and 11 showed that ½ in. of uncompressed fuse lying beyond the area of pressure was sufficient to insure a strong flash.

Of the experiments with caps, No. 13, 14, 15, 20, and 22 showed perfect results in all cases where the end of the fuse was cut square and placed in loose contact with the fulminate, even when the crimping was unnecessarily severe. It is noteworthy that no experiment was made with the fuse in contact with the fulminate and the cap crimped to the tip of the fuse, as this would have involved danger of accidental explosion of the fulminate in the crimping process.

No. 16 and 18 gave perfect results with the end of the fuse ¼ and ½ in. from the fulminate, although it is conceivable that with weak fuse misfires might occur from this practice if it were followed regularly.

No. 17, considered in connection with No. 9 and 10, indicates the possibility of misfires that can easily occur in practice, and one that would hardly be suspected without a special investigation. The experiments show that pressure at the tip of the fuse, especially if it be applied several times and from different directions so as to roll or crush the fuse and disarrange the powder train, decidedly weakens the flash, to such an extent that when the end of the fuse was ¼ in. from the fulminate it caused nine misfires out of 20. In contrast to this, with moderate crimping, all of 20 trials were successful when the end of the fuse was ½ in. from the fulminate. The incident of careless crimping that I mentioned, with its four misfires out of 18 loaded holes, was doubtless of this nature, and was due to crushing and crimping the fuse at its tip, as shown by an investigation of the single cap recovered after soaking it in water. Considerations of caution prevented me from carrying my investigation to the extent that my ex-employee did.

Experiment 19 failed to produce any misfires, although the practice of cutting the fuse with a long slant is commonly regarded as a cause of misfires, and cannot be recommended. The experiment was made in cold weather. Probably if the fuse were warm, the slanting end would show a greater tendency to curl over when pressed against the fulminate and thus prevent the flash from striking the fulminate. It is also probable that the chance of misfires from hard crimping would be increased with warm fuse, because it would then be softer and more easily crushed.

Experiment 21 was made to test the possibility of misfires being caused by the condensation of moisture in the flash (experiment 12) on the cold fulminate, so as to prevent its explosion, but the result was negative.

I realize that to make experiments of this kind conclusive as to the proportion of missed holes caused by the different methods of attaching the cap to the fuse, it would be necessary greatly to increase the number of tests; but, as I stated before, my object was rather to test the conclusions formed by observations made under working conditions, and incidentally to learn anything new that might come up; and the number of trials was sufficient for this purpose. As I hoped, they showed up the ease with which misfires could be caused by a slight variation from the commonly approved method of attaching fuse and cap.

Summary of Conclusions

To summarize my conclusions, I would make the following recommendations:

1. Cut the fuse square, with an instrument that does not mash the end, such as a sharp knife, a pair of sheep shears, or, best of all, a broad, thin, sharp chisel used with a mallet.

2. Insert the fuse into the cap until the end is in loose contact with the fulminate.

3. Use the California crimper (broad type), giving the cap one firm squeeze close to the open end. If working where there is water in the holes, protect the cap from dampness by applying grease or tar.

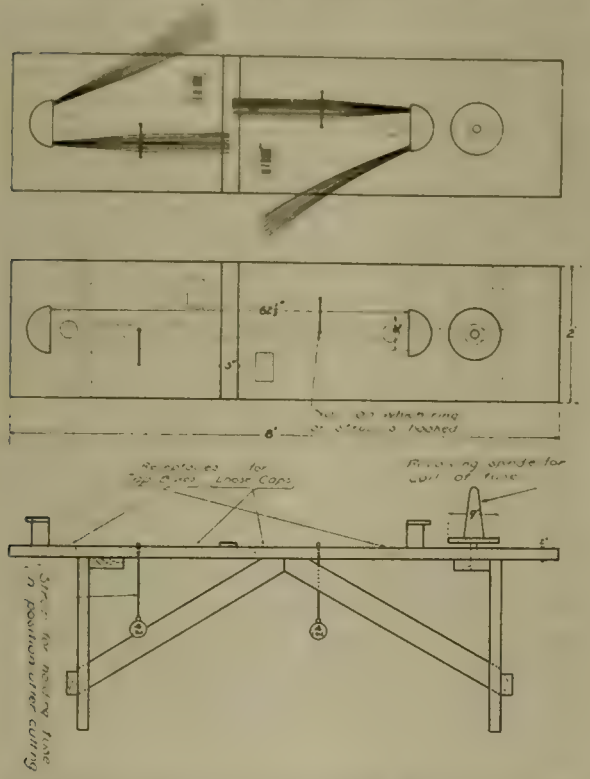
4. Particularly avoid crimping the cap over the tip of the fuse. Always leave ¼ to ½ in. of uncrimped fuse at the end.

5. If possible, have one reliable man trained to prepare all the fuse for the mine (according to the size of the mine).

Previous to making this investigation I had been bothered with an undue number of misfires in the mine. Each miner had been allowed to prepare his own fuse and caps, but on adopting the system of having all the fuse and caps prepared by one man, the misfires were

almost eliminated. Where the magnitude of the operations permits, it is well to take the further step of instituting the blasting crew system. With any system some misfires will happen, but with care they need not occur so often as to call attention to themselves by their frequency.

A convenient fuse-cutting table is shown in the drawing. The distance between the semicircular blocks can be arranged for cutting any length of fuse desired, but the dimensions shown are for six-foot fuse. The three-



FUSE-CUTTING TABLE. THE UPPER FIGURE SHOWS FUSE AFTER CUTTING AND READY FOR ATTACHING THE CAPS.

inch strip across the table midway between the semicircular blocks serves as a cutting-block when cutting the fuse with a chisel. The upper sketch shows the cut fuse ready for attaching the caps. The use of this table offers an opportunity for the introduction of efficiency principles. For the fastest work the caps are laid in the cap receptacle, with their open ends toward the fuse. They are then in a convenient position to be quickly slipped on the fuse. The caps are all put on the fuse before the crimping is done.

Water in Pennsylvania Anthracite Mines

The quantity of water that must be pumped and hoisted from these mines has increased nearly 10% in the past 10 years, and will continue to increase, making the mining of anthracite more expensive. It has been computed that every ton of coal removed from the mines involves the removal of a ton of water every year thereafter, until the mine and all workings connected with it are worked out or abandoned. In 1904 there were 846 pumps underground, and in 1914 they were increased to 929, besides water hoists. Water delivered at the surface in these years was 446,120 and 489,600 gal. per minute, respectively.

Moving a Shovel Up and Down Grades*

In moving a shovel any distance across country, especially where grades are encountered, it is safe to say that it takes twice as long with the boom up as with the boom down. When an engineer attempts to move the shovel with the boom up, the centre of gravity is high, and when there is any settling or unevenness of the track, there is a great likelihood that the shovel will turn over. With the boom down, on the other hand, there is a better distribution of the weight, consequently less blocking is required under the track, and it is not necessary to shim the track so carefully, as it does not have to be so level in order to make conditions safe.

The best way is to drop the boom on a truck or on a four or five-yard car, having the centre of the boom supported on the truck or car. The end of the boom, of course, is meanwhile resting on the boom step. Tie the boom to the circle with chains running from the circle brace clevises to the clevises on the sides of the boom; take the hoisting chain off the drum and drop it on the circle; take out the front car coupler so as to get a clear lead ahead; then run a cable on the drum and lead the cable ahead. A stake or stump will pull out with much ease, consequently the end of the cable should be fastened to a 'dead-man.' This should preferably be a heavy piece of timber 10 to 12 ft. long, dropped into a pit dug for it at right angles to the direction in which the shovel is traveling. A ditch should be dug out of the pit leading toward the shovel, so as to provide clearance for the cable which is attached to the centre of the timber. The timber is held in the pit by driving rails or pieces of timbers crosswise over it into the sides of the pit. The dipper and handle may either be hauled independently in a wagon by horses, or in a truck attached to the end of the shovel. This last method is the more satisfactory, as the loading process is easier.

In going down hill, the cable may be led under the shovel and anchored, as before, to a 'dead-man.' The shovel may then be lowered under perfect control by simply manipulating the hoisting brake. In climbing over steep short hills, it has been found more satisfactory to use the hoisting chain instead of the cable, because in cases such as this the strain is often too great for an ordinary sized cable.

ANTHRACITE COAL shipped to market during January totaled 5,175,732 tons, much of which was from storage yards.

*Abstract from *The Excavating Engineer.*

Improvements at the Reduction Works of the Anaconda Copper Company

*When John D. Ryan and B. B. Thayer were at Butte last December the important announcement was made that about $6,000,000 would be expended by the Company in improvements at the reduction works at Anaconda and Great Falls. These improvements are expected to result in considerable savings in metal and operation costs, and will permit the Company to work a lower grade of ore than has hitherto been possible, and will thus result in a considerable prolongation of the life of the mines.

At the present time the recovery made on the ore sent to Anaconda and Great Falls is only about 78% of the copper content. It is expected to raise this recovery to about 91% by the use of the flotation process on the material which now leaves the concentrator. This will require radical changes in the lower part of the mill. The upper portion will remain much the same as it is now, except that a Symons disc crusher will be added in each section in order to obtain increased crusher capacity. By so doing, the capacity of the concentrator will be increased from about 12,500 tons per day to 15,000 tons per day. The jigs on the roll and Huntington mill floors will be replaced by roughing tables of a special design which will make concentrate and coarse tailing. The tailing will be reground in pebble mills, so that it will pass a screen with about 60 holes to the lineal inch. This finely ground sand will then go to the flotation machines, which will be situated on the lower table floor and which will make a concentrate containing about 8% of copper and a tailing of only about 0.1% copper. The slime which is now treated on round tables will be further treated in flotation machines, making a tailing which can go to waste and concentrate which will go to the filter plant.

Under the new system there will be no first-class ore and all of the ore from the mines will go to the concentrator instead of being partly sent to the blast-furnaces. No coarse concentrate will be produced, and the field of the blast-furnaces will be greatly restricted, if the latter are not entirely eliminated. In order to take care of all of the concentrate which has been going to the blast-furnaces, as well as the concentrate which results from the treatment of first-class ore and from the increased recovery, a new roaster plant will be constructed containing 40 furnaces of 22 ft. 6 in. diameter. These furnaces will be charged by a conveyor system instead of by cars as are the furnaces in the old roasting plant. The calcine from this plant, as well as from the old roasting plant, will be hauled by the present tramming system to the present reverberatory plant. The furnaces in this plant are all being enlarged and equipped with pulverized coal burners. The new furnaces will be 25 ft. wide by almost 150 ft. long and will smelt about 650 tons per day each. The present reverberatory buildings will therefore house furnaces having an aggregate capacity almost two and a half times as great as before, and will smelt all of the concentrate coming from both roasting plants.

The barrel-shaped converters in the converter plant are being replaced by large upright converters of the Great Falls type about 20 ft. diameter. There will be seven of these converters, and they will be able to produce about 22,000,000 lb. of copper per month. The slag from these converters, which is now being solidified and resmelted in the blast-furnaces, will be tapped into large ladles and poured from these directly into a huge reverberatory which will be constructed in the relining department of the converter plant. This furnace will be by far the largest reverberatory in the world, and will be 25 ft. wide by 175 ft. long. It will receive about 700 tons of molten converter slag and 350 tons of fine ore per day. The furnace will clean the converter slag to such an extent that it may run to waste.

The new plant will be partly supplied with air from a turbo blower having a capacity of about 35,000 cu. ft. of free air per minute. This blower is direct connected to a steam turbine and runs at about 3400 r.p.m. It is now in operation and has proved highly successful. The blast-furnace and the briquetting plants will, under the new system, be no longer required, but will be kept intact and in good repair, so that they may be used in emergencies or at times when the price of copper is high and it may be advisable to push the copper output beyond the maximum capacity of the other departments.

The improvements at Anaconda will cost about $4,000,000. At Great Falls about $1,750,000 will be spent. A new refinery is being constructed at Great Falls which will have a capacity of 10,000,000 lb. of copper per month. It will replace the old refinery which has been in operation a great many years and which is no longer economical. The new plant will, however, have twice the capacity of the old plant. The refinery will be kept in operation, partly or entirely, on copper shipped from Anaconda, depending on whether or not the Great Falls smelter is in operation. The new smelter at Great Falls will be completed and the pulverized coal system, which has proved so successful at Anaconda, will be applied to the Great Falls furnace. Coal from the Lochray coalfields is to be burned. The ash content of this coal is high, but this has not proved detrimental. Both the output per furnace and the tonnage smelted per ton of coal will be greatly increased over the old system of gas firing. No concentration of ore will be done at Great Falls. All of the ore will come to Anaconda and concentrate only will be shipped from there. The blast-furnace department at Great Falls

*Abstract from *The Anode*, February 1915.

will also be closed, and all smelting will be done in reverberatories, as at Anaconda.

The new leaching plant at Anaconda, which will be operated on tailing that has accumulated during the past years to such an extent that about 15,000,000 tons is available for re-treatment, is nearing completion, and will probably be started early in April. It will treat from 2000 to 2500 tons per day of tailing containing from 13 to 14 lb. of copper per ton, and will make from 600,000 to 700,000 lb. of copper per month at low cost. The supply of tailing for this plant is sufficient to keep it in operation for a period of about twenty years.

The new acid plant is also nearing completion and will be able to make somewhat over 100 tons of acid per day. This acid will be used in the leaching plant and in the new flotation plants.

The Company has much experimental work under way along various lines, which may in the course of a few years lead to the establishment of other important lines of industry at Anaconda and other points.

Placer Mining Claims in the Yukon

By J. A. MacDONALD

In accordance with the terms of the Yukon placer mining act, 'mining' or 'placer mining' includes every mode and method of working whereby earth, soil, gravel, or cement may be removed, washed, shifted, or refined or otherwise dealt with, for the purpose of obtaining gold or such other minerals or stones, but does not include the working of rock *in situ*.

Size and form of claims.—A claim on a creek must not exceed 500 ft. in length, measured along the base line of the creek, established or to be established by a government survey. The rear boundaries of the claim are made parallel to the base line, and are defined by measuring 1000 ft. on each side of such base line. In the event of the base line not being established, the claim may be staked along the general direction of the valley of the creek. Claims situated elsewhere than on a creek shall not exceed 500 ft. in length parallel to the base line of the creek toward which it fronts by 1000 ft. A claim fronting on a creek or river is staked as nearly as possible parallel to the general direction of the valley of the creek or river, and conforms to the boundaries which the base line, when established, defines. Claims are measured horizontally irrespective of inequalities on the surface of the ground. The official survey which establishes the base of a creek or river at the same time establishes the side lines of claims located on the creek or river, and is final as to the location of such base line and side lines.

A creek claim must be as nearly as possible rectangular in form, and must be marked by two legal posts firmly fixed in the ground on the base line at each end of the claim; claims situated elsewhere than on a creek must be as nearly as possible rectangular in form and must be marked by two legal posts firmly fixed in the ground in a line parallel to the base line, and on the side nearest to the creek or river toward which it fronts. The line between the two posts is to be well cut out so that one post may, if the nature of the surface will permit, be seen from the other. One of the flattened sides of each post shall face the claim, and on each post shall be written, on the side facing the claim, a legible notice stating the name or number of the claim, or both if possible, its length in feet, the date when staked, and the full Christian and surname of the locator. The posts are numbered 1 and 2, respectively, and it is not lawful to move them, except that No. 2 may be moved by a Dominion land surveyor if the distance between the posts exceeds the length prescribed by the Yukon placer mining act, but not otherwise.

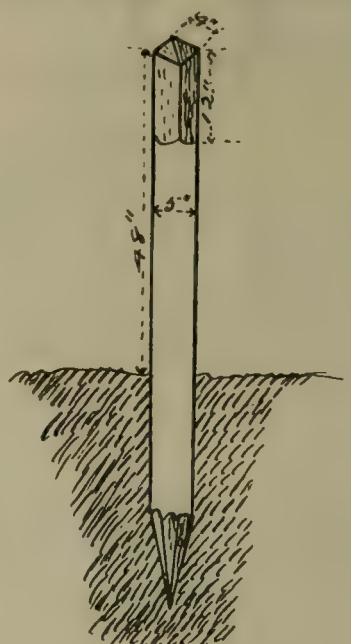


FIG. 1. LEGAL POST.

A legal post must be a stake having a diameter throughout of not less than five inches, standing not less than four feet above the ground, and flattened on two sides for at least one foot from the top, each of the sides so flattened measuring at least four inches across the face, and includes also any stump or tree cut off and flattened or faced to the aforesaid height and size. Any person or party of persons locating the first claim on any creek, hill, bench, bar, or plain, or locating a claim on any creek, hill, bench, bar, or plain upon which there is no recorded claim, is entitled to a

claim or claims respectively of the following size, namely: one locator, one claim 1500 ft. in length; a party of two locators, two claims, each of 1250 ft. in length; a party of more than two locators, two claims, each of 1000 ft. in length, and for each member of the party beyond two, a claim of the ordinary size only.

The boundaries of any claim in the Yukon, by order of the gold commissioner or mining recorder, upon application by the owner, may be enlarged to the size of a claim allowed by the act if such an enlargement will

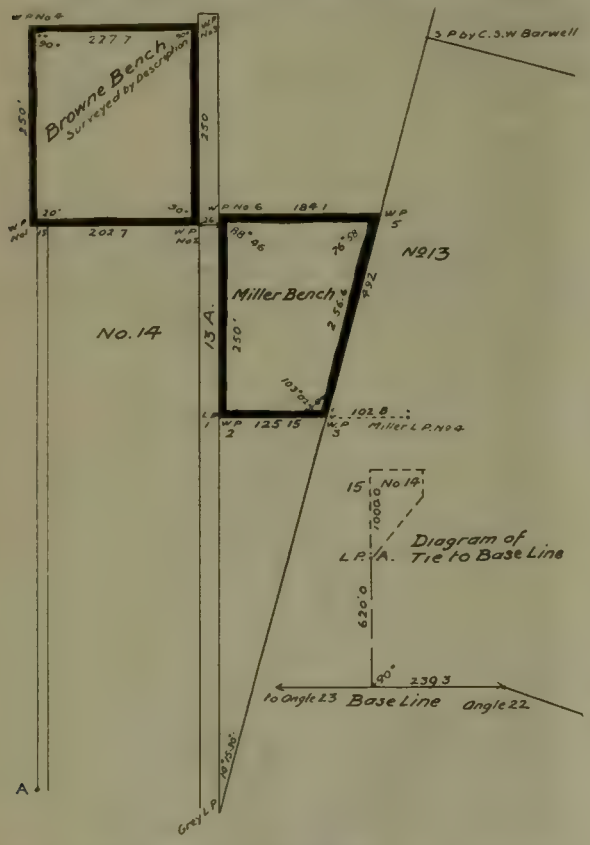


FIG. 2. BENCH CLAIM ON HUNKER CREEK. THE IMPORTANCE OF ACCURATE SURVEYS MAY BE INFERRED FROM THE FACT THAT ONE CLAIM 100 FT. SQUARE HAS YIELDED $80,000.

not interfere with any mining property which is owned by any other person or which is subject to the terms of an agreement with the Crown.

Locating and recording.—An application for a grant of a claim must be filed with the mining recorder within ten days after the location thereof, if it is located within ten miles of the mining recorder's office. One extra day is allowed for every additional ten miles or fraction thereof. The location of a claim on Sunday or any public holiday is not for that reason invalid. In the event of a claim being more than 100 miles from a recorder's office, and situated where other claims are being located, the locators, not less than five in number, are authorized to meet and appoint one of their number an emergency recorder, who shall act in that capacity until a mining recorder is appointed. The emergency

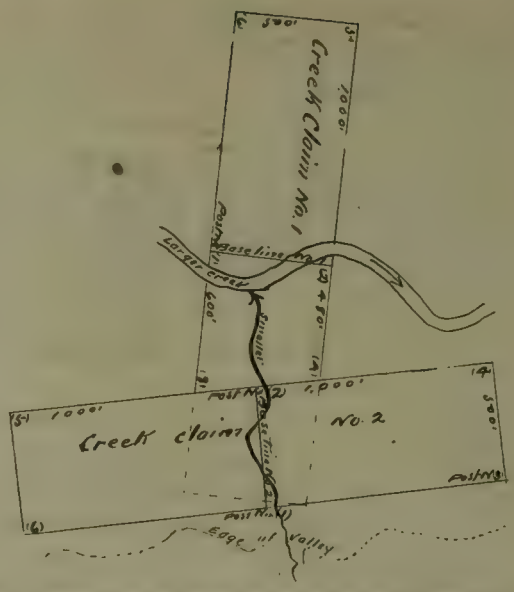


FIG. 3. RIGHT ANGLED CREEK CLAIM GIVING NO. 2 ONE-HALF THE PAY-STREAK OF NO. 1. IN THIS CASE A SMALL CREEK RUNS INTO A LARGER ONE AT RIGHT ANGLES TO THE PAY-STREAK OF THE LARGER CREEK, WHICH HAS A WIDE VALLEY ON THE SIDE UPON WHICH THE SMALLER CREEK ENTERS. A MINER STAKES OUT A CLAIM ALONG THE SMALLER CREEK IN THE VALLEY OF THE LARGER ONE SO THAT HIS CLAIM OF 1000 FT. ON EACH SIDE OF HIS BASE LINE (OF THE SMALLER CREEK) WILL INCLUDE POSSIBLY UP TO 2000 FT. OF THE PAY-STREAK OF THE LARGER CREEK.

recorder must, at the earliest possible date after his appointment, notify the nearest mining recorder thereof, and upon the arrival of the mining recorder, he shall deliver to him his records and the fees received for recording claims.

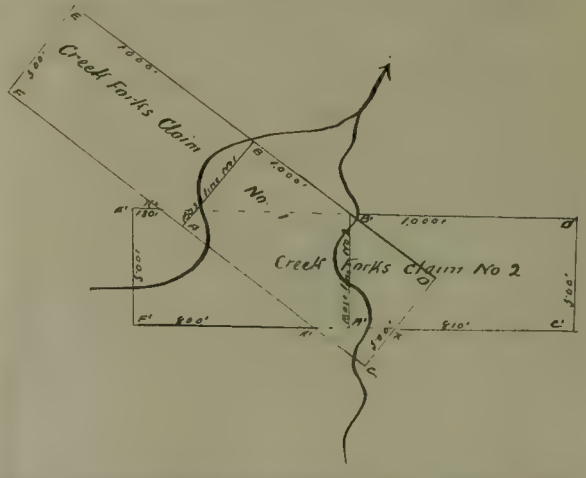


FIG. 4. CREEK FORKS CLAIM GIVING NO. 1 TWO LENGTHS OF PAY-STREAK. A BASE LINE IS RUN UP EACH FORK. A MINER STAKES A CLAIM ON ONE FORK A SHORT DISTANCE UP FROM THE FORK, AND HIS CLAIM BEING 1000 FT. ON EACH SIDE OF THE BASE LINE MAY EXTEND ACROSS THE OTHER FORK, AS SHOWN IN THE FIGURE, THUS GIVING HIM, THE OWNER OF CLAIM NO. 1, TWO LENGTHS OF PAY-STREAK, EACH ALMOST THE LENGTH OF A CLAIM.

Surveys of claims made under instructions issued by direction of the commissioner to a duly qualified Dominion land surveyor are accepted as defining absolutely the boundaries of the claims surveyed, provided the returns of the survey are approved by the commissioner or an official appointed by him for that purpose, and notice of such survey has been published in the Yukon official gazette for 12 consecutive issues, and remained unprotested during that period.

The owner of a claim so surveyed must, prior to the first appearance of the advertisement in the Yukon official gazette, cause to be posted in a conspicuous spot on the claim a notice of his intention to advertise the survey of the claim, and also a plan of the survey of the claim prepared by the surveyor. If, within the time during which such notice is published, the survey is protested, the protest shall be heard and decided upon by the gold commissioner, and if a decision is rendered varying the boundaries of the claim from those defined by the advertised survey, the owner of the claim may have the claim re-surveyed and fresh returns prepared embodying the changes involved by such decision, and such re-survey being approved by the commissioner, or the official appointed by him for that purpose, may without advertisement be accepted by the gold commissioner in lieu of the survey that has been protested. The expenses in connection with the survey and advertisement of claims must be defrayed by the owners of the claims, but no fees are charged by the government for filing plans, etc.

Title.—Any person having duly located a claim may obtain a grant thereof for one or five years by paying to the mining recorder, in advance, the fees prescribed.

Water rights.—Every person owning a claim is entitled to the seepage water on his claim and to the use of so much of the water naturally flowing through or past his claim and not already lawfully appropriated, as, in the opinion of the mining inspector, is necessary for the due working thereof; and is entitled to drain his own claim free of charge.

Stamp-Mill Data at the Brunswick Consolidated

This Company's plant is at Grass Valley, California, and the report for 1914 gives the following:

Stamps working	20
Ore crushed, tons	16,237
Duty per stamp-day (7010 hours lost)	2.326
Quicksilver fed to batteries, ounces	14,756
Value of bullion recovered per ounce of quicksilver fed.	$18.212
Amalgam recovered, ounces	40,267
Bullion in amalgam, ounces	15,663
Gold in bullion, ounces	12,992
Silver in bullion, ounces	2,622
Average value of bullion per ounce	$16.908
Bullion yield per ton of ore	16.628
Concentrate saved, tons	288
Loss in tailing, per ton	$0.88
Extraction by amalgamation and concentration, per cent	93.9
Cost of milling and concentrate treatment, per ton	$0.926

Spelter Production of the Butte & Superior Mine

The report of the Butte & Superior Copper Co. for the last quarter of 1914 contains the following interesting data:

Details of operation	Fourth quarter	Third quarter
Mine development, feet	2,242	5,309
Ore milled, dry tons	33,520	100,600
Average zinc content, per cent	19.4538	18.582
Average silver content, ounces per ton	8.9286	8.6359
Zinc concentrate produced, pounds	20,464,000	60,974,368
Average zinc in concentrate, per cent	53.947	54.32
Total zinc in concentrate, pounds	11,039,557	33,121,312
Average silver in zinc concentrate, ounces per ton	23.54	24.15
Mill recovery, per cent total zinc recovered in concentrate	84.65	89.14
Mining cost per ton	$3.288	$3.201
Milling cost per ton	2.466	2.049
Total cost per ton, mining and milling	5.754	5.250

The reduced output was due to a shut-down for 61 days for repairs to the main shaft, mill overhaul, and general surface improvements.

The financial results were as follows:

	Fourth quarter.	Third quarter.
Net value of zinc concentrate at mill	$238,803	$738,803
Net value of lead concentrate at mill	75,966	282,033
Total value of products	$314,769	$1,020,836
Net profit with miscellaneous income	130,537	499,136

Mining Costs at the Portland Mine

The following figures refer to the cost of mining at this well known Cripple Creek property during 1914, and are from the report of the manager, Frank L. Smale:

Stoping:		Cost per ton crude.
Breaking ore:		
Labor	$0.361	
Explosives	0.177	
Machine-drills	0.119	
		$0.657
Tramming		0.189
Timbering:		
Labor	$0.214	
Timber	0.128	
		0.342
Hoisting		0.161
Sorting and loading		0.160
Pumping		....
Lighting		0.020
Assaying and sampling		0.033
Surveying		0.015
Repairs and replacements		0.200
General expense		0.109
Office expense		0.019
Total stoping, 278,993 crude tons at average cost of		$1.905
Development work only,* 55,820 crude tons at average cost of		2.352
Total, 334,813 crude tons at average cost of		$1.980

*Drifts, cross-cuts, rises, winzes, and shaft-sinking.

DISCUSSION

Readers of the MINING PRESS *are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.*

Amalgamation in Hardinge Mills

The Editor:

Sir—Having given the subject no inconsiderable attention, and being therefore deeply interested in the discussion in the *Press* with reference to amalgamation in Hardinge mills, which covers the general ground of violent grinding of gold ores in bulk in presence of mercury, some of my experiences along these lines may be worth while.

I have never been one to believe that cyanidation would ever become a universal cure-all for gold extraction, and I am indeed glad that amalgamation is again seeking a hearing. My own experiences with amalgamation have led me to favor it. Some notes on pan and barrel work follow.

At the Curaren mill, in Honduras, where the ore was a clear yellow bulky quartz, with clay in the seams, containing about 2.75% iron pyrite, assaying $7 gold and 34 oz. silver per ton, stamps were used to crush to 30 mesh. The 5-ft. pans, 3 ft. 8 in. deep, were charged with about 1½ tons of ore and about 80% water (by volume). This filled the pan to within 8 or 10 inches of the top, the pulp becoming about the consistence of soft mortar. The charge was ground for one hour, then 10 lb. of salt, 10 lb. of sulphate of iron, and 2 flasks (150 lb.) of mercury were added. The grinding was continued for 2 hours more, when the mullers, which were run at 125 r.p.m., were raised one inch. In 3 hours more, or 6 hours in all, the pan was discharged into the settling tank, which contained 200 or 300 lb. of extra mercury, and was half filled with water. Additional water was added to the settler, while in operation, until quite full.

The settler was 10 ft. in diameter, 3 ft. deep, provided with arms turning 25 times per minute to agitate the pulp in order that the amalgam and mercury might be released from the pulp and properly settle into the extra mercury at the bottom. After one hour the tailing was gradually discharged, beginning from the top outlet, the water continuing to flow until the operation was finished. The extraction at this plant averaged 92% gold and 78% silver. It will be observed that this ore, except the pyrite content, was free in character. No concentration was employed here.

At the Rosario mill in Honduras, at which plant also I was at one time superintendent, the ores were rather more complex, consisting of white ribbon quartz with considerable black slate. I observed no indication of talc or graphite in either the slate or quartz that would tend to 'sicken' the mercury. But these ores contained 3.5% of iron pyrite and about 1.5% zinc-blende. The ore contained $9 gold and 28 to 30 oz. silver per ton. The extraction was 86% gold and 67% silver. The pan practice at this mill was in every respect similar to the Curaren plant, except that 15 lb. of sulphate and 250 lb. of mercury were used in each charge. The general clean-up of these plants occurred once each month, when a careful inventory of losses and expenditures was taken. The mercury loss at the Curaren mill was about 7 to 8% per month, while at the Rosario not more than 10% per month. Had these ores contained no silver, such large quantities of mercury would not have been necessary, nor would the losses have been so large in proportion. At the Rosario mill the tailing from the settlers was concentrated on Frue vanners, the concentrate roasted, then reground and amalgamated in pans, without chemicals, and with excellent results.

My first experience in violent grinding of gold ore in bulk in presence of mercury was a number of years ago at Hacienda La Providencia, Puebla, Mexico. In this mill were 16 wooden cylinders, 6 by 8 ft., mounted to revolve about thirty times per minute on their longitudinal axes. They were known as barrel amalgamators. These barrels were in 4 rows of 4 each, each row having its separate clean-up sluice-way, which was 6 ft. wide at the top and 5 ft. 8 in. wide at the bottom, and 1 ft. deep, having a grade of 1 to 20, the bottom of the sluice being about 2 ft. below the rim of the lowest barrel in the row. For a space of 10 ft. below the barrels the sluice was smooth, having an iron bar a few feet below the barrels reaching across from side to side, to hold the balls from going down the run on cleaning up. These sluices were made of masonry, finished smooth with cement on the surface. Cast iron cups, 2½ inches in diameter, were placed in rows 6 in. between centres, each cup having a space equal to its own diameter in the rows and arranged so that the space in the first row would be covered by a cup in the second, and so on. These cups were 1¼ in. deep, with rounded bottoms, all firmly imbedded evenly to the rims smoothly in the cement, this portion of the sluice being 30 ft. long.

The ores of this mill were clear ribbon or stratified quartz, with fine streaks of black slate in the seams containing about 2% iron pyrite, with traces or insignificant quantities of galena, the whole assaying about $12 gold and 20 to 25 oz. silver per ton. Large pieces of ore, too big for the mortars, were broken by hand, there being no crusher on the property. The ore was

then milled with wooden stamps having cast iron shoes and dies, square, to cover every part of the mortar bottom. As the milled ore became small enough, from ¼ in. to 'fines,' it was thrown aside for the barrel charges. That portion thrown out of the mortars considered too large for further treatment was returned by the battery man, who fed by hand. There were no screens to these batteries, and the ore was crushed dry. About two tons of ore was charged to each barrel through a hole in the side, about eight inches square, made for the purpose, tightly closed and bolted when ready for use.

The barrels were lined with steel strips 2 in. wide and ½ in. thick, screwed to the sides lengthwise, about 2 in. space between the strips. A heavy oak timber, about one foot square, ran through the centre of the barrel to act as a shaft, rounded at the bearings, and the whole driven by water power.

When the ore was charged, about 200 lb. of iron balls, 3 in. diameter each, about 2 flasks (140 lb.) of mercury, 15 lb. salt, and 75% water (by volume) were added. The whole mass occupied something less than two-thirds of the barrel. It was then turned for 6 hours at 30 r.p.m., when it was stopped, opened, enough water added completely to fill, then closed, and turned again for about 20 minutes to soften the charge, when the whole mass was slowly dumped into the sluice beneath. There was a constant flow of water over this sluice, about ¼ in. deep, which, when a charge was dumped, quickly swept the tailing away, leaving the mercury and amalgam safely in the cups of the sluice. After the clear water had carried away the sand from all the cups, which the peculiar action of the currents soon accomplished, the cups were cleaned out with small iron spoons made to fit snugly the rounded bottoms of the cups, which operation was performed readily by two men in about one hour. The extraction of gold was never below 90%, and frequently as high as 95%, and silver 64 to 67 per cent.

I operated this property for four years, and saw no reason to change the very efficient work performed by this primitive mill. Labor was cheap, and fairly reliable. The property had been operated for over a hundred years, and the operators, from father to son, were expert in this work. There was no flouring of mercury, nor was there any undue loss of this material, more than should be expected in the best modern mills.

I have related these experiences because the principle involved is similar to the work sought to be performed successfully by the more modern tube-mill, except that the practice under consideration should be a continuous operation. Therefore, the conclusions I have reached, from years of experience and a more recent special study of the subject, cover four important factors in the problem, each to be seriously taken into consideration before any success may be expected: (1) the proper consistence of the pulp; (2) the proper quantity of mercury to use; (3) the subsequent mercury bath: (4) the proper capacity of the machine.

1. The pulp should be thick enough to hold the fine globules of mercury in thorough suspension as it revolves throughout the tube. About 75% (by volume) of water would, in most cases, result in the best consistence, although that must be determined by conditions and the character of the ore. When too thin, the pulp cannot be well amalgamated, and the mercury is likely to be whipped into a sickened condition. The consistence of soft mortar is therefore the best, and the safest. While grinding, the pulp should not be flooded for any purpose.

2. The quantity of mercury to be used should be determined entirely by the content of the ore and consistence of the pulp. According to the facility with which the gold is amalgamated, the quantity of mercury should be regulated. If the ores contain zinc, lead, arsenic, antimony, talc, or graphite, or any other substance tending to affect the activity of the mercury, more mercury should be added to lessen such bad effects, in proportion to the detrimental material contained in the ores. In such cases it may become necessary to use as much as can possibly be carried, in fine globules, by the stiff pulp, in proper suspension without running together to form larger bodies in the mill. But with free ores, or comparatively so, half the quantity would suffice.

3. The subsequent mercury bath is all important to the success of this operation. The lesson may be taken from the performance of the settler, in pan work, for collecting the amalgam and preventing the loss of mercury. This bath should be ample in capacity, and permanent, changed when showing signs of requiring quickening; and the proper dilution of the pulp as it enters the bath.

4. The quantity of ore treated, within economical reason, should depend upon the quality of the work. The capacity of the machine is a matter of judgment, to be based upon results obtained. Amalgamation is a delicate and an important operation in itself. To do good work one should not try to make a tonnage record for grinding and expect to get the best extraction at the same time. When I hear of a 22 in. by 8-ft. Hardinge mill endeavoring to grind and properly amalgamate 175 tons of ore per day, when the makers of that mill announce 144 tons as the extreme capacity limit for that size *for grinding alone,* and presumably under the most favorable conditions, I feel that something must be radically wrong and am not surprised at unsatisfactory results. On the other hand, I am surprised to hear of having to stop a Hardinge mill every day to clean it out. It would be very interesting to know how and why it is done, and how long it takes to do it.

In conclusion, it is more than evident that violent grinding of gold ores in presence of mercury, in itself, does not necessarily result in flouring and loss of mercury. In my opinion, the tube-mill and barrel amalgamator are not any more violent than the grinding pan with mullers running at 125 r.p.m. I have had wide experience with both systems, and I am yet to be convinced.

J. W. PINDER.

San Francisco, California, February 3.

CONCENTRATES

Readers of the MINING PRESS *are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.*

MINERS on contract in the Mt. Morgan mine, Queensland, last year earned the following wages: stoping, $3.98; development, $5.86; and shovelers, $3.46 per shift of eight hours.

WATER USED by 11 mines at Kalgoorlie in October 1914 totaled 1,237,097 gal. per day, in the treatment of 5235 tons of ore per day, equal to 236 gal. per ton of ore treated. This water was used for every purpose in power plants and the mills.

COLLOID is a term capable of only a negative definition. The characteristics of a colloid are not those of a crystalloid. In solution it diffuses through membranes with difficulty and possesses low osmotic pressure. The matter in colloidal solution is unaffected by the action of gravity until coagulated by an electrolyte.

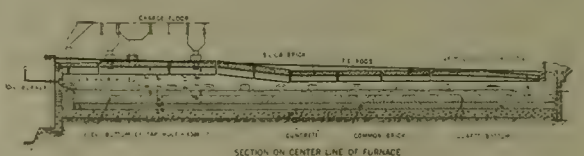
AVERAGE PRICE for rough trimmed mica is about 35c. per pound. For extra large sizes, as high as $1 per pound can be obtained. For mica which is only fit for grinding, the price is about $15 per ton. At the present, San Francisco trade in the mineral, which has been chiefly an export one, is stopped owing to the unsettled conditions in Europe.

ALASKA SLUICES were introduced last year for the first time in the history of the Lena Goldfields property, Siberia, and recovered from 96 to 98% of the gold, compared with 88 to 93% by the trommel machines and other Siberian methods employed. It has been decided to supplant all washing machines and Siberian sluices, *kulibinas*, by Alaska type sluices as fast as possible.

GOLD is found only in the native state, and not as a chloride, which is one of the forms of silver found in ores. The usual method for the preparation of gold chloride is to dissolve gold in aqua regia (1 part nitric and 3 parts hydrochloric acid), and evaporate the liquid to dryness, keeping the temperature as low as possible. A brownish red mass is formed, consisting of $AuCl_3$, mixed with more or less of the protochloride and hydrochloric acid. On adding water the protochloride is decomposed into gold and trichloride, but the acid can be eliminated only by shaking with ether, which withdraws the trichloride from its solution in water.

UNDER THE LAWS OF COLORADO (Mills' Annotated Statutes, 1912, sections 4875-4876), "any person who has or hereafter may have a tunnel or cross-cut, the mouth of which is located on his own ground or on ground in his lawful occupation, shall have the right to drive and continue the same through and across any located or patented claim in front of the mouth of such tunnel, but not to follow or drive upon any vein belonging to the owner of such claim. Such tunnel or cross-cut may be driven and worked for the purpose of drainage and for the purpose of reaching and working the mining ground of the tunnel owner beyond the intersected claim." It is also provided that the owner of the intersected claim shall at all times have the right to survey the tunnel and a right to compensation for ore taken from beneath his claim or for injury done to his ground. In view of this section, a tunnel-site location, the line of which crosses a patented claim, would appear to be a valid location, except, of course, no rights could be acquired thereunder in a patented ground or any lodes found therein.

VITAL POINTS IN REVERBERATORY SMELTING as practised at Steptoe, Nevada, are as follows, according to R. E. H. Pomeroy in the *Transactions* of the A. I. M. E. Factors affecting efficient combustion of the fuel: (1) The use of a burner to give a proper atomization of the oil so as to obtain a long uniform flame without overheating any portion of the furnace; and (2) regulation of the draft so as to furnish the proper mixture of gases for



NO. 2 REVERBERATORY FURNACE AT M'GILL, NEVADA.

complete combustion in the furnace. Factors affecting the operation of the furnace proper: (1) Careful preparation of the charge by adequate mixing of all ingredients before charging; (2) addition of enough lime rock, preferably coarse, to produce an active boiling in the furnace; (3) maintaining a deep bath of molten matte to equalize and distribute the heat over the whole of the hearth; (4) frequent skimming so as to carry only a thin layer of slag over the matte bath; and (5) operating the furnace for the best smelting conditions ignoring the waste-heat boilers as factors in the power supply. Factors affecting the life of the furnace: (1) The furnace roof set high over the hottest portion of the hearth; (2) frequent fettling to protect the side walls, and (3) frequent charging and active charge mixtures to avoid floater and blanket formation requiring excessive firing.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

NEW YORK

Business Feeling in New York. The Copper Situation: German Consumption, Porphyry Costs, and Export Trade.—Inspiration, Arizona Commercial, North Butte.

In view of the complications arising from war zone measures, it is not at all surprising that a reactionary tone should have prevailed throughout the week. New York has been such a centre of the activity arising from the abnormal conditions abroad that, for a time, it has been inclined to forget about the conflagration that is raging, until some phase such as that of the present moment brings it back to sharpened realization. There has been no little consolation derived from the fact that although a ticklish situation promised to develop, there has been no free selling of securities, simply a dullness that distressed brokers more than security owners.

The copper situation is apparently righting itself faster than might be expected. Present consumption is undoubtedly largely based on ordnance requirements, but in any event demands have warranted the resumption of work at capacity in the Lake region, where the Calumet & Hecla and its subsidiaries are again on full time. None of the resulting increased output will be marketable for delivery earlier than April or May, but it indicates a better feeling and improved conditions. Just what American copper producers are to do with the metal which Germany has been buying for years is a problem, though a study of the finished products turned out by German manufacturers ought in the present juncture to be interesting to every factory owner in this country. Our copper producers can look for an increased home market if American ingenuity in smaller manufactures reaches out to take the business on which the German consumption of copper was mostly based.

It has undoubtedly been in the mind of nearly everyone not following the situation very closely that the porphyry mines must suffer greatly in the way of copper costs while running on a curtailed output. To such it will be something of a surprise to note that, notwithstanding demoralized conditions prevailing during the last quarter of 1914, the principal low-grade coppers made records for the year in turning out reduced tonnage at low cost. Inasmuch as costs go up with reduced tonnage and fall as output increases, the figures are all the more surprising. Utah's costs for the quarter were 6.68c.; Nevada, 8.42c.; Ray, 8.64c.; and Chino, 7.71c. per pound. On these figures, Chino alone showed a material increase; Ray Consolidated was within one-tenth of a cent of its record for the June quarter of 8.54c.; while Utah and Nevada made their best showing for the year. These properties and the other low-grade producers that must depend on large tonnage and stable market conditions for profit are the factors mostly interested in the export trade as a balance-wheel for the market. For some time authorities have been inclined to view copper as being in the hands of the producers marketwise. And while this is undoubtedly true, it has resulted often in giving a regrettable advantage to the foreign buyer. One of the principal topics of discussion at the recent National Foreign Trade Council at St. Louis was the question of the legality of agreements between competitors covering export trade. John D. Ryan, with copper in mind beyond a doubt, spoke at some length of the disadvantages wrought by the Sherman law in this regard. Since that time, however, there has been a *pronunciamento* from Washington slanting decidedly in favor of combinations between exporters made to avoid cut-throat competition. Not content altogether with mere expressions of opinion, the copper interests represented by Phelps, Dodge & Co., the American Smelting & Refining Co., and the Amalgamated, have joined hands with the United States Steel Corporation in asking for definite legislation that will permit of common selling agencies on export business. It is difficult to exaggerate the importance of this movement, just at this time when the matter of export trade is so much to the fore. As to copper specifically, it means that it will be impossible hereafter for foreign buyers continually to get the cheapest metal in this market as they have done all too frequently in past years. In every movement that has brought order out of chaos in the copper world, Mr. Ryan has been a power. He tranquilized Butte, and eliminated Heinze; when production outstripped consumption some four years ago, it was he who got the representatives together in London and saved the situation; now, it may be taken for granted, if further measures are taken to conserve one of our greatest natural resources, the results will be largely due to Mr. Ryan.

Inspiration's convertible bonds have never been sold up to the prices achieved by some of the issues put out by other similar copper companies, most of which issues have since been all converted. The market features in Inspiration have moved Eugene Meyer, Jr. & Co. to start something of a campaign on the bonds.——Arizona Commercial, after many financial ups and downs, is at last said to be earning a net profit of some $10,000 per month.——North Butte, which was one of the spectacular successes of Mr. Ryan's earlier career, is evidently back as a high-grade copper mine. The Edith May vein on the 2800-ft. level is showing the richest ore which the mine has had since its first bonanza days under the Cole-Ryan management.

WASHINGTON, D. C.

Bill to Allow Development of Certain Land in Utah.—Chances of Other Mining Legislation.

The bill dealing with the location, entry, and patenting of lands within the former Uncompahgre Indian Reservation in Utah, containing gilsonite and other similar minerals, has been reported on favorably by Senator Smoot to the public lands committee of the Senate. The amendments made are immaterial. The bill relates to lands not so far disposed of and reserved for future action by Congress. It has been found that on these lands are extensive and valuable veins of gilsonite. No elaterite, ozocerite, or sand asphaltum worth while has been found there. Residents of Utah have urged the opening of the area under the general mining laws, contending that this would open to location and entry by the general public of considerable areas of land containing the mineral and promote a healthy competition with the owners of the deposits, the title of which has passed from the United States. That is the report of the Department of the Interior which has favored the bill opening the lands under the general public land laws. But Secretary Franklin K. Lane says that in view of the fact that it is the intention of the bill to open the gilsonite lands under the general mining laws, wording should be added to the bill making it entirely clear that the lands in question, if entirely mineral, shall be opened only to location and disposition under the mining laws, and if non-mineral, under the non-mineral land laws of the United States; and so the committee has amended the bill to read, "Entry under all land laws of the United States according

to the character of the lands or of the mineral deposits therein."

Now that the ship-purchase bill is temporarily shelved, there is hope for some of the minor mining legislation such as that involving the experimental and rescue stations and the codification commission bill. There is going to be a great rush to grind bills out in the last 10 days of the session, and these bills ought to go through as well as the gilsonite bill mentioned above. The leasing bill is absolutely dead, seemingly.

HOUGHTON, MICHIGAN

INCOME TAX LAW.—MANGANESE DEPOSITS.—SHARES IN 1868 AND 1915.—COPPER IN THE NONESUCH FORMATION.

The report comes from Boston that John R. Stanton, of the Baltic Mining Co., has filed an application in the federal court for an order to exempt the mining companies from complying with the provisions of the income tax law. Mr. Stanton points out that some distinction should be made between mining companies and other corporations not owning mines, in computing the depreciation in the value of the property on which an income tax is to be paid.

Several reports have been made recently that the old Clark mine at Copper Harbor would be opened for manganese in the near future. According to F. W. Nichols, the resident agent for the property, there is no truth in these reports. It might be suggested to these people who are making so much of the present shortage of manganese in this country that they consider opening some of the old mines in the Michigan iron district. It is well known that some of these iron mines closed down because of the large amount of manganese mixed with the iron ore.

A memorandum of the business of the Boston Stock Exchange of March 24, 1868, was found in the files of a late resident of Hancock. The following comparison of the figures of that day with those of today are very interesting:

Mines.	Offered.	Asked.	Today.
Allouez	$ 3.50	.....	$ 42.75
Calumet	22.00	$30.00	395.00
Franklin	15.00	15.50	5.00
Hancock	5.40	.....	11.75
Quincy	27.00	29.00	56.50
Superior	1.00	1.50	28.25

Great interest was aroused during the last year by the reported richness of the Nonesuch formation at the White Pine mine at the extreme southern end of the district in Ontonagon county. Early in November exploration work was started on the Smith property about 10 miles west of the White Pine, on what was believed to be the Nonesuch formation. The exploration work is being done on Sec. 7, T. 50, R. 42 and on Sec. 12, T. 50, R. 43. Considerable test pitting has been done and a shaft has been sunk 70 ft. A 40-ft. cross-cut has been driven through the formation, and 15 ft. of drifts to date. F. B. Close, who is in charge of the exploration work, is in Houghton securing a diamond-drill outfit, and drilling will be begun as soon as possible. Mr. Close states that the 'rock' in the cross-cut will average about 12 lb. of copper per ton.

GRANTS PASS, OREGON

PLACER MINING ACTIVITIES.—LOGAN AND DEEP GRAVEL PROPERTIES.—GRANITE HILL QUARTZ.—A NEW GOLD PRODUCER.—LIMESTONE.

Though there have been several cold snaps to freeze ditches and check the water supply, taken as a whole this has been a favorable season for the hydraulic placers of Josephine county. There has been considerable rain, and there is plenty of snow on the higher ranges, assuring a full head for the giants till early summer. Many thousand dollars of gold is exchanged at the local banks every week, and heavy shipments are being made direct by miners to the mint at San Francisco.

TAILING DREDGE UNDER CONSTRUCTION.

BOW GANTRY C. & H. DREDGE.

Gold worth $6000 to $10,000 has been taken from the sluices of the Logan mine, of the Waldo district, with every monthly clean-up. The manager, John Logan, says that the mine will enjoy a long run this season, as there is an abundance of water and plenty of rich ground. Though one of the oldest placers in southern Oregon, the vast acreage of old channel on the Logan gives it a great supply of working ground. The gravel washes down easily, and contains gold from the surface to bedrock. A hydraulic elevator, to assist in disposing of the tailing, is one of the mechanical features of this property.—— In this same district the Deep Gravel mine is operated by H. L. Herzinger, day and night. The Deep Gravel did not get started promptly last fall, as much new machinery was added to the equipment, and this was late in coming.

The manager for the Oregon Gold Mines Co., James O'Grady, which Company revived the old Granite Hill mine of Grouse creek, a few months ago, is highly pleased with results. Several good clean-ups have been made, as a result of the operation of 10 stamps of the mill. This was on ore crushed from a new vein opened near the surface, and above water-level. The shoot contains free gold principally, and is from 10 to 18 ft. wide. A similar vein has been opened on the Ida, one of the Granite Hill claims. With the careful and economical management now being given it, the Granite Hill seems certain to prove a profitable venture. Though the lower levels are yet flooded, the water will be removed as the development and mining of the upper levels proceeds. A cyanide plant will probably be erected to treat base ores, of which there is a good tonnage.

The Jim Blaine is a new quartz mine lately added to Josephine county's list of gold producers. This property is

on Grave creek, and is really a part of the holdings of the Columbia Mines Co. the latter being a placer company. The quartz property has been leased from the Columbia company by George Epperly, Charles Hansen and Bergmen Bros. These men have erected a stamp mill, and will have direct charge of the property. The mill is now crushing ore.

The crushing of Josephine limestone, for use as a fertilizer is now to be done on a commercial scale. As there are mountains of this in western and southern Josephine county, the industry promises to become one of considerable extent. The first plant is being installed by C. W. Courtney on Marble mountain, near Wilderville, and but a short distance from the western terminal of the Grants Pass & Western railroad, to which line the product will be hauled for shipment. Another plant will be built beyond Hays hill, on Deer creek, where there is an immense deposit.

FAIRBANKS, ALASKA

QUARTZ MINING.—PROBLEM OF HANDLING LOW-GRADE GRAVEL.—MACHINE-DRILLS AND REDUCTION OF LABOR.—WORK ON THE CREEKS.—TOLOVANA.

That the quartz outlook for the district is much brighter at present than for a year past is evident to anyone who takes note of the recent development. The gradual decrease in placer mining has induced more men to investigate the quartz prospects till cheaper power and transportation allows of the large bodies of low-grade gravel still available in the district.

Operators in the Fairbanks district owning deep low-grade ground are doing much figuring at present on the question of lowering costs. Undoubtedly the railroad will result in cheaper power, but it is toward better mining methods that much experimenting will be done. For instance, along the Chatanika river are large areas of low-grade ground that while frozen, the gravel and sediment is also very tight and hard. Much difficulty is experienced in driving points, a big crew of pointmen being necessary. Plans are at present under way to fashion a steam point that can be fitted into the chuck of a machine of the 'jackhamer' type. While the present type of point is not strong enough to stand the heavy-hitting machine, it is also suggested that the machine be used to drill the hole, a 'sweater' being then inserted to do the thawing. In that case, however, the escape of steam from the hole would be hard to prevent. It would seem that a heavier point combining both properties of driving and drilling would have to be devised to meet with the best success. At one plant, a 'jackhamer' has been used with the idea of inserting 'sweaters.' The machine was run by steam, and while it finished the hole in bedrock that was fairly hard, in other ground the steam escaping through the hollow steel caused the hole to cave and render the steel almost impossible to pull. The successful solving of this problem is of great interest to the district.

That the introduction of power drills will be a big factor in the future development is evident from the marked success attending the installation of machines at the property of Crites & Feldman on Fairbanks creek. Aside from the Newsboy mine, Crites & Feldman are the only operators so far to listen to the preaching of engineers about the vast efficiency of machines. Five men are now needed to keep the 5-stamp mill busy one shift per day. Before, 15 men could not keep the mill supplied for the same period. At present, one machine strips all the ore two shovelers can handle, while the machine-man sharpens his own steel. The carman runs 100 ft. of drift per month on development work, besides doing the tramming. The millman completes the crew. The machines used are the Ingersoll-Rand stopers and 'jackhamer,' and while the exact figures are not made public, it is understood that a substantial profit is made every month, as the ore is of excellent grade. So far all development has been toward driving the main adit.

Huddleston Bros. are working on a fine looking prospect at the head of Too Much Gold creek, a tributary to Fairbanks creek. The ground is owned by O'Neill and Landecker. Visitors qualified to know say that as far as opened the vein shows good ore and promises fair returns for the lessees. Down the same creek, Lou Goyette is extracting some ore from the White Horse claim. Several tons is awaiting the completion of the customs mill, which is now being built.

Still farther up Fairbanks creek, Bert Stevens is working on his property opposite 13 Above. A test run has shown profitable ore. August Hess is investigating a rich stringer near the Mizpah claim that shows good ore. So far only surface work has been done.——Opposite this claim, Charles Heilig is now building a small custom mill to serve the numerous prospects on the creek. A Huntington mill, with apron plates, purchased from the Tolovana mine, will be the amalgamating unit. The gyratory crusher from the Rainbow mine, capable of producing a feed suitable for a Huntington, will complete the crushing equipment. Large bins have been provided, and with a good water supply this mill will be in a position to help greatly the prospectors on this creek. The mill should be operating in February.——At the head of Fairbanks creek, Foss & Farveen have done a great deal of development in the last three months. Several hundred feet of adits has been driven and 75 tons of ore has been milled at the Chatham Mining Co.'s mill. The ore averaged $25 per ton. No more will be milled till the Heilig custom mill is in operation.

If the option on the Chatham Mining Co.'s claims is not taken up by the holder, E. L. Scrafford, it is probable that this property will soon be reopened. While the ore already won yielded a good profit with hand labor, the rock now in sight is lower grade. It is the intention of the management to install machines.——Joe Henderson is working a lease on the Homestake property. The vein is narrow, but of high grade. The operations up to date have been profitable to the lessee.——Production continues steadily at the Rhoads-Hall mine. The 5-stamp mill is kept in continuous operation, and the ore still yields a good profit. About 25 men are employed.——Miners are examining the Tolovana mine with the object of leasing it, but no decision has been arrived at yet. ——At the Spalding mine, a lease has been taken by Drury, Lundblad, Irvine & Spalding. Both the Soo and Wild Rose claims are under lease. Most of the work so far has been directed toward opening the Wild Rose, and a good orebody will soon be ready for stoping. As $80,000 was taken out of a small block of ground on the same lead a short distance away, the lessees expect to make a good showing when it is opened. A 3-stamp mill is on the property. These claims are at the head of Dome creek.

The stampede to the Tolovana country is not as spirited at present as a few weeks ago. Many men have gone into the new diggings, but most of them have returned to wait for favorable reports. Many holes have been sunk on the tributaries of Livengood creek, on which the original discovery was made. So far, however, by late reports, no holes have been 'bedrocked' on Livengood creek, although some are down over 80 ft. at present. There is still a chance for 'pay' on the main creek, although the tributaries so far show nothing in many holes. The men doing the most work are the most optimistic of the future. Even if no 'pay' channels rich enough to drift out are found, it is thought by many that the creek will make a good dredging property. Some gold is found all the way down from grass roots, but whether it amounts to enough per yard for a dredge is as yet problematical. Twingood creek is about 60 miles from Olnes, a station on the Tanana Valley railway. A fairly good trail has been made, and dog-teams have made the trip in 24 hours.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press.

A great number of shippers of bullion have an idea that some of the United States assay offices are closed, and therefore not receiving bullion. This is not so. The lower branch of Congress, after three years of ineffectual legislation to abolish the assay offices at Salt Lake City, Utah, Carson City, Boise, Helena, and Deadwood, have this year ceased their fight on the institutions and provided an appropriation for their maintenance. They are receiving bullion as usual and giving it prompt attention.

ALASKA

'The Petroleum Fields of Alaska' is the title of a short paper by Alfred H. Brooks presented to the February meeting of the A. I. M. E. in New York. Petroleum seepages are known in Alaska at four localities, all on the Pacific seaboard. These, named from east to west, are Yakataga, Katalla on Controller bay, Iniskin bay on Cook inlet, and Cold bay on the Alaska peninsula. Besides these, a petroleum residue has been found near Smith bay on the north Arctic coast of the territory. At Katalla, Cold bay, and Iniskin bay there has been some drilling for oil, and in the first field several productive wells have been opened. Alaskan petroleum, so far as its composition is known, is a refining oil, with a paraffin base and low sulphur content. The Katalla field is a region of closely folded and faulted Tertiary rocks, possibly comparable in its structure to that of the California fields. Much of the drilling in this field was done without any regard to geologic structures, and but few good logs are available. The presence of oil is indicated by the success achieved, but it will require further drilling to determine the presence or absence of a large pool. At Yakataga the structure of the oil-bearing formation appears to be much simpler, and it ought to be possible to test the field without a large amount of drilling. In both the Iniskin and Cold Bay fields, Middle Jurassic sandstone forms the country rock in the oil-bearing area. The open folding should be favorable to oil pools; on the other hand, some faulting has been observed. There is reason to believe that the oil-bearing formation found in these two fields may have a wider distribution in the Alaska peninsula. Whether it carries petroleum at other localities has not been determined. On the whole, there is good hope of finding petroleum in the Alaska peninsula. Alaska affords a steadily growing market for petroleum and petroleum products. In 1913, 15,682,000 gal. of crude oil, 1,735,000 gal. of naphtha, 661,000 gal. of illuminating, and 150,000 gal. of lubricating oil were shipped to Alaska. If any oilfield were developed on the Alaska peninsula, it would be specially well situated for supplying the local markets on Seward Peninsula, Yukon river, and Pacific seaboard. As early as 1865 the Russians knew of the existence of oil in Alaska.

Bethel

(Special Correspondence.)—It is rumored that there has been a rich discovery on Kwisluk river, and that it will create a boom this spring. Some gold is taken out every summer in this area. Cost of living is high, $14 for 100 lb. of flour, $15 for 100 lb. of sugar, $1 per meal at the roadhouse, and everything in proportion, foodstuffs rising in price this fall as soon as navigation closed. A mining man from Iditarod, discussing recently the high cost of provisions, which are at least 35% more here than at Iditarod, pointed out that there is no reason for this, as the mines in the present state of development do not justify such high charges, and the freight rate is about one-fourth higher to Bethel than to Iditarod, so it is, as I formerly stated, that this country is better for capitalists than for a poor man.

A review of the mining situation in this district is as follows: the gravel is from 1 to 50 ft. deep, and may be more in places; mining is done where gravel is from 1 to 4 ft. deep, and this is what I would term poor men's diggings, as it can be handled with the old methods of shoveling into boxes and by hand rockers; the deeper gravel has not yet been prospected; some attempts have been made to sink shafts, but they never get to bedrock on account of water, in some only at a few feet; to carry on a systematic prospecting in this ground requires capital, as it is almost impossible without drills, and that is too advanced for the ordinary prospector.

Bethel, December 14, 1914.

Juneau

The Alaska Mexican, Alaska Treadwell, and Alaska United companies will pay No. 77, 111, and 30 dividends, of 20c., $1, and 30c. per share, respectively, on February 27.

Tolovana

Various rumors about this district have been circulated, but there is nothing new to report, except that Marsh and Wheeler are down 90 ft. without having found bedrock. H. Marsh is optimistic about the area.

ARIZONA

Cochise County

Ore shipments have been resumed from the Letson lease of the Higgins property at Bisbee. The ore will be taken from a dump which has been made during the period of development since August last.

Greenlee County

A 20-ft. flywheel on an air-compressor at the Arizona Copper Co.'s smelter flew to pieces last week, killing the engineer on shift, who was at the throttle. The engine was also badly damaged.

Yavapai County

Ore from 1200 ft. in the United Verde Extension mine is now being sent to the United Verde smelter at Jerome. A wide lode has been opened in this property.——It is stated that a transportation and drainage tunnel is proposed for the Bradshaw mountain district. It would be about 6000 ft. long, and would cut several veins at 1400 ft. vertical depth.

CONCENTRATOR AND SMELTER AT NEEDLES, NEAR BORDER OF ARIZONA AND CALIFORNIA.

CALIFORNIA

Amador County

New machinery for the Original Amador mill is being installed, and it is hoped that the 20 stamps and Hardinge mills will crush 300 tons per day, instead of 90 tons as at present. T. S. O'Brien is in charge.——The Bunker Hill company distributed 2½c. per share last week, being dividend No. 103. High-grade ore was recently opened at 2400 feet.

Calaveras County

Advices from Angels Camp state that the mining outlook in this county is encouraging, and numerous properties are under investigation.

The Caliwash Mining Co., of Seattle, with a capital of 50,000 $1 shares, is preparing to start work in Chile gulch at Mokelumne Hill. John Johnston is president and general manager.

Kern County

Sulphide ore has been opened for some distance below 400 ft. in the Sunshine mine at Randsburg. The main shaft is down 525 ft., and this is the first property in the district to open this ore, which is of high grade.——The Phoenix mine and mill have been overhauled, and a much better saving is being made.——Other properties busy in this district are the Consolidated, Old Glory No. 2, King Solomon, numerous lessees, and the Red Dog mill.

Mariposa County

(Special Correspondence.)—The new hydro-electric plant of the Mountain King Mining Co. was started on February 13. It is situated on the Merced river. The dam, of the gravity overflow type, is 90 ft. long, 11 ft. high, and 10 ft. wide at the base, made of reinforced concrete. The power house is of concrete also, containing one 350-kva., 3-phase, 4000-volt generator, direct coupled to a scroll-case turbine running at 600 r.p.m., made by S. Morgan Smith Co. The transmission line is 1½ miles long. Three transformers reduce the voltage from 4000 to 440 and 220. A new modern, 30-stamp, 200-ton mill, driven by motors, is being erected, and may start on June 1. A 600-cu. ft. Sullivan cross-compound compressor has been installed. It is driven by a 100-hp. motor. An electric locomotive will haul ore and other cars. An electric incline tramway has been built for haulage between the Yosemite Valley railway and the mine tunnel. The whole equipment was designed by Rudolph W. Van Norden and constructed by John R. Cahill, of San Francisco.

Mountain King, February 16.

Nevada County

During the installation of new machinery at the Empire mine, the miners were laid off for several days, but have now returned to work. The large electric hoist is in position, and improvements made to the shaft.—— A miner named Damiano is suing the Birchville Mining Co. for $25,000 for damages caused by an accident.——A renewal of the bond on the Idaho-Maryland mine is being arranged between G. W. Nellis, the lessee, and S. P. Dorsey and sons. The property is fully equipped.

Development of the major gravel claims on Cement hill is giving good results.——A rotary crushing machine with 100 tons capacity per day is to be installed on the Meister mine of the Columbia Consolidated company, near Washington. E. C. Klinker is in charge.

Placer County

(Special Correspondence.)—Since the last rains, mining has become brisk on Forest Hill divide. Five leases are being operated on the property of the Mayflower company; W. E. White has cut a large body of auriferous gravel on his Belford lease; Wallace, McKenzie, and Rhodes & Son, leasing in Gavins cañon on the Canothus ground, are all in 'pay' gravel, and are doing well; work is progressing rapidly at the Excelsior mine, the long adit being about finished and a rise being driven into the old channel; the old Dardanells is producing as usual; some good gravel is being extracted from the Baltimore right along; the White Oak Co. is still driving an adit in rock hard black slate, the ground is getting very wet, and it expects to break good gravel any day; the owners deserve it as they have worked eight years without any returns from their claim; the Buckeye people are finishing a rise to a new ground and expect to work the mine for many years more; and there are several large quartz prospects. We look for a lively summer.

Forest Hill, February 12.

Plumas County

Eight miles from Greenville the Mountain Meadows Mining Co. is prospecting 3000 acres of ground, which is partly in this and partly in Lassen county, and the erection of a dredge is proonble.

Shasta County

The Bully Hill Copper Co. has increased its working force at the experimental plant, where the zinc-copper ores are being treated.

The fume suit was continued in San Francisco on February 23, after nine weeks' recess, Judge Van Fleet presiding over the court.——A new mill is nearly finished by the Victor Power & Mining Co. at Harrison gulch. This type of machine is the first of five units of 40-ton capacity each per day. This Company's Gold Hill, Midas, and Victor mines produced over $20,000 in the past three months, and the cyanide plant is extracting $9000 per month from old tailing.

Siskiyou County

On Greenhorn creek the El Oro Dredging Co., of Oroville, controls 110 acres of ground, and has a dredge at work, which has handled 18 acres since August 17, 1914. The average depth is about 18 ft. The Company is testing ground between this area and Yreka, near the state highway.——The Ash Creek mine and mill is to start in March. Enough shares in the Company were sold in Yreka to allow of this being done.

Tuolumne County

(Special Correspondence.)—Tuolumne county will have a splendid exhibit of gold specimens and ores at the Panama-Pacific Exposition. The collection comprises samples from scores of mines, and its actual gold value will amount to many thousands of dollars.

Work at the Draper mine, situated near Soulsbyville, is revealing orebodies equal to the best ever opened, according to the best information obtainable. The mine is the property of Andrew McCormick, of Stockton, and was visited this week by the owner.——A retaining dam is being constructed at the Black Oak to impound the tailing from the mill, which in the past has been going to Curtis creek.——It is expected that extraction of auriferous gravel from the property of the Springfield Tunnel & Development Co. will begin within a few weeks. The drainage tunnel is in 2400 ft., the face now being past the first of a series of channels which will be opened by rises. A good gold yield is assured when gravel can be taken out, the extensive development of the property having conclusively proved this. Water has been the retarding agency, but the drainage tunnel will, it is believed, forever dispose of this problem.——It is reported that work has been resumed at the Garfield mine, east of Tuolumne.

Sonora, February 13.

COLORADO

Clear Creek County

The Georgetown Sampling Works is working overtime to cope with ore shipments.——The Homestake adit has cut one of the lodes which it was driven to develop, and it is 30 ft. wide.——Numerous small mines in the district are being actively worked.

Lake County (Leadville)

The Lake County Metal Miners' Association met at Lead-

ville on February 13, when state and local mining conditions were discussed.——A hydraulic rock quarrying machine has been devised by S. C. Monberg of Leadville, who is a mining blacksmith. It has a new feature in the self-sharpening points. ——The Big Five company has arranged for a long lease with the Ibex company for 25 blocks of ground between the Yak tunnel and the Big Four shaft. A 1000-ft. adit will be necessary to open this ground.——Old tailing from the old Adams mill, worth about $60,000, is to be shipped by T. Horrigan and partners to the Leadville district mill, where a flotation process will treat the material.

TELLER COUNTY (CRIPPLE CREEK)

Representatives of all industries from Denver, Colorado Springs, and Pueblo inspected the Cripple Creek district on February 26 and 27.——*The Daily Mining and Financial Record* is preparing a 'Greater Cripple Creek' edition for distribution.——M. B. Burke and eastern people have acquired the H. A. McIntyre interests on Gold, Raven, and Globe hills, and Battle mountain for $100,000.

The output of Stratton's Independence in December was as follows: mine ore, 4260 tons averaging $6.60 per ton; dump and low-grade mine ore treated, 9400 tons; net profit, $6700.

IDAHO

The report of the state inspector of mines for 1913 covered 225 pages, with many illustrations, but that for 1914 is only 55 pages with one picture. This is due to the lack of ample appropriation for the publication. The output of metals was as follows: lead, 345,334,206 lb.; zinc, 49,239,000 lb.; silver, 13,621,123 oz.; copper, 5,178,000 lb.; gold, 62,238 oz.; and total value, $24,976,706. Over 90% of these came from Shoshone County mines. There were about 5200 men employed, and there were 27 fatal, 79 serious, and 312 minor accidents. Development of mines and metallurgical improvements are briefly discussed, also the state's natural resources. Six pages are devoted to statistical matter.

SHOSHONE COUNTY (COEUR D'ALENE)

'Friendliness v. Friction at the Bunker Hill & Sullivan,' was the title of an article in the *Press* of January 9, by John A. Goodell. In it the Kellogg Industrial Y. M. C. A. was discussed. The secretary, J. E. Sturdevant, has published a report of the year's work, which resulted in all bills being paid and a small surplus. There were 25,635 baths taken by members, 11,420 letters written, 12,219 books lent, 860 attended the educational classes, and 4450 the gymnasium and athletics.

The Monitor mine is to be extensively developed, under the personal supervision of Otis Hill, of Spokane, director and one of the heaviest stockholders in the Montana-Idaho Copper Co., organized several months ago to take over the Monitor and adjacent properties. When the forest fires of 1900 swept through the Coeur d'Alene they left the site of the Monitor mine a heap of ruins. The 700-ft. shaft was filled with charred timbers and ruined machinery, and, though an extensive body of high-grade copper ore had been uncovered, the damage done by the fire stopped all further improvement. An adit is now being driven 1000 ft. below the 700-ft. level of the old Monitor shaft. Machine-drills and other plant have been installed and substantial buildings erected. The portal of the adit is situated 1000 ft. above the tracks of the Milwaukee line, permitting cars to be loaded direct from the adit by a gravity system. In the course of the adit several orebodies are known to exist, which the management expects to reach within a few hundred feet.

Spokane stockholders in the Caledonia Mining Co., operating at Kellogg, have received notice that the directors recently adopted a resolution authorizing the declaration of monthly dividends of 2c. per share each for March, April, and May, of $52,100 for each 30-day period, a total of $156,300. To date Caledonia has paid $322,539 in dividends, all but $52,000 of which has been distributed since the Company was reorganized, following the settlement of the litigation with the Bunker Hill & Sullivan company, including $104,200 paid in January and February of this year. When the declarations for the next three months are paid, the total disbursements will aggregate $478,829, or approximately 18.5% of the issued capitalization of $2,605,000.

It is reported that the National Copper Co. is to resume operations at its mine and mill near Mullan.——The new Callow flotation plant at the Hunter mill is working, and a total recovery of 90% is expected from all departments. The ore is peculiar, as it contains silver and lead in a gangue of heavy spar. The flotation concentrate assays up to 500 oz. silver and 40% lead.——The Coeur d'Alene Antimony Mining Co. has been formed by Wallace, Wardner, and Kellogg people to work the antimony mine at the mouth of Pine creek, which has been closed since 1889.

NATIONAL COPPER CO.'S PROPERTY, NEAR MULLAN, IDAHO.

MICHIGAN

HOUGHTON COUNTY (THE COPPER COUNTRY)

Finnish employees of the Calumet & Hecla, Osceola, Wolverine, Mohawk, Ahmeek, Allouez, Centennial, and other mining companies of the northern part of Houghton county, held a meeting last week for the purpose of considering plans to expel from the district the socialistic agitators who are again working among them in the guise of union labor organizers.

MISSOURI

JASPER COUNTY

In the annual mining and industrial issue of *The Joplin News Herald* are given some interesting figures on the Missouri-Kansas-Oklahoma zinc-lead district. The output during the past two years was as follows:

Ore.	1913. Pounds.	1914. Pounds.
Blende	541,107,593	490,148,273
Calamine	40,346,251	32,562,300
Lead	94,962,640	87,364,481
Total value	$14,356,461	$11,922,837

The Joplin and other Missouri districts contributed $9,283,653 to the yield of 1914. From 1830 to 1914, inclusive, the total production of all fields in this region was $267,452,915. The twenty districts contain many individual producers, probably 1000, which makes the total output a large one. On account of the number of small mines, one of great size stands

out boldly. There are several of these, but the greatest is probably the Oronogo Circle, on a lease of 126 acres of the Granby Mining & Smelting Co.'s land 10 miles northeast of Joplin. Its output is over $12,000,000, and the present workings at 225 ft. are underlaid by new deposits from 240 to

MAP OF THE JOPLIN AND OTHER MISSOURI ZINC ORE DISTRICTS WHERE MINING IS VERY ACTIVE.

290 ft. There is operating one central plant of 1000 tons daily capacity, supplied from three, and later on, four shafts. A gasoline locomotive hauls the ore cars between these points. Electric motors in the plant use 1200 hp. A model of the property is on view in the Palace of Mines and Metallurgy at the Panama-Pacific Exposition.

MONTANA

Fergus County

During 1914 the Barnes-King Development Co. produced 51,471 tons of ore, yielding $424,272, or $8.242 per ton. Costs totaled $4.403 and profits $3.839 per ton. The total net profit was $150,419. The manager, George T. McGee, states that the North Moccasin in Fergus, and Piegan-Gloster in Lewis and Clark county, show promising developments. Reserves in the latter property are about 30,000 tons of $8.35 ore. The new mill is 75% completed, and will probably start on May 1. Dividends may be expected later on in the year. From March 1, 1911, to the end of 1914, the Company's revenue was $1,115,330, including cash and bonds worth $262,420. The expenditure was $950,882.

Silverbow County

The city of Butte has granted a 10-year franchise for a right-of-way through its streets for the transport of ore to the Davis-Daly company on the consideration of one cent per ton hauled. The last quarterly report of this Company shows that the Colorado shaft was down to 2500 ft. on December 15, and cross-cutting is now being done. Good ore has been opened on this and the 1750-ft. level. For better ventilation this shaft is to be connected with the Moonlight shaft of the Anaconda. Owing to copper in the mine-water the iron pipe has been replaced by wood-lined iron pipes. The recent assessment has brought in $250,000.——It is fairly definitely known that the Anaconda company will reopen the old Alice mine, the first work being to retimber the main shaft, which is 1600 ft. deep.

NEVADA

Mineral County

At a vertical depth of 1200 ft., and 6000 ft. in the adit, the Hubbard ore-shoot has been cut by the Lucky Boy company. This orebody was opened previously by a shaft, and yielded rich ore. The adit is 6 by 8 ft. in the clear, with a 2 by 3-ft. drain, and has unwatered the Hubbard vein and other properties in the district.

Nye County

(Special Correspondence.) In its new Scorpion shaft, so called on account of the number and size of scorpions found in sinking, the Eureka Johnnie company has cut rich gold specimen ore at 22 ft. Most of the vein was covered with wash but has been opened for 60 ft., showing free gold. It is from one to three feet wide, and improves with depth, in a sedimentary formation.

Johnnie, February 20.

Six mines at Tonopah produced 10,081 tons of ore worth $207,418 during the past week.——In January the Belmont treated 16,100 tons, yielding 309,142 oz. bullion, with a profit of $115,159. A dividend of 12½c. per share will be paid on April 1, half of the usual distribution.——The Tonopah company treated 12,600 tons, shipped 231,825 oz. bullion, and made a profit of $56,875.——Profits of the Jim Butler were $18,033. ——At 400 ft. the Extension is stoping 14 ft. of ore.

Storey County

At 2500 ft. in the north end of the Comstock lode the Consolidated Virginia company is driving on a well defined quartz vein, assaying $1 to $4 per ton. Indications are favorable. ——The Ophir is shipping ore to the Kinkead mill.——The Mexican is extracting ore from 2300 ft., and sinking below this level.——At 2650 ft. the Union Con. is driving north and south on a quartz stringer.——The Pumping Association is busy at 2500 ft., preparing for pumping at 2700 ft. ——The Yellow Jacket, in the Gold Hill area, is opening a good quartz orebody at 1200 ft.——The Caledonia is prospecting at 1000 feet.

OREGON

In *The Mineral Resources of Oregon* for December, published monthly by the state Bureau of Mines and Geology, the 'Ore Deposits of Northeastern Oregon,' is the title of a paper by Arthur M. Swartley. It covers 229 pages and is accompanied by illustrations and maps. Field work was done in 1913, and up to September 10, 1914. G. E. Goodspeed, Jr., aided in this work. The area includes Baker, much of Grant, the

BEN HARRISON MILL, BAKER COUNTY, OREGON.

southern portion of Union and Wallowa, and the north part of Malheur counties. The ranges are called the Blue mountains. The dominant geologic feature of the mining region is the granitic mass termed by the author the 'Blue Mountain Batholith,' which means a giant intrusion of a granitic rock extending to unknown depths. The ore deposits are the product of this intrusion into older rocks. The gold output in 1913 was $1,525,182, from 55 placer and 20 quartz mines. The book gives considerable detail of the Cornucopia district, with the Union-Companion, Cornucopia, Last Chance, and other properties; the Wallowa district; Bald Mountain-Elkhorn region; and the Greenhorn area with the various mines therein. A total of 97 halftones and maps adds greatly to the value of

the report. All Oregon mining men should secure a copy of this work.

The mining outlook for the Sumpter district seems to be bright. It is reported that the Ben Harrison mine has been sold to the American Smelting & Refining Co. Under the management of W. C. Fellows the property has been well developed.——The Imperial mine is again producing ore for the mill and shipments. It has been leased by C. L. Arzeno.——The Golden Gate 10-stamp mill is finished. It was erected by B. L. McLain of Sumpter.——It is probable that more dredges will be constructed in the region.

UTAH

Beaver County

The Fortuna Royal Gold Mining & Milling Co. has been organized at Beaver, with a capital of $200,000, to develop the Royal and Annie La Rue claims in the Fortuna district, mentioned in the *Press* several months ago.

Juab County

For the purpose of draining about 50 of the mines and properties of the Tintic district, the Tintic Tunnel Co. is now being organized, according to *The Salt Lake Tribune*. The promoters propose to drive a tunnel from near the head of Goshen valley, at an elevation of about 5000 ft., due west, which shall intersect the Tintic district north of Treasure hill and which will gain a depth of about 1500 ft. below the collar of the Bullock and Laclede shafts. The bore will crosscut practically all of the north-south fissures in the Tintic district at nearly right angles, and will gain a depth of from 1000 to 3000 ft. below the collars of the shafts of the various properties. It is estimated that the cost of the tunnel, which will be about five miles long, will approximate $1,000,000. The Company will own and control the greater portion of the East Tintic, Diamond, and Silver country, and the property-owners of that section, who so far have been approached on the project, have signified a willingness to do all in their power to make the enterprise a success. No one has shown a disposition to block or hinder the project. The directorate, consisting of some of the most prominent and active men in Utah mining circles, will be completed during the next few days and it is proposed to start the work within the next 30 days. The capitalization of the Company has not been decided on, but tentative plans are being considered for the issuing of $1,000,000 in bonds. Engineers are now engaged in making surveys and getting out detailed data, which will be completed about March 1. It is proposed to use electric power in the tunnel, which is to be double-tracked for transportation purposes. A concrete ditch will be built either beneath the tracks or to one side, which is to have a capacity of 75 sec.ft. of water per minute. For a number of years it has been the desire of mining men to drain the Tintic district. Water has been one of the greatest handicaps to a number of the deeper mines, and the cost of pumping from the deeper levels in which heavy tonnages of ore have been encountered has prevented the mining of the ore. The proposed tunnel would not only make the mining of the ore profitable, but would afford a means of transportation and the necessary water for milling purposes.

Salt Lake County

The fourth quarterly report of the Utah-Apex Mining Co. states that there is little of importance to note. Prospecting has revealed ore in the upper workings, and a large area remains to be opened. Separation of the zinc content is proving difficult. The low price of lead has affected the revenue, which was $200,728 for the term. The net profit was $69,914.

Summit County

Work has been resumed at the Snake Creek tunnel at Park City. To relieve the pressure of water from the heading, it is proposed to drive around to the left of the present face, and so divert the flow, when the tunnel will be continued. The present flow is 7500 gal. per minute. G. W. Lambourne is general manager, and J. Matheson in charge for the J. A. McIlwee Contracting Co. The total length is to be 14,000 ft., of which over 10,000 ft. has been driven.

WASHINGTON

Stevens County

The Last Chance mine of Northport has been acquired by the Norman Lead Mines Co., of Spokane. A 1500-ft. adit is to be driven to cut the vein at 770 ft. on its dip. The mine has been developed for over 10 years, and has shipped lead-silver-zinc ore worth about $410,000. Sidney Norman is manager.

CANADA

The Mines Branch of the Department of Mines, Ottawa, has published 'Economic Minerals and Mining Industries of Canada' as a Panama-Pacific edition, as the Dominion has a large display of ores and metals at the Exposition at San Francisco. The book consists of 78 pages, profusely illustrated, with an excellent map of the country. All minerals are discussed in brief, yet in an interesting manner.

Alberta

Dingman No. 2 well of the Calgary Petroleum Products Co. is yielding 54°B. oil from 2772 ft., which is about 150 ft. above the oil-sand cut by the original well. Drilling in the two wells was at the rate of 10.83 and 5.73 ft. per day, respectively.

Coal mine accidents in this province in 1914 were as follows: fatal, 209; serious, 44; and slight, 50; a total of 303.

British Columbia

The preliminary review and estimate of mineral production of British Columbia in 1914 is published in *Bulletin* No. 1 of the provincial Bureau of Mines, as compiled by Wm. Fleet Robertson, the mineralogist. The output was as follows:

	1913.		1914.*	
	Quantity.	Value.	Quantity.	Value.
Gold, placer	.....	$ 510,000	.....	$ 524,000
Gold, lode, oz	272,254	5,627,490	246,936	5,104,126
Total gold		$ 6,137,490		$ 5,628,126
Silver, oz	3,465,856	1,968,606	3,394,752	1,768,666
Lead, lb	55,364,677	1,175,832	52,424,732	1,834,866
Copper, lb	46,460,305	7,094,489	44,968,541	5,845,910
Zinc, lb	6,758,768	324,421	7,029,276	309,288
Total metals		$17,700,838		$15,386,856
Coal, long tons	2,137,483	7,481,190	1,821,308	6,374,578
Coke, long tons	286,045	1,716,270	237,931	1,427,586
Building materials, etc.	.....	3,398,100	.....	3,000,000
Total value production		$30,296,398		$26,189,020

*Estimated.

As with other countries, the war affected the metal output somewhat, and prices considerably. The following dividends were paid by metal mining companies: Consolidated, $464,376; Granby, $449,955; Hedley, $300,000; and Standard, $475,000, a total of $1,689,331, compared with $2,390,131 in 1913.

Work has been resumed at the Consolidated Mining & Smelting Co.'s No. 1 mine, near Ainsworth, which has been closed since August 3.——The Silver Hoard company adjoining has also started.

Ontario

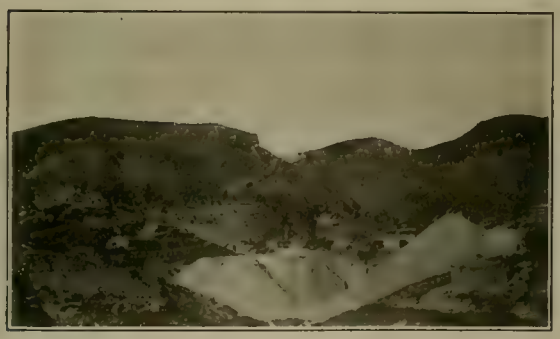
During January the Alexo nickel mine produced 808 tons of ore.——The Crean Hill and No. 2 mines of the Canadian Copper Co. are to be reopened, and all the blast-furnaces at the smelter blown in.

The total shipments of ore from Cobalt since 1904 to the end of 1914 amount to 198,155 tons.

MEXICO

The main mineral zone of the Santa Eulalia district is the subject of a 44-page paper presented to the February meeting of the A. I. M. E. at New York, by Basil Prescott. The district lies 12 miles southeast of the city of Chihuahua. Official records of the state place the discovery of the ore in 1707 and the production is between $300,000,000 and $500,000,000. Toward the end of the eighteenth century there were 6000 people in Santa Eulalia, 63 *haciendas*, 168 reduction and cupelling furnaces, while the city of Chihuahua had 70,000 people and 20 smelting plants. Americans entered the district in about the eighties (1880).

The ore deposits occur in a Cretaceous limestone of unknown thickness, overlain by a series of rhyolitic tuffs and flows. The limestone is gently folded and is cut by several systems of fissures, of which only those with a general north-south strike are pre-mineral, and control the deposition. The deposits are of two main types, the earlier silver-bearing iron sulphide types occur as high-grade tabular bodies resembling veins and as large masses of relatively low-grade ore. The gangue of this type is composed of lime-iron silicates that point toward a close association with an igneous rock mass which has not yet been encountered. In the later silver-lead-zinc type the ore occurs in vertical chimneys and horizontal *mantas*, principally as oxides, though at a depth of 1500 ft. some sulphides have been developed. During oxidation the ore chambers have increased in size owing to the solution of the walls by the sulphuric acid generated in the process, and a substitution has taken place of nearly one-half part by weight of the original constituents of the ore, by newly introduced elements and radicals. Both types are believed to have come from greater depths than those yet reached by mining, and their ultimate source, from a consideration of similar deposits, is believed to be an igneous rock in contact with the limestone at some horizon below. The deposits are thought to have been formed at unusually great depths, as indicated by the proved great vertical range of the silicate minerals



PART OF SANTA EULALIA DISTRICT, SHOWING SANTO DOMINGO, SAN TOY, BUENA TIERRA, AND POTOSI MINES.

coupled with the absence of the igneous rock, and by the practically unchanged character of the silver-lead-zinc ores as far as developed. The volcanic capping is believed to be distinctly later than the economically important ore deposition.

It is reported at Douglas, Arizona, that the rains of last December destroyed the town of La Dura, flooded La Colorado mine, and destroyed the new mill. The property had been closed for some time on account of the revolution.—— The Lucky Tiger Combination company paid a dividend of 9c. per share on February 13, equal to $64,380. Work is going on as usual at the mine, but food and supplies are short in the district. The manager, L. R. Budrow, was at Douglas last week.——General Juan G. Cabral entered Cananea with about 3000 men on February 17. The army is well trained and equipped.

PERSONAL

W. J. Loring is in California.

H. W. Turner is back from London.

Morton Webber sailed on the *Baltic*, on January 27, for London.

T. T. Read is attending the mining convention at Spokane this week.

O. L. Kittenbach will sail for Manila, February 27, on the *Manchuria*.

Howard W. DuBois was in San Francisco recently returning from Alaska.

Frederick C. Gilbert, of Durango, has been spending a month in California.

D. C. Jackling has been tendered a place on the directorate of the Missouri Pacific railroad.

Malcolm Maclaren was in San Francisco on his way to Korea to examine the Suan mine.

Fred G. Farish has gone to Mexico to manage the Lluvia de Oro G. M. Co.'s mines in Chihuahua.

David McClure has returned to San Francisco from South America and London and is living at the University Club.

H. N. Stronck delivered a lecture on 'Management Engineering' at the University of California on February 16.

P. Thill, formerly master mechanic at the Great Falls plant of the Anaconda Copper Mining Co., has been appointed assistant chief engineer in charge of all engineering work done at Great Falls.

Arthur Crowfoot, who was employed at the Boston & Montana reduction works for nineteen years, has been appointed superintendent of the concentrator of the Arizona Copper Co. at Morenci, Arizona.

Joseph W. Boyle, president and general manager of the Canadian-Klondyke company, left Dawson on January 28 and will go as far as New York. He will visit Ottawa and Montreal before returning.

L. V. Bender, formerly assistant general superintendent at the Washoe Reduction Works, was appointed general superintendent, and H. S. Ware, formerly blast-furnace superintendent, was appointed to assistant general superintendent.

J. H. Klepinger, W. T. Burns, and P. Thill, of the B. & M. reduction department of the Anaconda Copper Mining Co., are in the East visiting various copper refineries for the purpose of collecting information for use in the design of the refinery that is to be built at Great Falls.

Obituary

A. H. Merritt died February 12 after being sick about three weeks, during which time his condition was not thought serious. Mr. Merritt was associated with the development of the West Coast Manufacturing & Supply Co. for the past thirty years, and its directing officer at the time of his death. He leaves many friends among employees and the business men with whom his work brought him into contact.

Schools and Societies

The Southern California section of the A. I. M. E. met at Los Angeles on February 24. A paper, 'Hydrometallurgy of Copper,' was read by W. L. Austin, of Riverside.

The Northwestern Mining Convention, to be held at Spokane, February 22 to 27, will have an ore-testing department arranged to determine the value of rocks and ores submitted from any part of the Northwest.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, February 24.

Antimony	20 —20¾
Electrolytic copper	15½ 15¾
Pig lead	4.10— 5 05
Quicksilver (flask)	$62.50
Spelter	9 — 9¼
Tin	38 39½
Zinc-dust, 100-kg. zinc-lined cases	12

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, February 24.—Electrolytic copper is quiet at 14.37 to 14.50 , lead strong at 3.85c., and spelter is strong at 8 to 9c , spot metal is scarce and futures are pressed for sale. Sales of April, May, and June spelter are reported at 10.50c., or about 2c. over prime western metal.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.		Average week ending	
Feb. 18	48.87	Jan. 13	48.98
" 19	48.75	" 20	48.98
" 20	48.75	" 27	48.77
" 21 Sunday		Feb. 3	48.52
" 22 Holiday		" 10	48.20
" 23	48.62	" 17	48.42
" 24	48.50	" 24	48.70

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	....
Feb.	57.53	....	Aug.	54.35	....
Mch.	58.01	....	Sept.	53.75	....
Apr.	58.52	....	Oct.	51.12	....
May	58.21	....	Nov.	49.12	....
June	56.43	....	Dec	49.27	....

Exports of silver to the Orient from London up to February 11 totaled £881,500 (9,000,000 oz.), against £578,500 (6,000,000 oz.) in the same period of 1914. It is possible that the German blockade of England will result in silver being kept in the United States, rather than risk its loss on vessels sunk; while neutral countries may increase their needs in advance. London advice states that prices are remarkable for the smallness of fluctuations. Early in February there was a brisk demand for the metal in India, due to low prices, increased duty, and the marriage season.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Jan. 28	52.50	Feb. 11	60.00
Feb. 4	55.00	" 18	62.50
		" 24	62.50

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	....	Aug.	80.00	....
Mar.	39.00	....	Sept.	76.25	....
Apr.	38.90	....	Oct.	53.00	....
May	39.00	....	Nov.	55.00	....
June	38.60	....	Dec.	53.10	....

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	....
Feb.	39.76	....	Aug.	50.20	....
Mch.	38.10	....	Sept.	33.10	....
Apr.	36.10	....	Oct.	30.40	....
May	33.29	....	Nov.	33.51	....
June	30.72	....	Dec.	33.60	....

On February 24 tin was weak at 37.50 to 38c. New York, and spot metal in London £177 per ton.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Feb. 18	14.37	Jan. 13	13.30
" 19	14.37	" 20	13.53
" 20	14.37	" 27	14.00
" 21 Sunday		Feb. 3	14.50
" 22 Holiday		" 10	14.29
" 23	14.50	" 17	14.30
" 24	14.50	" 24	14.42

Monthly averages.

	1914.	1915.		1914	1915.
Jan.	14.21	13.60	July	13.26	....
Feb.	14.46	....	Aug.	12.34	....
Mch.	14.11	....	Sept.	12.02	....
Apr.	14.19	....	Oct.	11.10	....
May	13.97	....	Nov.	11.75	....
June	13.60	....	Dec.	12.75	....

Export figures are again to be published by the customs department each week and not held for 30 days, a regulation in force for some time past. During the third week of February the exports totaled 7,142,042 lb., of which 5,077,497 lb went to England. Complete statistics of the exports in 1914 are now available, this being 840,080,922 lb., about 80,000,000 lb. under that of 1913.——The United Verde, Arizona, production in 1914 was 32,449,116 lb., about 3,000,000 lb. less than in 1913.——London prices of copper are £64 15s. to £65. 2s. 6d. per ton. Stocks in England totaled 38,283,840 pounds.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Feb. 18	3.85	Jan. 13	3.70
" 19	3.85	" 20	3.70
" 20	3.85	" 27	3.70
" 21 Sunday		Feb. 3	3.80
" 22 Holiday		" 10	3.80
" 23	3.85	" 17	3.85
" 24	3.85	" 24	3.85

Monthly averages.

	1914.	1915.		1914	1915.
Jan.	4.11	3.73	July	3.80	....
Feb	4.02	....	Aug.	3.86	....
Mch.	3.94	....	Sept.	3.82	....
Apr.	3.86	....	Oct.	3.60	....
May	3.90	....	Nov.	3.68	....
June	3.90	....	Dec.	3.80	....

London quotations for lead are £20 per ton, or 4.26c. per pound.

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date		Average week ending	
Feb. 11	7.75	Jan. 6	5.50
" 12 Holiday		" 13	5.85
" 13	8.00	" 20	6.13
" 14 Sunday		" 27	6.88
" 15	8.25	Feb. 3	7.58
" 16	8.50	" 10	7.75
" 17	8.75	" 17	8.24

Monthly averages.

	1914.	1915.		1914	1915.
Jan.	5.14	6 30	July	4.75	....
Feb.	5.22	....	Aug.	4.45	....
Mch.	5.12	....	Sept.	5.16	....
Apr.	4.98	....	Oct.	4.75	....
May	4.91	....	Nov.	5.01	....
June	4.84	....	Dec.	5.40	....

Our metal telegram from New York was mutilated, and gave quotations for the week of 8 to 9c. for spelter, but prices are now between 9 and 10c.——The Joplin market is excited, and in the third week of February 60% zinc ore sold for $75 per ton, choice lots realizing $78, while $80 is expected next week. In the corresponding week of 1914 blende sold for only $40 to $43.50 per ton.——London quotations are £40 2s.6d. per ton, or 8.6c. per pound.

MANGANESE

On account of the German blockade of England and the probable cessation of manganese shipments to the United States, the price of manganese ore has jumped from $68 at Baltimore to $100 per ton at Pittsburgh. Steel companies of the latter place are said to be sufferers, as they have been relying upon the stock on hand and contracts with dealers for their supply this year

COMPANY REPORTS

JIM BUTLER TONOPAH MINING COMPANY

The report of this Nevada Company covers the year ended September 30, 1914. The Belmont plant at Millers treated for the Company 34,722 tons of ore worth $744,799, yielding $247,800 net profit. In 1913 the results were 19,181 tons, $385,957, and $104,682 respectively. The low price of silver affected the revenue considerably. The treasurer's statement shows cash and loans on collateral valued at $235,781. There is silver stored worth $85,297.

The general superintendent, Frederick Bradshaw, states that work in the Wandering Boy area produced 20,533 tons of ore, and development totaled 7761 ft. The Desert Queen mine produced 14,189 tons of ore, and development amounted to 3612 ft. Ore reserves in the property consist of 34,642 tons of positive, 13,723 tons of possible, and 1832 tons of probable ore, a total of 50,197 tons.

SHATTUCK-ARIZONA COPPER COMPANY

This Company operates in Cochise county, Arizona, and the report is for the year 1914. During August, September, and up to October 23, the output was reduced to 50% capacity, on account of the metal market, and then the mine was closed. Good developments resulted at 200, 400, 700, and 850 ft., in the copper area; between 100 and 300 ft. the gold-silver ore continued to open well; and work in the lead area was stopped. The present rate of development is 700 ft. per month, the mine being in good condition.

A total of 84,801 dry tons of copper ore, and 52 tons of lead ore were smelted, yielding 10,846,918 lb. copper, 14,065 lb. lead, 198,419 oz. silver, and 2445 oz. gold. The net cost of refined copper produced was 8.72c. per pound. The total revenue was $1,660,573; net profit, $587,497; and dividends, $525,000. Cash and metal on hand is valued at $1,045,315.

BRUNSWICK CONSOLIDATED GOLD MINING COMPANY

This Company operates at Grass Valley, California, and is one of the few companies in the state making any report public, it setting a good example. The report under review covers the year ended January 28, 1915, and the remarks of the president, W. H. Oscanyan; vice-president and general manager, R. Chester Turner; superintendent, C. H. Mallen; and secretary, J. Stadtfeld, include the following points of interest: Development totaled 2702 ft., including 240 ft. of sinking in the new shaft. This footage is 600 more than in 1913. The shaft cut quartz veins at 90, 151, and 190 ft. below the floor of the 1250-ft level. The Brunswick ore-shoot continues to furnish the mill with a good grade of material. Where it flattens, the gold content is higher. The heavy flow of water at 1100 ft. in the new shaft has diminished considerably, and the pump at 1250 ft. can cope with the water by working 13 out of 24 hours. Stoping on Company account was confined to No. 4 shoot above the 1250-ft. incline level. Some small bonanzas were found. The failure of No. 5 rise to develop the ore expected leaves little above 1250 ft. Reserves total about 16,000 tons of good ore and 5000 tons of low-grade material. It is proposed to erect a head-frame over the new vertical shaft, a new mill or addition to the present one, a cyanide plant for concentrate, and an assay office.

The 20-stamp mill crushed 16,237 tons of ore, 1795 tons of which was on tributers' account. Bullion recovered from amalgamation and concentration was $288,392. Mill details will be given in another issue of the *Press*. Including balances from 1913, the year's revenue was $343,869. All charges totaled $165,957, and four dividends of 6c. each per share, amounting to $94,869, were paid, and another on March 15.

MINERAL STATISTICS

America's Mineral Products

The mineral products of the United States are discussed in a small volume now being distributed by the U. S. Geological Survey which contains a fund of information concerning the useful minerals and their values and production in all the states during 1912 and 1913. The figures given in some of the tables are stupendous. In one table are given the figures for mineral production from 1880 to 1913, the metals being valued at $185,000,000 in 1880 and increasing to $883,000,000 in 1913. The non-metallic minerals increased from $173,000,000 in 1880 to $1,562,000,000 in 1913, and the total mineral production from $365,000,000 to $2,446,000,000. This total for 1913 was an increase over 1912 of more than $200,000,000. The value of the metals imported for consumption in 1913 was $237,000,000, and of those exported $319,000,000. The value of the total mineral production from 1880 to 1913, inclusive, was $35,197,000,000. These huge figures are of general interest, but the chief value of the volume lies in the figures and discussion of the increased or decreased production of each state during recent years. Seventy principal minerals are discussed in the pamphlet, entitled 'Mineral Products of the United States in 1912 and 1913,' a copy of which may be obtained free of charge from the Director, U. S. Geological Survey, Washington, D. C.

Radium, Uranium, and Vanadium

The year 1914 was an eventful one in the industry of mining radium, uranium, and vanadium ores showing by far the largest year's production yet made. Figures collected by Frank L. Hess, of the U. S. Geological Survey, indicate that the output amounted to about 4300 short tons of dry ore carrying 87 tons of uranium oxide and 22.4 grams of metallic radium. The ore was valued at about $445,000. The ore produced in 1913 contained 41 tons of uranium oxide and 10.5 grams of radium, and that produced in 1912 contained 26 tons of uranium oxide and 6.7 grams of radium. About 90% of the contained radium is thought to be recoverable under improved processes.

In Utah the Standard Chemical Co. made the first commercial production of carnotite ores from the Henry mountains during the year, and the commercial production of uvanite, a radium-bearing mineral new to science, accompanied by other uranium minerals, one or more of which are yet to be described, was begun at Temple Rock, 45 miles southwest of Green River. Shipments were made from newly opened carnotite deposits at Court House, northwest of Moab, Utah, and from deposits 16 or 18 miles southeast of Moab. A first shipment was also made from Blue Mountain, Routt county, Colorado.

The Paradox valley region was, however, as usual, the chief producing area, and from it came the bulk of the ores. The Standard Chemical Co. was the largest single producer, and shipped more than half of the country's output.

Two companies, the Standard Chemical Co. and the Radium Company of America, produced radium salts during the year, and W. A. Schlesinger started a radium-refining laboratory. The European war stopped nearly all operations in both mines and reduction plants; for the two companies mentioned sold their product largely in Europe and practically all the ore bought by brokers was sold abroad. A little more than 1200 tons of ore, containing 28.1 tons of uranium oxide and 7.2 grams of radium, was consigned to Europe, but as the foreign refineries were closed, a part of it was held in transit.

No vanadinite or similar ores are known to have been sold for vanadium during the year.

New Machines and Devices

Water-Wheels and Accessories at the Exposition

In the Palace of Machinery, at the Panama-Pacific Exposition, one of the most complete installations is that of the Pelton Water Wheel Co. and its co-exhibitors. Water-power development is such an essential factor in the economic life of the Pacific Coast states, that it was felt by the Exposition authorities that a complete working exhibit showing all the phases of hydraulic installations would be of great interest.

The general plan of this exhibit may be divided into three parts: (1) an operating replica of a high-head hydro-electric installation; (2) an operating replica of a low-head turbine installation; and (3) a display of Pelton equipment as designed and built for use in various classes of installations.

It being obviously impractical to secure high-head natural flow, this is provided in the first section of the exhibit, by means of a Pelton-Doble turbine pump, which will be driven by a 150-hp. 6-cylinder submarine type Diesel engine, manufactured by the New London Ship & Engine Co. The pump is of the single-stage type, designed to lift against an effective head of 200 ft. In order to secure this head with a single stage, it is obvious that the speed must be materially higher than 350 r.p.m., the speed of the Diesel engine. In order to secure this speed, a herring-bone speed increasing gear, built by the Falke Gear Co., is interposed between pump and engine, in lieu of standard flexible couplings. The guaranteed efficiency of this type of gear is 98½%. This speed increasing gear is direct connected to the pump, which it drives at a speed of 1800 r.p.m. In the discharge line of the Pelton-Doble high-pressure pump, is installed a Venturi recording meter, thus providing an accurate and continuous measurement of its output. The effective pressure of the pump discharge is measured by means of Crosby indicating gages; these being installed as well, on the suction side of the pump.

The water from the pump is discharged directly into a Pelton-Doble tangential wheel. This wheel represents the largest type of construction in tangential work and is of the overhung type, direct connected to a water-wheel type, 75-kw., 300-r.p.m., direct-current generator, manufactured by the General Electric Co., and part of their co-exhibit. Observation windows are placed in the base of this wheel, so that the action of the jet as it impinges on the buckets can be carefully observed. The regulation is maintained within very close limits, by means of a Pelton-Doble oil-pressure governor, actuating a needle nozzle with auxiliary relief valves, all of the Pelton-Doble type. From the switchboard, the electric power is conveyed to the mains of the Exposition, and is utilized as part of the energy supplied on the grounds.

The second section of the Pelton company's exhibit consists of a Pelton-Doble high-pressure, high-capacity vertical-type deep-well pump, which is driven by means of a 110-hp., 1760-r.p.m., alternating-current, vertical pump motor, built by the Westinghouse Electric & Manufacturing Co., and part of its co-exhibit. The energy for operating this motor is taken from the alternating current high tension mains of the Exposition. The motor is of a design especially worked out to meet the requirements of vertical turbine pumps. Crosby indicating gages and a recording Venturi meter are placed in the discharge line, the latter, as well as the Venturi meter measuring the water input of the tangential water-wheel unit, being a co-exhibit of the Builders Iron Foundry, of Providence, Rhode Island.

After passing the recording Venturi meter, the water under a pressure equivalent to a head of 50 ft. (this being obtained by the single stage runner of the deep-well pump) is discharged into a Pelton-Francis high specific speed turbine.

It is important to mention that an interesting feature of the exhibit is the special equipment provided for maintaining a supply of oil under proper pressure for operating the automatic governor of both the turbine unit and the tangential wheel unit.

Referring to the Pelton-Francis turbine, which is of the horizontal type, this is direct connected to a 30-kw. 1400-r.p.m. direct-current generator, which is also part of the co-exhibit of the Westinghouse company. The energy from this generator is delivered to the service mains of the Exposition.

The third section of the exhibit consists of a number of Pelton products arranged to show general design and construction. The principal item of this exhibit is a 20,000-hp., single-discharge runner, Pelton-Francis turbine, designed and built for direct connection to a 15,000-kva. alternating-current generator. This unit is designed to operate at 360 r.p.m. under an effective head of 500 ft. This turbine will be set up complete, except that the runner will be left out.

There will also be a number of the Pelton ball-bearing hydraulic giants on exhibition. These giants are a great improvement over the old ones used during the period when hydraulic mining in California was in its heyday, and now meet a wide range of use in various classes of construction work.

Commercial Paragraphs

The Hardinge Conical Mill Co. announces that the Calumet & Hecla Mining Co. has completed the installation of 12 large Hardinge mills in its new plant at the White Pine mine.

The Wood Drill Works, Paterson, New Jersey, publishes a leaflet on the 'Brownie' drill. This machine weighs 83 lb. and the tripod 65 lb., a one-man drill. It is designed especially for breaking up boulders for crushers and road work, small tunnels, and sewers, and will drill to 8 ft. The cylinder and chest is of vanadium-tungsten iron. A complete outfit, with set of steels to 7 ft. and dressing tools, is $125 f.o.b. Paterson.

The Harbison-Walker Refractories Co., of Pittsburgh, has just distributed an interesting and well arranged booklet of 113 pages, entitled 'A Study of the Malleable Furnace.' The six chapters, with illustrations, cover the following: characteristics of malleable iron, properties, process of manufacture, furnace construction, operation, micro-structure of malleable cast iron with a number of micro-photos and analyses, and a record of a typical heat. All iron workers should secure a copy of this useful book.

The Colorado Iron Works Co. announces the establishment of a down-town office in Denver for the accommodation of its many customers and friends who may find it inconvenient to visit the main office at the works. Suitable quarters have been obtained in the Ideal building, corner 17th and Champa streets, the most central and accessible part of the business district, where the mining fraternity is invited to call when opportunity offers. The office is in charge of Hugh B. Lowden, secretary of the Company, and Randall P. Akins, sales manager, will make it his headquarters when in the city

MINING PRESS

Volume 110 SAN FRANCISCO, MARCH 6, 1915 Number 10

1915 MARCH—THIRD MONTH 1915

Monetary and commercial matters at the East continue unsettled and seem to show a lack of confidence in the future. As to the duration of the war, there is no general expectation of an early cessation of hostilities.—*Mining and Scientific Press*, March 4, 1865.

SUN.	MON.	TUE.	WED.	THU.	FRI.	SAT.
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

Panama Canal Co. organized in France.....**March 3, 1880**
Troops withdrawn from Cripple Creek.....**March 18-19, 1894**
Collapse of the Secretan Copper Syndicate.....**March 22, 1889**
Alaska Purchased from Russia.....**March 30, 1867**

If you are interested in any kind of surface deposit which is obviously not a vein, call it a 'blow out.' This is very impressive.—*The Cynical Superintendent.*

PALACE OF MINES AND METALLURGY, PANAMA-PACIFIC INTERNATIONAL EXPOSITION

MINING PRESS

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Buyers Directory—Page 28
Advertisers Index—Last Page

TABLE OF CONTENTS

EDITORIAL Page.

Notes 353
Anaconda's Growth 354
Tungsten 354
The Status of the Mining Engineer. *By T. A. Rickard*... 355

ARTICLES

CHROMITE POSSIBILITIES IN CALIFORNIA.
By Samuel H. Dolbear..... 356

Chromic iron ore, which is used in the preparation of refractory materials, ferrochrome and other alloys, and the making of chromium salts, occurs widely distributed throughout the United States. It was first mined in California in 1880, production here at one time reached 2000 or 3000 tons per year, but with changed conditions has decreased to a total of 255 tons in 1913, according to the United States Geological Survey. The larger part of the world's supply has lately been drawn from France and the possessions of Great Britain. The war in Europe has caused domestic consumers again to turn toward California. The deposits of this state and their commercial possibilities are here discussed by one who speaks from authoritative knowledge.

CANADIAN MINERALS AT THE PANAMA-PACIFIC EXPOSITION.. 359

The great variety of mineral products of Canada are set forth in a well chosen and carefully arranged exhibit.

CAVING SYSTEM AT THE OHIO COPPER MINE.
By F. Sommer Schmidt..... 361

By the use of radiating rises from levels 60 ft. apart, Felix Macdonald has brought the mining cost at the Ohio copper mine down to an average of 22c. per ton; probably the lowest figure for underground mining in the United States. The orebody is 450 ft. wide and extends from the 100-ft. level to the adit through which the ore is drawn out, 1200 ft. below, with a dip of 50°. Of the ore, 75% is secured in mining. Hammer drills are used in the rises, 80% of the ore caves, and no shoveling is required. Two men draw a daily output of 2500 tons.

PROFITS OF THE RAND MINES, LTD., SUBSIDIARIES..... 364

January profits, in most cases, show a gratifying increase over the preceding month. The supply of laborers has increased, and a larger output is expected during February.

METALLURGICAL PRACTICE IN THE PORCUPINE DISTRICT.
By Noel Cunningham..... 365

There are six mills in the Porcupine district and two markedly different classes of ore to be handled. The best method of treating each and the difficulties which arise in attempting to treat mixtures of the two in one mine are here discussed by a millman of two and one-half years' experience in the district, who believes that counter-current decantation is the most satisfactory general method, agitation should be continuous, and pressure filters are more suitable than vacuum filters, while the choice of crushing machinery, use of amalgamation, and of concentration depend on the relative amounts of the two ores to be treated.

PRACTICAL POINTS ON SAMPLING.
By Arthur Feust..... 368

Attention to details often spells the difference between success and failure, especially in mine examination work. The general principles of sampling are well established; one of the younger engineers here describes for the benefit of his less experienced colleagues the details of methods which have been tried and found satisfactory.

Page.

PROSPECTING RIVER BARS IN COLD COUNTRIES.
By Thomas N. Turner..... 371

With the help of the frost it is possible to sink a shaft through water to the river bed beneath.

THE SAM YET PROSPECTING MILL.
By Algernon Del Mar..... 371

Good results are not always dependent upon refined methods, and the latest equipment, as an ingenious Chinese has demonstrated in Nevada.

INCREASING THE USE OF STEEL SUPPORTS IN MINES.
By Frank H. Wagner..... 372

Steel supports are more permanent than timber, but require more labor to erect, cannot easily be altered to fit, are less resilient than timber, and more attacked by corrosive mine water. A combination of wooden butts and steel sets removes many of these objections.

SAFETY POWDER-BOXES 373

Boxes designed to decrease danger from accident at the Nevada Consolidated open-cut workings have been found to lead to economy in the use of powder.

KALI SITUATION IN 1914. 373

The war has caused a shortage of labor and the decreased output has led to an increase in overhead charges.

DEPARTMENTS

DISCUSSION:

Molybdenum. *By Faris V. Bush*..... 374

The Romero mine, near Las Vegas, New Mexico, is producing a molybdenite concentrate, 70 to 90% pure, which sells readily for $1.50 per pound of pure molybdenite.

Patents and Metallurgists. *By Jay A. Carpenter*.... 374

Users of patented machinery and processes are too apt to forget that the cost of perfecting, popularizing, and selling is properly chargeable in the market price or royalty. Sometimes this leads to a blunting of the sense of morality.

CONCENTRATES 376

MINING IN THE FAR NORTH.

Hot Springs, Gold Mountain, Koyukuk, and Andreafski Districts.
By Emil Edward Hurja..... 377

Output in the Hot Springs district of the Tanana in 1914 exceeded that of any previous year, clean-ups aggregating $1,000,000. There is less activity in the Gold Mountain and Red Mountain districts, but the Andreafski is a new district where the search for gold has met with much success.

REVIEW OF MINING: Special correspondence from Lordsburg, New Mexico; New York; Kalgoorlie, Western Australia; San Diego, California; Austin, Texas; Washington, D. C..... 379
THE MINING SUMMARY 383
PERSONAL 388
SCHOOLS AND SOCIETIES 388
THE MARKET PLACE:
Metal Prices 389
New York Metal Review 390
Current Prices of Ores, Minerals, Chemicals, Oil, and Candles 391
BOOK REVIEWS 392
The Cyanide Handbook. *By J. E. Clennell.*
San Francisco Folio. *By A. C. Lawson.*
RECENT PATENTS 392
NEW MACHINES AND DEVICES:
A Safety Self-Oiling Clutch 393
Mounted Jackhamer Drills 393
By Way of Correction 393
The Fuller-Lehigh Pulverizer Mill 394

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AN index to volume 109 of the *Press* is now available and will be sent on request.

STATEMENTS as to impending heavy shipments of phosphate rock from Montana to Japan prove to have been premature. Mitsui & Company state that no such contracts have been made as were announced locally.

AWARD of the gold medal of the Institution of Mining and Metallurgy to Mr. Willet G. Miller is a fitting bestowal of the order of merit of the Institution upon a man who stands head and shoulders above his fellows.

PENDING arrival of Mr. T. A. Rickard, in April, Mr. Thomas T. Read, New York editor of the *Press*, will be in charge of the editorial work. Mr. Read will remain in San Francisco through the period of the Exposition, after which he will resume his duties in New York.

BERLIN will, when normal conditions are restored, quote independent prices on zinc, lead, aluminum, and antimony, if the present plans of the Elders of the Merchants of the City of Berlin are carried out. The Berlin Copper Exchange has made a satisfactory record, and the new move will lead to a corresponding expansion of the Metal Exchange, rendering it independent of London quotations. Germany consumes two-thirds as much spelter as the United States, and considerably more than England, but the price of spelter in Germany has heretofore been fixed in London. The move is therefore a logical one in some respects, but it is much to be regretted that such readjustments of trade relations are resulting from antagonisms aroused by the heat of conflict, rather than from the normal play of economic forces.

THE tin market in Bolivia has considerably improved during the past two months, but in October and November several mining companies suspended operations, so that the tin production has been much reduced. Early in January there was a meeting of the tin producers to consider the offer made by an American smelting concern to buy concentrate. A minimum of 1000 tons per month had to be guaranteed, but the people who were in favor of selling to the United States could not get this quantity together. Señor Patiño did not send a representative to the meeting, and as the whole Bolivian tin output at the present probably does not exceed 1800 tons of concentrate per month, of which about 1000 is produced by Patiño, nothing could be done. Señor Patiño is under heavy obligations to an English firm that is, of course, opposed to affording companies a chance to smelt tin ores in competition with them.

MAIL from northern Mexico, as far south as Durango, is now being received regularly, and with only about one day's delay as compared with normal times. From the southern states the mails are very irregular. A letter from Pachuca was recently almost a month on the road, and even then was sent out by automobile. Pachuca mines and mills are seriously hampered from lack of supplies, though a trainload was received from the north in January. The situation is being met by borrowing and co-operation. Bullion can not be shipped, and money for payrolls is scarce, so that labor troubles threaten. Early in February the Loreto mill was treating about 1000 tons per day, the Guerrero 200, the Santa Gertrudis 400, and La Blanca was running at capacity. Progreso was operating at a reduced rate. Despite the many difficulties with which they are surrounded, the engineers manifest the best of feeling and show that invincible optimism which has been so large a factor in making mining possible in the far places of the world.

IMPORTANT results from the research work on petroleum conducted by the United States Bureau of Mines were announced this week by Mr. Franklin K. Lane, secretary of the Department of Interior. The first is an improvement in refining process which will permit an increase of 200 per cent in the yield of gasoline obtained from crude petroleum, and the second is a method of manufacture from crude petroleum of toluol and benzol (bases for dyestuffs and explosives) hitherto obtained from Germany and made from coal tar. Both processes will be patented for the benefit of the public and are expected to operate to an important degree toward making the country commercially independent. The discoveries are due to Mr. Walter F. Rittman, working in the laboratories of Columbia University. While refining processes capable of yielding an amount of gasoline equal to that proposed have been known, they have been owned by one of the refining companies only, and the new public process will serve not only to equalize somewhat the competition, but also to conserve the supply of oil for the future.

ANACONDA'S GROWTH

That the whole is greater than any of its parts is one of the axioms of mathematics, but the continued growth of the Anaconda Copper Mining Company is steadily making it more important than the Amalgamated Copper Company, which controls it. About five years ago the Anaconda increased its capitalization to $150,000,000 in order to absorb all the Butte properties which had been for some time controlled by the Amalgamated, and the Boston & Montana, Washoe, Trenton, Red Metal, Butte & Boston, Parrot, Colusa Parrot, Original Consolidated, and Alice mining companies, the Big Blackfoot Lumber Company, and the Diamond Coal & Coke Company all became component parts of the Anaconda organization. Last year the International Smelting & Refining Company, which had grown up out of the Amalgamated interests and was controlled by it, was taken over by the Anaconda through a share exchange arrangement. The International, with $10,000,000 of issued capital, owns the Raritan Copper Works, Raritan Terminal & Transportation Company, New Jersey Storage & Warehouse Company, International Lead Refining Company, and the Tooele Valley Railroad Company. The assets of this Company amount to about double its issued capital, of which 43 per cent was then held by the United Metals Selling Company, which is entirely owned by the Amalgamated. The United Metals, with a capitalization of $5,000,000, is the sales organization which markets the metals produced by all the companies mentioned. It is now announced that the Anaconda will carry out its policy of consolidation of management to the logical conclusion by purchasing the United Metals Selling Company from the Amalgamated. This makes the Anaconda a self-contained unit, permitting simplicity of managerial relations from the breaking of the ore in the mine to the final sale of the metal in the market, and should lead to economy of operation. In order to purchase the United Metals the Anaconda has just negotiated the sale of $16,000,000 of 5 per cent two-year notes to the National City Bank of New York. Only a part of the note issue is required for this purpose, and the Anaconda will also take over $12,500,000 of notes of the Amalgamated which mature on March 15. Last week we described in some detail the changes in practice at the Montana properties, which will involve the expenditure of some $6,000,000 for the increasing of the refinery capacity at Great Falls, improvements in the smelting plant at Anaconda, and the construction of flotation and leaching plants there. As an example of the scale on which things are being done, it is interesting to note that the Anaconda has just placed an order for twenty-eight 22½-foot 7-hearth Wedge roasting furnaces, while the reverberatories are being enlarged to a smelting capacity of 650 tons per day each. The excellent metallurgical work which is being done at Anaconda reflects credit on the whole profession in America, and the recently announced promotion of Mr. Frederick Laist is well deserved. Notable results have been also achieved by the safety department, under Mr. C. W. Goodale in the past year.

TUNGSTEN

One of our subscribers writes to inquire regarding the ores, occurrence, uses, metallurgy, and markets for tungsten, and this metal is of enough general interest to justify a brief review of the factors in its production; the more so since the United States is second in the output of tungsten ores, with a production of 1390 tons of 60 per cent concentrate in 1913. The leading place was held by Burma, which between 1910 and 1913 increased from an output of 370 tons to 2900 tons. Portugal is a close competitor of the United States, with 1380 tons in 1913, and, as the industry seems to be growing more rapidly there than here, will probably soon outstrip us.

The commercially valuable ores of tungsten are wolframite, hübnerite, and scheelite, the first is a tungstate of iron and manganese, the second pure tungstate of manganese, and the third tungstate of calcium, all of them containing from 75 to 80 per cent of WO_3. In Burma, wolframite occurs throughout the districts of Tavoy and Mergui in association with cassiterite, and the low cost of labor there prevailing permits the production and delivery to England of 68 per cent concentrate at a cost of only a little over $300 per ton, corresponding to a profit of $180 per ton at a market price of $7.30 per unit (1 per cent) of WO_3. The output of Portugal is chiefly wolframite, and is rapidly increasing. All three minerals are produced in the United States, as has been described in detail by Mr. F. L. Hess in the 'Mineral Resources of the United States for 1913.' The Boulder district of Colorado, which produced two-thirds of the $700,000 worth of tungsten output of this country in 1913, is unique in that the mineral there exploited is ferberite, tungstate of iron, which is nowhere else mined.

The chief use of tungsten is in the form of ferrotungsten for making alloy steels, especially as high-speed cutting tools; 85 per cent of the annual output being devoted to this purpose. The concentrate is reduced with carbon in an electric arc furnace, the resulting product containing 50 to 80 per cent tungsten, and about ½ per cent carbon. The presence of carbon is undesirable, and much study is being devoted to perfecting the process of reduction. Another important use is in the form of wire as the filament in incandescent lamps. For the making of the wire it is necessary to first make pure WO_3 from the concentrate by chemical processes, and the oxide is then reduced at 1000°C. by hydrogen or pure carbon, yielding a grayish black powder which is pressed into bars through which an electric current can be passed, the heat produced sintering the metal particles together so that the bar can be swaged down and finally drawn into wire. The great advantage of tungsten as a material for filaments is that it can be heated to a much higher temperature than carbon without disintegrating, and the amount of light produced increases rapidly with increase of temperature, so that a tungsten lamp produces three times the light when consuming the same amount of current as a carbon lamp. More recently it has been found possible to fill the bulbs with nitrogen, thus removing the small amount of air

remaining in even the most nearly perfect vacuum. This permits the use of even higher temperatures, and these new lamps, which are still somewhat expensive to make, give six times the light for the same current as a carbon lamp. When tungsten lamps were first made, no way was known of consolidating the powder produced by the reduction of the oxide except by making it into paste with a binder. A series of brilliant researches carried out at the Schenectady laboratories of the General Electric Company chiefly by Mr. G. C. Fink, under the direction of Mr. W. R. Whitney, brought about the production of ductile tungsten by the process described, and many new uses are suggested. It has been proposed to erect reduction plants for the manufacture of ferrotungsten in the western states, notably Colorado, but it has so far not been found feasible, as the freight rates to the East on concentrate are low and the rates on ferro-alloys high. Scheelite, which is produced in the Atolia and Randsburg districts of California, the Oracle district, Arizona, and the Snake Range, Nevada, gives trouble in the electric furnace through the production of a sticky basic slag, and therefore commands a price $1 per unit less.

THE STATUS OF THE MINING ENGINEER

The announcement of Mr. Ambrose Swasey's benefaction to promote engineering research was made in New York nearly at the same time as the publication of the fact that the Institution of Mining and Metallurgy in London had been granted a Royal Charter. These two incidents are full of significance. Mr. Swasey gives $200,000 to promote engineering research; himself an engineer, he asks the United Engineering Society to administer this foundation. The gift is made by an engineer for engineers, to be administered by engineers. The United Engineering Society was formed in 1905 to accept Mr. Andrew Carnegie's gift of money for the erection of the building that was destined to be the official headquarters of the national engineering societies. At that time the American Society of Civil Engineers declined to join the joint enterprise because it had a comfortable home of its own already, so that the American Society of Electrical Engineers, the American Society of Mechanical Engineers, and the American Institute of Mining Engineers became the beneficiaries, and victims, of Mr. Carnegie's generosity. In course of time the debt incurred by the purchase of the land on which the building was erected was liquidated by the joint societies, until finally the United Engineering Society owned a commodious and comfortable headquarters in the commercial metropolis. The aloofness of the Civil Engineers caused some heart-burnings, but no enduring ill feeling, among the other three technical societies. This is proved by the present willingness of the Society of Civil Engineers to co-operate with the Electrical, Mechanical, and Mining societies in the administration of the fund devoted by Mr. Swasey "to the greatest good of the engineering profession and to the benefit of mankind." It is hoped, and believed, that his gift will prove a nucleus of a bigger endowment for engineering research, such as will develop into a national establishment to which the newest problems of engineering may be brought for solution. Such and when timely may "help the engine over the centre," as Holley said. It will enable the engineer to formulate problems and so aid the scientist to solve them. An illustration of this great factor in technical progress was afforded in the same week as saw the event we are discussing, for the feat of telephoning from New York to San Francisco, 3400 miles, was rendered practicable by the use of the Pupin coil, the invention of which was due to the clear ascertainment and statement of the essential factors modifying long-distance telephony. That achievement synchronized with the Swasey foundation and pointed the way toward further triumphs in those branches of science that are not least glorious because they are not utilitarian. At the same time, as already stated, the British organization of mining and metallurgical engineers obtained its charter. This came soon after the acquisition of a freehold home in the city of London and served not only to mark the coming of age of the premier mining engineering society in the British empire, but also to signify the attainment of a recognized status. Sad to relate, this honor was obtained in face of sustained opposition on the part of the older society, the Institution of Civil Engineers, which arrogated to itself the position of being the only real thing in professional engineering and attempted to regard the mining profession as a poor, if not disreputable, relative from the country. The absurdity of this pose on the part of the early Victorian representative of non-military engineering will provoke a more ready smile in San Francisco than in New York, and in New York than in London. The charter of the Civil Institution, founded in 1818, ignores mining, which, as an art, antedates most of the other branches of non-military engineering. A recent effort made by this same Institution to ascertain the requirements of engineering education omits reference to the science now applied with worldwide energy to the art of winning the metals, while it has a good deal to say concerning the gasworks, waterworks, railway, dock, and other branches of engineering. The Civil Engineers presented a formal protest against the granting of a charter to the organization of mining engineers both on this occasion and 15 years ago, when similar steps were taken. This time the protest failed, despite sundry statements involving verbal inexactitudes of a regrettable kind. We are glad that it failed. Any attempt to stratify the engineering professions is unseemly and unnecessary. In no walk of life are spurious distinctions of less consequence: it is efficiency and character alone that count. On that score the mining engineer neither claims nor grants precedence. He is engaged in work that involves personal responsibility to an acute degree; he faces moral problems that demand the highest character: he performs services that involve the maximum of technical skill. He has come to his own at last, and he intends to prove himself worthy of the trust.—*T. A. Rickard.*

Chromite Possibilities in California

By SAMUEL H. DOLBEAR

Chromic iron ore, as is true of magnesite and manganese, is widely distributed over large areas in the Coast Range and some parts of the Sierra Nevadas in California. According to Arthur S. Eakle,* it is known to occur in 26 counties. Deposits are also found in Alaska. California production up to the present time has amounted to about 40,000 tons, and while this amount seems large, the California deposits have, as a matter of fact, been a small factor in the markets of the world. The New Caledonia deposits and those of South Rhodesia have been the principal producers of late years. Macedonia formerly mined the largest quantities of this ore, but is no longer an important factor, as producers are unable to compete with operators of other countries. The annual consumption of chromic iron ore in the United States is about 31,000 long tons. The average production of late years has been but 300 or 400 tons per year, and this has come entirely from California.

Chrome ore was first mined in California about 1880. The earliest discoveries were in Del Norte, Alameda, and San Luis Obispo counties. The mines of these and other counties yielded 2000 or 3000 tons per year until about 1895 or 1896, much of the ore being shipped to the Atlantic seaboard and to Europe. Removal of the protective tariff and competition of newly discovered deposits in other countries resulted in the complete closing of the California mines for several years. Operations were resumed in 1900, but it was not until the past two or three years that production has been more than two or three hundred tons per year. On the whole, the future of California chromite is brighter today than it has been for several years. There was mined and sold 201 tons in 1912, and 255 tons in 1913, according to the reports of the U. S. Geological Survey. The figures furnished by the California State Mining Bureau for this period are 1270 tons in 1912 and 1180 tons in 1913.

A CALIFORNIA CHROMITE DEPOSIT.

Just what effect the European war is likely to exert on the California chrome industry is not quite apparent. The countries producing the largest quantities of ore are among the possessions of England, while France is the largest producer of ferro-chrome alloys. No records are kept of ferro-chrome importations, so that the extent of our dependence upon Europe for this commodity is not known. Chromium alloys are manufactured in the United States at Niagara Falls. It may be a significant fact that months before the European trouble broke out, American manufacturers of chrome compounds had

*'Minerals of California,' *Bull.* 67, California State Mining Bureau.

manifested a keen interest in the chrome fields of this state, and representatives visited California investigating the possibility of purchasing ore at this point. Another hopeful phase of the present situation is that those who are investigating the local field with a view toward the manufacture of manganese alloys, are also considering the possibility of a local ferro-chrome production. Furthermore, American brokers have made inquiries in California during the past two years for large tonnages for delivery in both Europe and America.

Uses of Chrome

For convenience, the principal uses of chrome ore may be placed in three classes: (1) refractory, as in the manufacture of chrome bricks, and its use in lining furnaces; (2) metallurgical, as in ferro-chrome and other alloys; (3) chemical, for the manufacture of potassium and sodium bichromate and other salts.

For the manufacture of chrome bricks, ore containing a rather high percentage of aluminum is preferred. Because of their neutral character, these bricks have proved particularly valuable in metallurgical work. They are affected but little by either the basic or acidic materials with which they may come in contact. For all practical purposes, this material is infusible, and has the added advantage of being unaffected by sudden changes in temperature. In some cases, the crude ore is used, pieces of the ore being hammered into place in the furnace and secured there by a binder made up of ore crushed to pass a No. 10 screen, and mixed with tar, molasses, or other volatile substances, and in some cases, small amounts of fire clay. A gentle heat is first applied and then slowly increased until the volatile materials have been oxidized, leaving a solid chromite wall. The life of this lining is said to exceed many times that of magnesite, silica, and other firebrick. Its application is not at all confined to steel practice; it having been successfully used in copper, lead, and other furnaces.

Chromium salts are used largely as dyes, pigments, and in tanning. The principal colors are green, yellow, orange, and red. They are also used as mordants in dyeing. The principal chrome chemicals of commerce are potassium and sodium chromates and bichromates, lead chromate, zinc chromate, chromium phosphate, and barium chromate.

CHROMITE ORE IN SOIL OF THE 'POTATO PATCH,' BLANCHE H. MINE.

Prices and Markets

As in the case of many of the chemical substances produced in California, there is no uniform price for chrome ore. It varies from about $10 to $17 per ton, the sale price depending in a measure upon the point of delivery, but more upon the ability of the purchaser to secure competitive figures. Recent quotations from producers are about $15 per ton on rail at the point of shipment. The

ore is not sold on the unit basis, as on the Atlantic seaboard, and some sales are made in short tons. The prices asked have been somewhat high, and in some cases cheaper ore can be produced. J. S. Diller, of the U. S. Geological Survey, is authority for the statement that California chrome ore cannot compete with foreign ore on the Atlantic seaboard. From correspondence which I have had with eastern chrome users, I feel that this statement is not entirely correct, and prices which have been offered are large enough to permit the shipment of local ore at a profit. As there is considerable variation in prices commanded at eastern seaports, there are undoubtedly times when shipments of California ore would be unprofitable.

Chromic Iron Deposits in California

As stated in a previous paragraph, chrome ore is widely distributed in California. No attempt will be made here, therefore, to indicate each deposit, but a few facts are given with regard to the more important ones. These are of especial interest, as they are the only chrome mines in the United States at present producing ore. A little ore has been mined of recent years in Wyoming, and some high-grade ore has been found in Alaska, but these are not active at this time.

Brown mine.—This mine is about two miles south of Dunsmuir in Shasta county near the Siskiyou county line. From a transportation point of view, its situation is fortunate, being but approximately one mile from the Southern Pacific railroad. Chrome ore has been known at this point for many years. As early as 1885 the manufacture of chromic salts was considered in connection with deposits at this place. The mine is now equipped with a gravity tram about 1600 ft. long, which brings the ore down to a good wagon road leading to the point of shipment. The chromic oxide content ranges from 45 to 55%. About 2500 tons had been produced from this mine up to January 1, 1915. During the past year, L. H. Brown, who has been engaged in the production of chrome ore since 1906, mined 867 tons, of which 567 was sold and shipped. Three hundred tons has been stored at railroad for future orders. The prospect seems good here for further production, the ore occurring in elongated lenses as wide as 25 ft. A series of these lenses has been traced for several hundred feet.

Lesco mine.—Nine claims constitute this property, each of which covers separate lenses of chrome ore. The mines are nine miles nearly due north of Piedra, a terminal point of a Santa Fe railway branch line in Fresno county. The road connecting the mine with Piedra, however, is over 20 miles long, and a portion of it cannot be traversed by wagons during the winter months. A railroad is projected which, if built, would terminate within eight miles of the property, and would be brought within four miles if there could be developed a sufficient tonnage. In the meantime, Clovis, a point on the Southern Pacific railroad, about 12 miles distant, is more accessible than Piedra. The first ore taken from these claims was hauled to the nearby Copper King mine for use in its smelter. Forty or fifty tons was hauled from the Mary Collins claim to the Fresno Copper Co.'s smelter near Academy. The principal development work on this property is on the Mary Collins and Blanche H. claims. On the Mary Collins mine a block about 12 ft. deep, 6 ft. wide, and containing about 60 tons of hard clean ore has been exposed. About 30 tons is also on the dump. Samples taken by me gave the following analysis:

	Per cent.
Chromic oxide	43.21
Silica	6.40
Ferric oxide	7.40
Aluminum oxide	33.80
Magnesium oxide	2.40

With the exception of shipments hauled by wagon to local smelters, all ore shipped from here passed through Piedra. The mine has not been operated since 1913, when about 60 tons was shipped.

On the Blanche H. mine, only small segregated lenses have been exposed. The claim is locally known as the 'Potato Patch,' owing to the fact that hard pieces of ore are found in the soil. These broken pieces of ore frequently weigh several pounds, and are recovered by screening the soil. They occur over 10 or 15 acres, the depth of the soil not being shown by the present workings. This is undoubtedly due to the comparatively rapid weathering of the surrounding country rock and the attendant liberation of lenses of ore. A sample of this ore gave the following analysis:

	Per cent.
Chromic oxide	43.72
Silica	11.70
Ferric oxide	4.30
Aluminum oxide	32.40
Magnesium oxide	1.10

In all of the samples which I took from this section aluminum oxide content is relatively high, a condition which is said to make it particularly adaptable to the manufacture of chrome brick.

Cedar Mountain mine.—Several thousand tons has been shipped from these deposits, which are situated about 14 miles southeast of Livermore in Alameda county. The deposit is about one mile from the Swindell Magnesite Co.'s mine. Of late years, but a few tons has been shipped from here, and most of this was taken from ore left on the dump at the time of closing down the mine. Some of the old workings are still open to a depth of 30 ft., and the drift faces show some ore. About one mile distant, in Devil's Hole, another deposit is said to exist, but this is almost inaccessible and nothing is known of its extent.

Miscellaneous occurrences.—Aside from those mentioned in the foregoing paragraphs, there has been little activity in the many deposits of California during the past year or two. A little development was done in some of the old workings near Santa Maria, San Luis Obispo county, in 1913, but this is understood to have revealed little of interest. Two new deposits of fairly high-grade ore have been lately discovered in San Bernardino county. One of these is situated about 18 miles west of Hesperia, a station on the Santa Fe main line.

about half way between Cajon pass and Victorville. The other is ten miles farther on in the same direction, and is at present not accessible for lack of roads. Analyses of the ore from these deposits made for Alexander Gray showed 45 to 68% Cr_2O_3. An interesting feature of these ores is that they are said to contain $1.20 per ton in gold and 4 oz. silver. As one of the reasons for believing that chrome ore is a segregation from the magma, is the absence of pneumalytic minerals, the study of this deposit should be of particular interest from a geological point of view.

A deposit of high-grade ore, averaging 60% chromic oxide, is reported 20 miles from Coalinga in Fresno county. The mine is accessible by good roads. In 1913 there was a production of 900 tons reported from Calaveras county. The source of this ore is shrouded in mystery, and the brokers handling the output decline to disclose the identity of the mine. It was recently stated that while the rail shipment originated in Calaveras county, the ore was mined in an adjoining county. Chromite is known to occur at several points in this and the five adjoining counties, Amador, Alpine, Tuolumne, Stanislaus, and San Joaquin. In Calaveras county it has been mined in Sec. 20, T. 4 N., R. 11 E., by the Penn Chemical Co. for use in its reverberatory furnaces at Campo Seco. It is also found sparingly at various points in the vicinity of Milton and at Big Trees.

The counties in California contributing chiefly to the production of chromic iron ore in the past are Shasta, San Luis Obispo, Fresno, Alameda, Del Norte, Tehama, Glenn, Placer, Calaveras, Siskiyou, Napa, and Sonoma.

Canadian Minerals at the Panama-Pacific Exposition

Realizing the rapid growth of the mineral industry—a growth that is shown by an increase in the past ten years of 140% in the annual mineral production—the Canadian exhibition commission has made a special feature of the mineral exhibit at the Panama-Pacific International Exposition, and has assembled a really magnificent collection, that is tastefully displayed and carefully ticketed, in the central and south courts of the big Canadian pavilion.

On the left, as one comes into the building from the north entrance, are typical specimens from the mines owned and operated by the Consolidated Mining & Smelting Company of Canada, Ltd., together with the products and by-products of their extraction. This Company was a pioneer in the field of electrolytic refining of lead bullion, and anodes and cathodes are on exhibit showing the various stages of the process, as perfected at Trail, British Columbia. In the next case are to be seen the ores mined by the Granby Consolidated Mining & Smelting Co., of Canada, Ltd., and the British Columbia Copper Co.; these are gold-copper and gold-silver-copper ores, and among them are some massive specimens of chalcopyrite, chalcocite, and auriferous pyrrhotite. With the exception of a few specimens of silver-lead ores in one case, the next five cases are devoted to gold-silver-copper and gold-copper ores from British Columbia, that help feed the before-mentioned smelters; some of the bornite specimens in these cases are of particular interest, insomuch that in some cases they have come from below the 900-ft. level, which would seem to indicate upward enrichment. A case of iron alloys, iron rails and chairs, and pig iron produced by electro-smelting comes next, and is followed by a case containing chrome iron and manganese ores, and another containing iron ores. Next to this comes a case of the famous silver ores from Cobalt, Ontario, where some splendid specimens of native silver heavily veined through smaltite and niccolite are seen; some of the specimens have been cut and polished in order to show the silver to better advantage. The last case on this side of the central court is filled with building and ornamental stones, and contains marbles, serpentines,

slates, and limestones, and some interesting specimens of sodalite and jasper conglomerate. Turning to the left into the south court, the visitor finds a beautiful array of chrysotile asbestos—a mineral of which Canada has almost a monopoly—and asbestos products from Thetford and Black Lake districts, Quebec; and then comes face to face with a moving scene showing, first, a plan of Cobalt mineral claims, then the place where the railroad cutting uncovered the far famed silver veins, and, last, the town of Cobalt as it appears today. Turning from this scene, the visitor sees a large case, over 30 ft. long, in which Canadian coals are exhibited. Here are to be seen large samples from the Lower Carboniferous beds of Nova Scotia and from the Cretaceous beds of Alberta and British Columbia; among the coal are coke, coal briquettes, tar sands, and oil shales, and on the shelves are samples of crude petroleum from the oilfields of Ontario. A companion case to this—behind which are the offices of the mineral department of the Canadian commission—contains some wonderfully rich gold ores from Porcupine and Nova Scotia; gold nuggets from the Klondyke; silver nuggets from Cobalt, one of which, with adhering gangue, weighs 450 lb.; typical gold ores; and cut and polished semi-precious stones. At the end of the court is a scene representing a cave, containing many and varied minerals, and through an opening in which is seen Dawson City, with the midnight sun playing over it. This scene is intended to convey to the visitor the fact that Canada's mineral wealth extends to the Arctic Circle. Continuing the tour of inspection, the nickel case is next in line, and is probably one of the most interesting cases in the exhibit. In the centre is a massive piece of pyrrhotite, weighing nearly one and a half tons, which gives one an idea of the nature of the Sudbury deposits; around it are large pieces of pyrrhotite and chalcopyrite—the typical Sudbury ore—and some of the rare nickel minerals—pentlandite (NiFeS), polydymite (NiS_2), millerite (NiS). Samples from the unusually interesting Alexo mine, in the Nipissing district, also are shown in this case. Besides the ore, the various forms in which nickel is marketed are shown, together with by-products obtained in the process of extracting the metal and articles manufactured of nickel. Leaving the south court and returning again to the central court, another case of building stones is seen, containing granites, marbles, gneisses, serpentines, and sandstones in the form of cubes, with one face polished. A case filled with graphite and products of manufacture comes next, and is followed by one of talc and apatite and one of mica. With the exception of a few samples of muscovite from British Columbia, the mica exhibited is phlogopite, or amber mica, from Ontario and Quebec, which, on account of its flexibility, is in greater demand than white mica for electrical insulation. Clay products, in the form of brick and tile, and cement are given a case, after which comes a case devoted to gypsum and feldspar. Gypsum is one of the staples of the maratime provinces, where it occurs in extensive deposits of excellent quality; it is found also in Ontario, Manitoba, and British Columbia. Besides the ordinary varieties, some beautiful specimens of alabaster, from New Brunswick, and selenite, from Nova Scotia, are on exhibit. Next to the gypsum case is one of corundum, and then one containing molybdenite, stibnite, celestite, barite, and pyrite, followed by a case of 'dry' gold and silver ores from the Yukon territory, another of gold-copper ores from the Nelson mining division of British Columbia, and another of silver-zinc and zinc ores. The last big case is filled with a splendid collection of silver-lead ores, gathered from all parts of the Dominion, but mainly from British Columbia.

Among palms and cycads, in the middle of the central court, are 70 small table cases in which the ores and economic minerals of the Dominion are displayed according to their geographical distribution. Many of these cases will repay the visitor for close inspection, and there will be someone on hand during exhibition hours to give any information that may be desired.

Tonnage of Materials Hauled in Mines

The mine-haulage problem, which is one of the most important features of the mining industry that the mining engineer and the mine manager have to deal with, is seldom given a passing thought by the layman, according to A. H. Fay in a paper to the Washington branch of the Electric Vehicle Association. The quantity of merchantable material handled by the various mines in the United States represents 570,000,000 tons of coal, 50,000,000 tons of iron ore, 75,000,000 to 100,000,000 tons of copper, gold, silver, lead, and zinc ore, and 10,000,000 to 20,000,000 tons of miscellaneous ore, such as phosphate rock, gypsum and other, besides several million tons of clay, sand, and gravel. In addition to this, there are probably 200,000,000 tons of waste material handled annually in the coal and metal mines, making the aggregate amount of ore, coal, and waste rock handled in the mines during a single year in excess of 1,000,000,000 tons. Should an engineering firm be given a contract to remove this material with a time limit of one year, it would have the largest engineering problem ever presented. The work of the Panama canal is cited as perhaps the greatest engineering feat of modern times, yet the amount handled at the canal each year was but slightly in excess of the iron ore and overburden handled in two states, namely Michigan and Minnesota.

INCREASED TAXES are to be levied on Rand mining companies by the Union Government of South Africa, as the revenue is falling short of requirements. The present profit tax amounts to about $5,760,000 per year, and the extra charge will yield $2,400,000 more.

BASE METALS from New South Wales and Queensland are exhibited in the Australian building at the Panama-Pacific Exposition. An excellent model, longitudinal section, of the Broken Hill lead-silver-zinc lode is on view.

Caving System at the Ohio Copper Mine

By F. SOMMER SCHMIDT

The cost of mining per ton at the Ohio Copper Co.'s mine is probably the lowest in the United States. The cost of mining and development for the past three years has been under 25c. per ton, with an average for the past 12 months of 24c., of which 2c. is for development. This includes all costs directly chargeable to mining as shown in the following. The Ohio company has mined 3,056,000 tons since December 1909, so that there is nothing experimental about the system. It can be used anywhere a caving system is applicable.

This system was developed by Felix Macdonald, who learned his business in the Lake Superior iron region, and who was one of the first to apply a caving system in a western metal mine. In perfecting it, Mr. Macdonald was assisted by Fred Turner, who became superintendent of the Ohio when Mr. Macdonald went to the Inspiration copper mine to establish this system with whatever modifications the new conditions required. Since the departure of Mr. Macdonald the system has been improved at the Ohio by Mr. Turner.

Mining Losses

The cheapness of the method cannot be denied. It has been on trial too long to leave any room for doubt. The amount of loss in mining due to ore becoming mixed with capping or overburden is not so definitely settled. This is a criticism that has been frequently made. It is my opinion that there is nothing inherent in the system that should cause any excessive loss. There is, however, a condition at the Ohio mine that would cause a serious loss with any caving system yet devised. This condition is the presence of a caved core in the heart of the mine, filled with capping, broken and ready to flow. This core represents the original higher grade ore that was first extracted, down to the 500-ft. level. Since this first work, which was done under the pressure of its own necessities, all subsequent operation has been in the nature of mining a border or fringe, widening as development progressed. The present ore reserve is partly of this border and partly unbroken ground underlying the cave. Any caving system contending with such an enemy in its midst, should be credited with the disadvantages thus occasioned.

The caved volume represents 4,500,000 tons. The mill has received 3,056,000 tons, to which can be added 100,000 tons in the chutes and some unknown small tonnage that might still be drawn from the cave. These figures would indicate a loss of 25%. I do not consider this a fair criterion of the method. With a new orebody of great extent, where the capping can be lowered uniformly over a large area, the losses need not be any greater than with any other system. Just what these losses are with other systems in operation, I cannot determine, but probably they are higher than was originally estimated.

To be frank, there is not a big low-grade mine in the country that would not be glad to take 25% loss in tonnage if the mining cost could be reduced to say 25c. per ton. I naturally make a distinction between mining and quarrying. Properties of this nature are all looking for profits and not conservation of resources for posterity. With the Ohio company it has never been a question of tonnage so much as a life and death grapple with other things. When these are taken into consideration, as they are in all low-grade mines, the amount of mining loss becomes less important than would appear at first sight.

General Features of the Mine

The Ohio orebody so far as developed is a zone 450 ft. wide between two strong fissures, extending from the 100-ft. level down to the Mascotte tunnel level 1300 ft. on the dip of 50°. This orebody is fractured quartzite with some monzonite. It caves well and also stands well. This fractured condition is an advantage, though not of such moment as appears at first sight, as the fractured condition can be obtained in any case by using a heavier overburden. The presence of the Mascotte tunnel below the ore with its electric transportation to the Ohio mill is also an advantage, as there is no cost of hoisting ore.

There are levels at 100, 300, 400, 500, and 750 ft., connecting with the shaft, which is used only for handling men, tools, and equipment. Sub-levels between the levels are now being spaced 60 ft. instead of the original 30.

Details of the System

The outstanding features of the system are:

1. The use of inclined rises, there being no vertical rises in the mine.

2. The blocking out of the ore into 20 by 50 ft., measured from centre to centre of drifts and cross-cuts which surround the blocks. Blocks 100 by 100 ft. are mined as units when possible. Blasting is confined to the levels or sub-levels.

3. Numerous rises undermining the blocks, 150 rises to a unit of 100 by 100 ft., which receive the broken ore.

4. Every level or sub-level is blasted instead of alternate ones, bringing down the honeycombed block above it 60 ft. high.

5. The ease of controlling 45° chutes which have tenders giving them personal attention at points a few feet under the level.

6. That 20% of the ore is extracted in drifts and cross-cuts and rises at an average cost of 79c. per ton, while 80% caves at a cost of 6.8c. per ton, making an average cost of 22c. per ton.

The ore on a level or sub-level is divided into blocks

20 by 50 ft. with drifts and cross-cuts. These workings are 6 by 7 ft., and cost $3.25 per foot or $1 per ton. They are driven at the average rate of 3 ft. per day, using a one-man Ingersoll or Holman drill. Every block of 100 by 100 ft. requires 700 ft. of these workings, which represents 2450 tons. These blocks are drilled with a two-man Ingersoll drill. The set-up spacing is 9 ft., making 11 set-ups for every 100 ft. From each set-up in the drifts there are drilled three 10-ft. holes and four 8-ft. holes, one vertical and three on each side. From each set-up made at the junction of a drift and cross-cut and set-ups made in the cross-cuts only the three back holes are drilled. (See Fig. 1 and 2.) An 8-ft. hole from one side will sometimes intersect the corresponding hole from the other side of the 20-ft. block, which, after deducting the width of the drift, is only 14 ft. thick. Two men can drill the holes of a set-up in one shift.

Each hole is loaded with 8 sticks of 1¼-in. E. L. F. Hercules, 40%, extra low freezing, dynamite. A block 100 by 100 ft. will thus require about 36 boxes of powder. The holes are blasted with caps and fuse, using 6-ft. fuse in the back holes and 5-ft. in the 'down' holes. When blasting a level, the fuse is all ignited simultaneously, the 'down' holes going off first with shorter fuse. One man can tend to lighting about 21 holes or three set-ups.

The result of this blast is the shattering of the whole block 100 by 100 ft. as a unit, which fills the open spaces of drifts and cross-cuts and in subsiding allows the block above 60 ft. high to settle. This block above has been pierced with rises which served the purpose of tapping the ore above, just as the rises below the level just blasted are going to tap this block. The rises have extracted about 15% of the volume of the block and thus give scope for the crushing forces of the mass.

The operations, therefore, that do the work are: (1) shaking up the block on the level; (2) extracting 5%

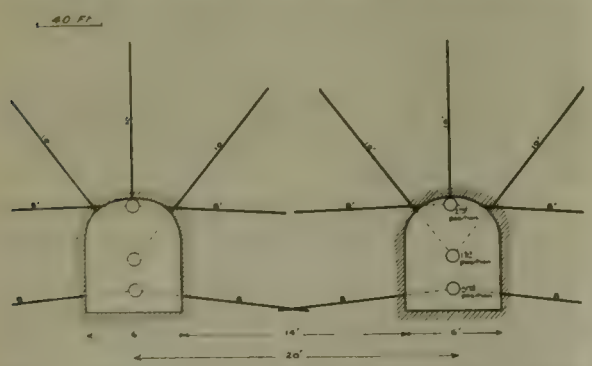


Fig. 1. Section showing drill holes for blasting a 20 by 50-ft. block.

of the mass on the level and 15% between the levels; (3) having a sufficient crushing force of overburden.

Three main chutes ultimately deliver all the ore and lead to the bins on the Mascotte tunnel. These chutes are cribbed, lined with rail, and measure 4 by 4 ft. inside the cribbing. These chutes, like all the rises in the mine, are on a slope of about 45°—never more than 50° and never less than 42°. Only the main chutes are timbered.

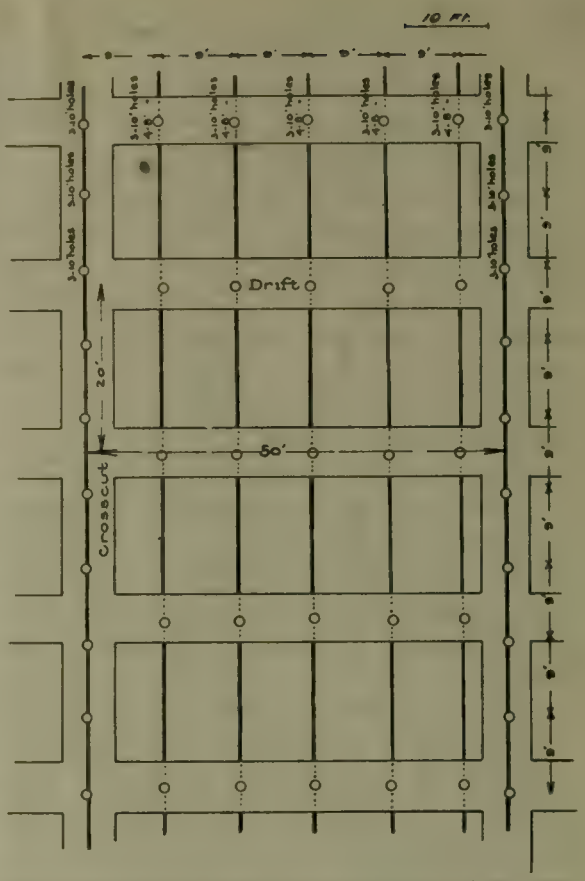


Fig. 2. Showing drill holes for blasting blocks 20 by 50 feet.

Branch chutes are driven from the main chutes, so as to reach a point on the sub-level below the block to be mined, at a point exactly under the centre of the block. A grizzly having 12-in. openings is placed at this point, which then becomes the control for the entire block. Branch chutes from this grizzly are extended to the corners of the 100-ft. block, and these branch chutes then become the main channels for a system of minor rises so placed that their collars are spaced 10 ft. centres uniformly over the entire area at the base of the block to be mined, or in other words, at the level or sub-level above. With the desired positions of the collars in mind, it becomes a question of determining at what point of the branch chute to begin radiating. Numerous rises will be driven from the same point and may look something like the ribs of a half-opened umbrella. Again, it will be necessary to start the radiating rises from some point not in the branch chutes, but from some point on another rise which itself is a radiation from some branch chute. As these rises are all on a slope of 45° there is considerable crossing back and forth, above and below each other in the

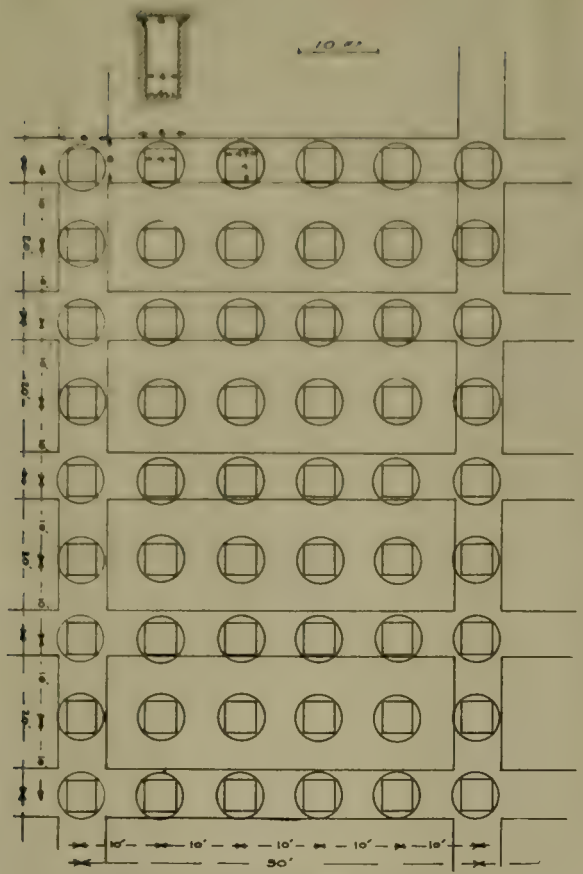


FIG. 3. SHOWING COLLARS OF RISES IN RELATION TO BLOCKS 20 BY 50 FEET.

planning of these rises. There results a system of ramifications much after the manner of the spinal cord with its system of nerves. Fig. 4 and Fig. 5 show such a system of rises in plan for a 100-ft. block. This plan has not been taken from the actual procedure in any one given case, but is typical of the system in general. While there appears to be no symmetry or regularity, this is due to the elasticity of the system, and the planning of these rises will be largely determined by the presence and situation of rises already driven for prospecting or development which can be impressed into this new service by properly adjusting the following plans. All rises driven for prospecting purposes have a slope of 45°, so that in course of time they will fit into the general scheme. Of course, the correspondence is not exact, but this makes little difference, as already indicated, as these openings serve to loosen the ground.

These rises are all 4 by 4 ft., and cost $1 per foot or 75c. per ton. The progress required of the men is 5 ft. per shift. In the short rises it is common to shoot twice a shift, making an average of 7 ft. per shift or 14 ft. per day. Hammer drills are used in the rises, and naturally there is no shoveling. In actual operations about six or seven rises are being worked at one time. It takes about two months to do the rising for a 100-ft. block.

CHUTES

There are usually about 150 rises to a 100-ft. block. The actual number called for with 10-ft. spacing is 121, but many of the collars become connected in two ways where such connection is very short and can easily be made. This gives a little elasticity in controlling the direction of flow.

After the level has been blasted it will be found that a large number of the chutes will not flow. Provision has been made for this by having drilled a round of 5 to 7 holes, 4½ to 6 ft. long, into the solid block at the tops of all rises before leaving them. Any of these can now be loaded and blasted, thus starting the flow at that point. In order to assist the flow the collars of the rises have been expanded like a funnel. In this way all the chutes are started and each one contributes its share.

The chute gate controlling every one of the rises is placed as closely under the level as possible in order to keep the capping from descending any farther than absolutely necessary. If the capping is allowed to descend

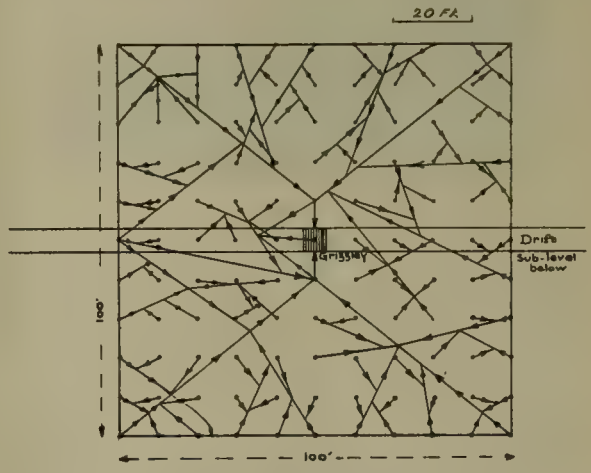


FIG. 4. PLAN SHOWING SYSTEM OF 45° RISES FOR A BLOCK 100 BY 100 FT., AND 60 FT. THICK.

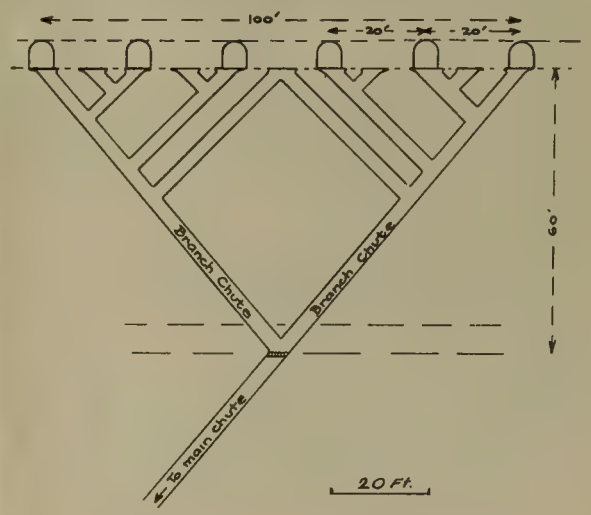


FIG. 5. SECTION SHOWING GENERAL SCHEME OF BRANCH RISES.

say 6 ft. in each of the 150 rises, it is manifest that a 10% slice will be lost when this block is caved. It will be lost because, having become mixed with capping, both will be rejected together. The present system of 60-ft. sub-levels, therefore, is an improvement over the original 30-ft., as this loss is occasioned only half as often. The chute timbers are therefore put right at the level and the gate only a few feet below.

All the rises from the block lead to a single grizzly on the sub-level below. To tap the chutes, and control the day's output, of perhaps 2500 tons, only 4 men per shift are required. When running freely, any chute will average 100 tons in 5 minutes. Not more than 50 tons is drawn from any chute at one time. A tag stating date, shift, and the tonnage drawn is attached to

OHIO COPPER CO. MILL.

each chute. Two men, with the occasional assistance of a boss, draw all the tonnage. One of these is at the grizzly and keeps the traffic clear with the aid of hammer and bar. The other, tending a chute, manipulates his gate, and has the opening constricted down to 2 by 2 ft. With bar, hammer, and drill steel, he attacks any oversize that clogs the chute. 'Bulldozing' is ruinous to the chute timbers and against orders. With the aid of his watch the tender estimates his 50 tons, with surprising accuracy, after which he drops his plank and tallies the tonnage on the chute record. It will be noted that a 45° chute is easily controlled.

Below the grizzly there are two men who tend to the rises and chutes down to the Mascotte. They keep the traffic open by patrolling the main arteries. Two men load the trains at the pockets in the Mascotte tunnel through which the ore is trammed to the mill at Lark, shown in the cut above.

Costs

In order to mine a block 100 by 100 by 60 ft. deep, which represents 50,000 tons, the following work must be done:

			Tons.	Per ton.
Drifts and cross-cuts..	700 ft. at	$3.25 = $2275	2,450	$0.93
Rises	6000 "	1.00 = 6000	8,000	0.75
Total and average		$1.24 $8275	10,450	$0.79

The cost per ton of mining the entire block then is:

Excavated	10,450 tons at	$0.79 =	$ 8,275	20.9% of tonnage
Caved	39,550 "	0.068 =	2,725	79.1% "
	50,000 tons		$11,000	

Average per ton, $0.22.

This cost per ton may be distributed as follows:

	Per cent.
Superintendence	8.2
Office	1.1
Technical engineers	3.9
Hoisting	4.1
Blacksmithing	2.5
Carpenter shop	1.8
Miners and shovelers	27.7
Timbering	7.0
Chute tending	8.1
Powder-men and roustabout	1.1
Loading trains	4.1
Supplies and power	30.4
Total	100.0

Profits of the Rand Mines, Ltd., Subsidiaries

The estimated profits for January, compared with those in December, are as follows:

	January.	December.
Modderfontein B.	£47,420	£44,699
New Modderfontein	62,317	57,542
Rose Deep	19,905	21,251
Geldenhuis Deep	9,220	9,531
Nourse Mines	9,697	11,906
City Deep	37,348	41,102
Village Deep	21,748	26,632
Ferreira Deep	45,955	26,650
Robinson	42,577	41,439
Crown Mines	70,072	74,070
Bantjes Consolidated	6,556	824
Durban Roodepoort Deep	2,804	5,207

In the Crown Mines the grade continues below what is called for by the estimated value of the ore reserves which are being mined. The cause of this difference is being carefully investigated. The supply of native labor is rapidly improving. There was an increase of over 1100 in the number of Kaffirs employed by the Company during January, and it is confidently anticipated that this will lead to a substantial increase in the tonnage treated in the course of the next few months.

The Bantjes Consolidated had a loss of £6556, due to the Central shaft breakdown. Repairs are progressing satisfactorily, and two hoisting compartments were expected to be completed during February; but a loss should be anticipated for that month.

Gold exported from the United States in the year 1914 totaled $242,711,000. Of last year's total, about $113,513,000 went to Ottawa on account of the Bank of England. Imports into this country during 1914 totaled $58,122,000.

Gold production of Rhodesia in 1914 was worth £3,580,207, against £2,903,267, £2,707,368, and £2,647,894 in the three previous years. There were 202 mines yielding metal.

Metallurgical Practice in the Porcupine District

By NOEL CUNNINGHAM

*Many excellent descriptions of the mills of the Porcupine district have been written, but no discussion exclusively devoted to the metallurgical technology has been given. These notes are intended to cover this feature briefly. They are based upon 2½ years' mill operation in the district; that is, practically since the beginning of metallurgical operations.

Character of the Porcupine ore.—There is no oxidized ore in the district, the surface having been deeply planed by glacial action in recent geologic time. The precious-metal content is about in the proportion of 85 of gold to 15 of silver by weight; hence, the silver is practically negligible. There are two classes of Porcupine ore, having very different characteristics; these will be referred to through this paper as class A and class B.

Class A ore is a pure quartz with inclusions of schist. Generally it is heavily fractured and breaks down readily to sharp hard grains, about minus 10 plus 20 mesh, requiring further comminution to release the gold. It contains little pyrite; the gold is entirely free and inclined to be coarse, but often spongy, going into solution readily on that account. This gold is 60 to 85% free milling, depending on the grade of ore.

Class B ore is an iron silicate schist, strongly laminated, containing 4 to 5% pyrite; its specific gravity is 2.8 to 3, depending on the amount of mineralization. In breaking the ore in the mine, generally over 25% of material through a ½-in. ring is made; the ore readily breaks down in milling and makes a comparatively large amount of non-crystalline slime; owing to its high specific gravity, however, it is quick settling. In my opinion, the gold in this ore is free, but so finely divided that it will neither pan nor amalgamate; it appears to be disseminated through the rock and not chiefly associated with the pyrite.

Veins of class A ore occur with or without side walls of class B, and veins of class B occur unassociated with class A; more often the veins are closely banded, class A and class B alternating, generally with class B in excess. Both classes of ore are more or less blocky at times, and with reference to class B this is indicative of low gold content.

From a treatment standpoint neither class of ore introduces any important difficulty, although there seems to be a tendency toward re-precipitation, due probably to some element in class B material. Practically no cyanicides are present in the ore, chemical consumption being about 0.2 lb. of cyanide per ton of ore; 1-lb. cyanide solution is sufficient for extraction, and protective alkalinity may be carried very low. With a well designed battery and tube-mill installation, a stamp duty of 15 tons or better can be readily maintained.

*Abstract from *Trans.* A. I. M. E., New York meeting, February 1915; presented also, by joint agreement, before the Canadian Mining Institute.

Outline of Treatment and Development at the Principal Mills

It will be of benefit to outline the treatment in the five principal mills of the district in chronological order, and to comment briefly on the metallurgical trend indicated.

First Hollinger mill.—Destroyed by fire before ready to operate. Treatment intended: fine crushing, plate amalgamation, and concentration of tailing.

First McIntyre mill.—Designed for treating class A ore. Crushing by 10 light stamps, fine grinding, plate amalgamation, and concentration of tailing from amalgamation. As the mine developed, chiefly class B ore was produced, from which good extraction could not be made by amalgamation. This mill was shut down after about a year's run.

Vipond.—Mill of 100 tons capacity treating a mixture of class A and class B ore. Treatment: fine grinding and plate amalgamation. Simple amalgamation did not make satisfactory recovery of the gold and the mill was shut down after a few months' run. Recently the mill resumed operation, amalgamation having been abandoned and a cyanide plant added. Treatment: fine grinding in cyanide solution, agitation, and complete counter-current decantation.

Dome.—A 40-stamp mill, recently increased to 80 stamps, treating a mixture of class A with a less amount of class B ore. Treatment, at start: stamping in water, primary amalgamation, fine grinding, secondary amalgamation, dewatering, agitation in cyanide solution, Merrill filters, to waste. Later: stamping, tube-milling, and plate amalgamation in water, cone classification to three products; (*a*) slime, dewatered and agitated in cyanide solution, Merrill filters to waste; (*b*) sand, leached; (*c*) concentrate, reground in tube-mill in closed circuit with classifier and amalgamation plate, classifier overflow to slime treatment.

Hollinger.—A 40-stamp mill, recently increased to 60 stamps, treating a mixture of class A and class B ore, the latter predominating. Treatment at start: stamping in solution, fine grinding, concentration, concentrates amalgamated in solution and returned to table tailing, table tailing to agitators, to Moore filter, to waste. Later: stamping in solution, fine grinding and concentration, concentrate agitated in strong solution, washed and impounded; table tailing to two steps of continuous decantation, to filters, to waste. Now building: plant for agitation and complete counter-current decantation for one-third of the tailing from table concentration.

Porcupine Crown.—Plant with 10 light stamps, later increased to 20, treating class A ore entirely. Treatment at start: stamping and fine grinding in water, fol-

lowed by plate amalgamation. Later: stamping and fine grinding in solution, with plate amalgamation in closed circuit with tube-mill and classifier, followed by agitation and complete counter-current decantation.

Second McIntyre mill.—Plant of 150 tons capacity, recently increased to 300 tons, treating a mixture of class A, with large preponderance of class B ore. Treatment at start: fine grinding in solution, agitation, Burt filter to waste. Later: the capacity was increased from 150 to 300 tons, the treatment being unchanged except that continuous decantation replaced filtration in the new unit.

Acme mill.—Now building with 40 stamps, to treat a mixture of class A and class B ore, the latter predominating. Treatment: stamping and fine grinding in solution, agitation, concentration, concentrate to be reground in solution, agitated, washed and impounded, table tailing to be treated by decantation.

Analysis of the Milling Practice.

A tendency toward extensive alteration in treatment methods will be at once apparent from a consideration of the above outline of milling practice and development. This is chiefly due to the fact that large bodies of class B ore are now being developed and treated, whereas the design of most of the mills was determined almost entirely from tests upon class A ore. The entire failure of unaided amalgamation is obvious. Amalgamation in conjunction with cyanidation is practised only at the Dome, where large bodies of class A ore are yet to be treated, and at the Porcupine Crown, where to date only class A ore has been found. At the latter mill, however, only a small plate area is used in the classifier tube-mill closed circuit, as the ore contains a large amount of coarse free gold which is readily caught at this point.

The equipment at the Porcupine mills offers good opportunities for comparison of various machines for doing the same work.

Stamps v. rolls and Hardinge ball-mills.—At the Vipond and the McIntyre mills, rolls and ball-mills are doing the work done by stamps at the other mills. The ore is chiefly soft schist and the ball-mills have been entirely satisfactory; power per ton of ore ground appears to be slightly higher with stamps for the production of identical results. Steel consumption is about the same, the stamps perhaps having slightly better efficiency in this respect; cost of operation and repairs is in favor of the ball-mill, while first cost and uniformity of operation (what might be termed lack of operating 'grief') are decidedly in favor of the ball-mill. While my own experience in the district has been entirely with stamps, and their performance was satisfactory, I am of the opinion that the ball-mill is preferable for breaking down the Porcupine ore ahead of the tube-mills.

It may be of interest to note, in passing, that at the McIntyre a first-class Chilean mill was discarded in favor of the ball-mill after the two had run side by side for a year. At the Vipond, Hardinge pebble mills are used for fine grinding, while cylindrical mills are in use in all the other mills. I do not know how the conical mills compare with the cylindrical mills in first cost, power required, performance, etc., but on theoretical lines I favor the cylindrical mill, where coarse gold is to be dissolved in solution, as more effectively trapping the gold particles and wearing them down to microscopic fineness, owing to the vertical end of the mill.

Stamping in water and amalgamating v. stamping in solution with no amalgamation.—Probably the best opportunity for studying this point is afforded by a comparison of the Dome and Hollinger practice. The advantages claimed for stamping in water and amalgamating are a better recovery of the coarse free gold and the saving in treatment cost, due to a smaller amount of solution to precipitate and a smaller amount of precipitate to handle. At first sight it would also appear that a saving in dissolved losses from the filters would be made, owing to the smaller amount of gold in solution going to the filters.

While at the Hollinger there is a smaller percentage of amalgamable gold in the mill heads than at the Dome, on the other hand, the coarse free gold per ton of ore in the mill heads is about the same, due to the fact that the head assay is nearly triple that of the Dome. Hence, if amalgamation is necessary in order to assure the dissolution of coarse gold in cyanide solution, difficulty from this source should be experienced at the Hollinger, where crushing is done in cyanide solution, with no amalgamation following.

This is not the case, however; all the coarse gold goes into solution in the classifier tube-mill closed circuit. This is proved by two facts in connection with the Hollinger operations. Table concentration after fine grinding is practised at the Hollinger, and any coarse free gold passing the tube-mill classifier closed circuit would be caught on the tables. No coarse gold is present in the table concentrate, however, no color of free gold ever showing on the tables; also practically no amalgam was produced (under 1% of the total value recovered) during six months pan-amalgamation of concentrate from the tables.

Facts also indicate that crushing in solution without amalgamation shows the best results in regard to amount of solution precipitated and dissolved gold mechanically lost. With the head assay at the Hollinger about three times as high, the precipitation ratio is only about twice that at the Dome, and the mechanical loss of dissolved gold and cyanide only about one-half. Nor is any saving in dissolved losses or treatment cost proved in favor of crushing in water followed by amalgamating. On the other hand, there are added to the treatment cost, (1) cost of amalgamation, (2) cost of increased cyanide consumption due to 'waste' solution precipitated and thrown away, and (3) in winter the cost of heating to mill temperature the quantity of water—equaling several times the weight of ore treated and introduced at nearly a freezing temperature—to replace the water and waste solution discharged with the tailing, which would not be necessary if crushing were done in solution. The

loss of gold left in 'waste' solution after precipitation must also be added to the cost.

In comparing Dome and Hollinger metallurgical practice, it is only fair to state that since the Dome ore is harder and more compact, the gold may be less spongy and therefore less amenable to cyanidation. The only deduction which can be drawn from the facts, as far as I know them, is, that apparently in treating average and low-grade ore of the district, amalgamation can be eliminated; that if amalgamation is eliminated and solution introduced at the stamps, a considerable saving in operating cost, cyanide, and dissolved gold losses is possible.

Unquestionably, more extensive study has been given to the treatment of the Dome ore than to any other in the district. Hence one hesitates to make what may appear to be a criticism of an operating system probably justified by a careful balancing of co-ordinate factors by an eminent firm of metallurgists. However, no metallurgical discussion would be complete without touching upon this point, which is the salient difference between the two metallurgical systems of the district.

Concentration v. non-concentration.—The Hollinger is the only mill employing a table concentration. About 16% of the gold in the ore is recovered in the concentrate, and the advantages claimed would indicate that the possibilities justify careful consideration. The pulp, with the concentrate removed, needs much less careful treatment than the entire pulp, concentrate included, would require, hence a small tonnage of concentrate may be given whatever treatment it demands to get the best result, while the large tonnage of pulp free from concentrate may receive the much smaller amount of attention it requires.

Table concentration at the Hollinger costs about 5c. per ton of ore treated, and recovers about 80 lb. of concentrate per ton of ore, assaying about 2½c. per pound, worth, therefore, about $2. In the careful treatment given the concentrate the value per pound of concentrate is brought down to about 0.3c.; in other words, a saving of $1.76 is made from the 80 lb. of concentrate from each ton of ore, which is a large enough amount to warrant the expenditure of 5c. to safeguard. The performance of the thickeners and filters is improved if a feed can be maintained composed of particles of one specific gravity, so that from the standpoint of better mill performance, due to keeping the concentrate out of the thickeners and filter, I am of the opinion that the expenditure of 5c. per ton of ore is justified where the concentrate taken out amounts to, say, 4% or more of the total tonnage. Another advantage is that even after a very careful treatment the concentrate tailing assays from $5 to $7 per ton of concentrate, equal to 12 to 20c. per ton of ore. Also the saving in treatment cost, due to the less agitation required for the pulp freed from concentrate, should be credited to concentration. Hence, I should say that if table concentration cost 20c. per ton, instead of 5c., it would still be justified when a considerable amount of class B ore is to be treated.

Agitation.—The ore particles composing the pulp coming to the agitators are extremely quick-settling and largely granular, after only a few minutes' shut-down the pulp compacts solidly in the bottom of the agitator so that, mechanically, agitation is a difficult problem. At the Dome four Pachucas in series are in operation, but all the other mills use the Dorr agitator, which seems to be peculiarly adapted to the local requirements. From the trouble experienced in keeping the Hollinger pulp in suspension in the filter-loading vats, I judge that the Pachuca agitator is expensive in power required to prevent the filling up of the cone. With a trifling amount of power and a normal air consumption the Dorr agitator meets all the mechanical difficulties.

Metallurgically the quicker-settling particles need longer treatment than the lighter material. Selective agitation of the quick-settling particles is therefore essential if the best results are to be obtained.[1] The Dorr agitator, allowing as it does control over the rate of flow through the tank of material of greater or less than the average settling rate, meets the metallurgical requirements of the ore.

Filter methods of the district compared.—The Merrill filter is in use at the Dome, and while direct treatment in the presses has been tried, it has been found that the use of agitators for the dissolution of the precious metals is preferable, as a very large and expensive filter installation would otherwise be required. The Moore filter at the Hollinger has indicated that the ore contains such a large proportion of quick-settling material that vacuum filtration is not altogether satisfactory. In the loading vats, six air-lifts are used, requiring 40 hp. at the compressor, and even with this intense circulation the heavy slime accumulates on the 60° hopper bottoms, resulting in such damage to the leaves that about one-third of the filter-operating cost is represented in repairs to filter-leaves. Then, too, with the strong circulation, due to the air-lifts, the cakes are channeled and uneven. On the whole, I do not consider that vacuum filtration is adapted to the Porcupine ore.

At the McIntyre mill, a Burt filter is doing good work and is stated to have been entirely satisfactory. At the Hollinger and the McIntyre mills, the pulp from the new sections will be treated by continuous counter-current decantation, while the pulp from the original sections will continue to be put through the filters, so that shortly some interesting comparative figures on the two methods should be available.

Continuous counter-current decantation.—It has been previously mentioned that no oxidized ore occurs in the district, and the clean undecomposed rock breaks down to give an ideal product in the thickeners. Class A ore makes no colloid, and class B ore, while grinding to an extremely fine, amorphous product, gives little trouble in settling, owing to its high specific gravity. Class A ore can be thickened to 30% moisture and class B to 35 to 45%, depending upon the percentage of concen-

[1]For an exposition of the term 'selective agitation,' see the paper by J. V. N. Dorr, in *Bulletin* No. 92, p. 2072 (August 1914).

trate. The critical moisture is 45%, when 5% of concentrate is present, and about 35% moisture with class B pulp, free from concentrate. On account of being able to get such unusually low moistures in the thickeners, a very high recovery of dissolved metals is possible by continuous decantation. Also, the fact that the cyanide strength of the solution from agitators to thickeners need only be carried at slightly above 1 lb. per ton favors the decantation system, where the mechanical loss of cyanide is generally higher than in ordinary filter practice. At the Porcupine Crown, with about $13 going into solution per ton of ore, and using four steps of decantation, with no filter, the dissolved gold loss is only 5c. and the mechanical loss of cyanide only 0.32 lb. per ton of ore.

The Hollinger mill put in two steps of continuous decantation early in 1913, and the complete counter-current decantation system was installed in the cyanide extension of the Porcupine Crown later the same year. Later still, the Vipond installed the counter-current decantation system, as did the McIntyre when the mill was enlarged. The Hollinger has a complete 300-ton plant under construction and the Acme mill a 600-ton plant, both to use this system.

Mill design.—The proper design for a mill treating Porcupine ore will depend upon the proportions of class A and class B ore to be handled. Unless there is to be a large excess of class A ore, amalgamation may be dispensed with, as the recovery by amalgamation will not warrant its use. If class A ore were in large excess it would still be an open question, but from a recovery standpoint amalgamation is unnecessary.

The Hardinge ball-mill may not show up as well on class A as on class B ore, but I am inclined to think that it would. With an excess of class B ore the ball-mill will be superior to stamps. I am of the opinion that a cylindrical tube-mill should be used for fine grinding, rather than a conical mill, if only for a theoretically better dissolution of coarse gold.

For the treatment of any considerable proportion of class B ore, table concentration, with separate treatment of the concentrate, will probably pay.

Agitation should be arranged to be continuous, preferably in a series of flat-bottomed agitators, allowing a preferential treatment for the quicker-settling portion of the ore.

If filtration is used, a pressure filter will be more satisfactory than a vacuum filter; however, the ore is so perfectly adapted to continuous counter-current decantation that this would seem to be the proper treatment.

On account of the severe winter conditions and the high cost of fuel, the object to strive for in the design should be as compact an arrangement of the equipment as possible, so as to minimize the cubic content of buildings to be heated.

In the district, the water supply is ample, the sites for mills are good, and the facilities for convenient tailing disposal are adequate. It is interesting to note, finally, that this is the only important gold-producing district near the Atlantic seaboard.

Practical Points on Sampling

By ARTHUR FEUST

Undoubtedly most of the following is an old story to experienced engineers, but for the benefit of the younger members of the mining profession I will describe some of the practical details to be observed in taking and cutting down samples for mine valuation as well as for metallurgical tests. Some of these details I have learned from other engineers and others I have myself devised.

On arriving at any property, after looking over the property, maps, and calculating the footage to be sam-

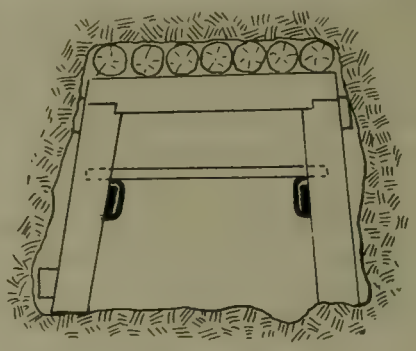


FIG. 1.

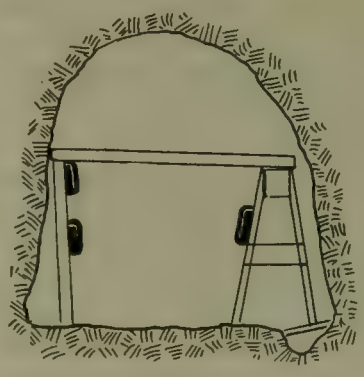


FIG. 2.

pled, it is advisable to make a pick analysis (see 'Mine Sampling and Valuation,' by C. S. Herzig), together with horn spoon tests in order to determine the character of the ore to be sampled before deciding on the sample interval, as well as whether the samples are to be taken as a unit or in sections across the orebody. By so doing, one will often save time and money for the client in subsequent operations, as long stretches of barren ground can be eliminated, thereby allowing closer sampling in the ore-shoots proper and giving greater accuracy.

Once the sample intervals and other questions have been decided and the actual work of taking the sample is under way, watching minor details, such as (*a*) temper of gads, (*b*) staging for high places, and (*c*) quantity decided to cut per foot sample, will greatly expedite further operations. By trying various tempers of steel

(marking the gads for identification of temper) for the first day or so, the exact temper for any particular rock may be determined, for what may answer best in one mine will be useless in another. For staging, no fixed rule can be given, as this depends on the ingenuity of the individual. Two of the simplest devices are sketched below, one for timbered, the other for untimbered ground. The quantity to cut per foot depends on facilities at hand and whether samples have to be transported any distance, for the reduction of big samples in out of

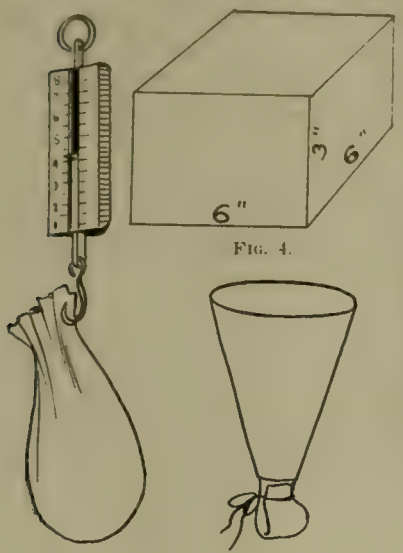


Fig. 4.

Fig. 3.

Fig. 5.

Fig. 6.

the way places with poor facilities is a problem in itself, being costly and tedious. In order to keep within bounds I have found that it is advisable for the first few days to use either a spring balance with a hook attachment (see Fig. 3), or a standard volume (see Fig. 4). Of these two, I prefer the spring balance, because it is simple and more accurate to gage the sample by weight than by volume, for by the latter method the sample will vary according to the size of the particles chipped off, the packing down into the standard volume, and the porosity of the ore sampled, besides involving a double transfer from the receptacle in which the sample is cut to the standard volume and thence to the sample sacks.

With regard to the various devices for taking or, rather, catching the sample, I have found nothing as satisfactory as the open canvas cone device shown in Fig. 5. It is simple, easily made, and offers the least chance of salting by retaining particles from one sample to the next. It can be throttled to avoid excess of material from any particular point, and has the great advantage that the material can be easily transferred to the sample sack without danger of spilling. As seen in the sketch, it consists of a heavy wire ring, over which the truncated canvas cone terminating in a small open cylinder can be sewed. The lower end is double and fastened with a simple surgeon's knot when in use. However, this device, like the canvas bucket and candle box, is open to the objection that clayey or wet material adheres to it and is apt to cause a great deal of lost time in cleaning and a possibility of salting. For material of the character above mentioned, I have found satisfactory one half of a 5-gallon kerosene tin with the sharp edges doubled over, using a few drops of kerosene to prevent the material from sticking (apologies to C. H. Wray of the Bewick-Moreing staff), as nothing adheres to this if the kerosene is renewed occasionally. Once the tin is abraded and corrodes it becomes useless, but a new one is easily procured.

Reducing samples. At this point in the operation I have seen many a sample ruined through haste and carelessness. A little more time and care expended adds greatly to the accuracy, especially in breaking up the larger pieces of ore where chips are apt to fly. Among the devices which I have seen where no laboratory crushers are available, the ones sketched below can be procured almost anywhere, as all prospects have at least some apology for a blacksmith shop. Fig. 7 is one I saw used by W. H. Wiley, of Los Angeles, in Chihuahua in 1906. Fig. 8 represents a favorite Mexican device. Fig. 9 one I have used quite often. In cutting down the sample by quartering the truncated cone is very useful, as the material can be poured through this very easily, insuring a uniform spreading out of the material as the cone raised, with a minimum loss by dusting. For cutting down the smaller sample, a Jones sampler can easily be made out of kerosene cans, if one is not at hand. The one sketched in figures 11 and 12 shows the construction I have used for several.

Metallurgical sample.—Very few engineers seem to give much attention to this sample, but to me it is just as important as the mine valuation samples, for if you do not get accurate results on what you can get out of

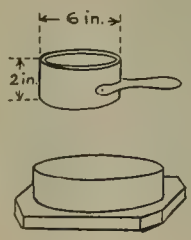


Fig. 7.

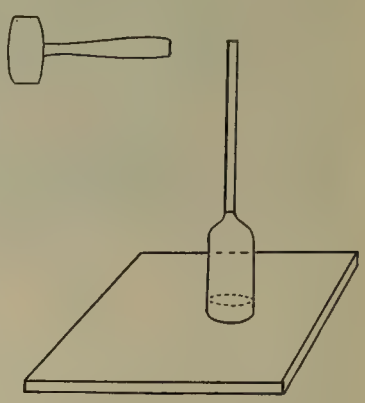


Fig. 8.

the ore, what is the use of knowing what is in the ore? Therefore, I recommend the following precautions:

1. Don't roast the sample in drying, as a roasted sample is useless for most metallurgical tests.

2. Don't crush the ore too fine in one operation, as the metallurgical sample should be taken as early as possible, especially when sulphides are present.

3. Don't cut clean ore samples and calculate the dilution afterward, especially where the walls are soft and decomposed; but cut waste along with the sample, if at

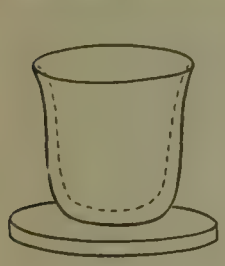


Fig. 9.

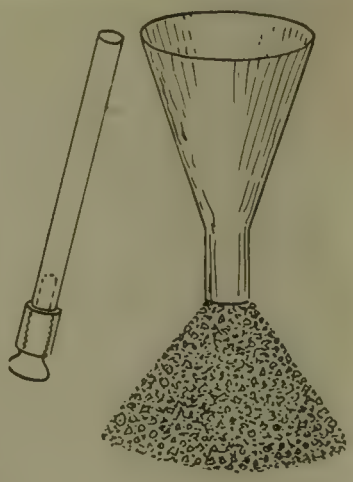


Fig. 10.

all possible, as this will have a vital bearing on the metallurgical test. The clean ore may be easy to treat by cyanidation, but the average ore may be difficult to treat, due to the colloids contained in the wall-rock.

4. Don't make up one composite sample from the entire mine, but keep the composite samples of different ore-shoots separate; also divide the ore-shoot into oxide and sulphide zones, making separate samples of these; for, whereas one part of an ore-shoot or one ore-shoot

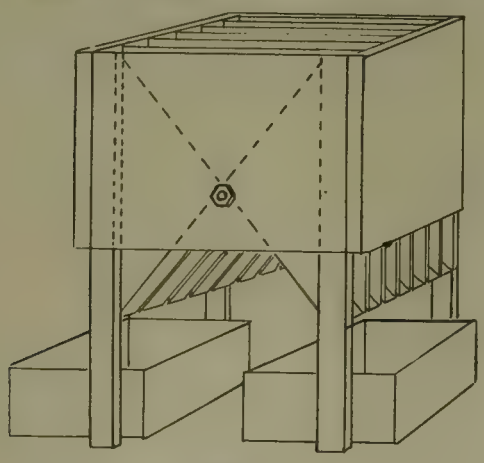


Fig. 11.

may be amenable to one method of treatment, the other may require entirely different treatment. Be sure to proportion each sample in your composite samples according to the tonnage it represents.

5. Don't place too much reliance on a high extraction obtained on some high-grade ore, as it is very deceptive; a poorer extraction usually results on lower grade ore.

6. Don't be afraid to take along a few pieces of high grade, some representative massive, or finely divided sulphides, or crystals; for by the aid of these the metallurgist may be able to identify minerals which are the source of difficulties in the metallurgical experiments.

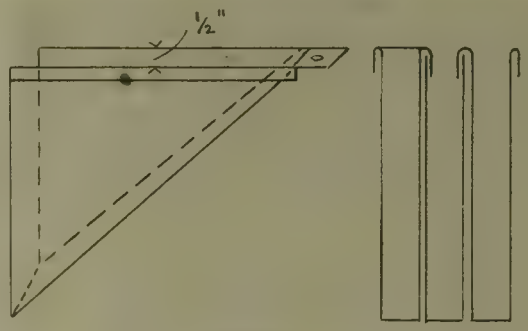


Fig. 12.

Likewise, representative pieces of wall-rock are at times invaluable.

7. Don't only cut a few check samples, but make up a few composite samples to check the assayer, as we are all human and none of us infallible.

The aggregate value of potash salts and fertilizer materials imported into the United States in 1914 was approximately $38,500,000, a decrease of $8,500,000. Imports were as follows in tons:

Material.	1913.	1914.
Kainit	465,900	329,600
Muriate of potash	213,800	168,500
Sulphate of potash	39,500	36,300
Manure salts	223,300	168,400
Nitrate of soda	625,900	543,700
Sulphate of ammonia	58,300	74,100
Bone dust and ash	34,600	36,000
Guano	19,100	25,600
*Apatite	3,000	100
*Calcium cyanamid	15,000	30,000
*Phosphates, crude	24,000	24,000
*Basic slag	15,000	10,000
*Other substances used as manure	115,000	197,000

*Fiscal year figures.

The year's purchases of the foregoing classification had an aggregate value of $37,117,000, as compared with $45,069,000 in 1913.

Crude acetic acid has been used up to the present time in the coagulation (thickening or setting) of rubber. An important discovery has been recently made in Ceylon by which cocoanut water will do this work as well and considerably cheaper. Large quantities of the liquid are available from cocoanut plantations. The water is allowed to ferment for four to five days, then one to two ounces of the liquid will coagulate one pint of pure latex (viscid, milky sap of the rubber tree). Ceylon exported rubber worth $22,000,000 in 1913, $5,089,167 going to the United States.

Gold production of New South Wales, Australia, in 1914 was 124,507 oz. fine, compared with 149,657 oz. in 1913.

Prospecting River Bars in Cold Countries

By THOMAS N. TURNER

It is sometimes desirable to investigate bars in river channels, either for their gold content or other qualities which the bar may have. The method for the examination of such bars, here described, is only applicable in cold climates.

Take for example a river channel of the cross-section shown in Fig. 1. Assume the river covered with ice to a depth of 4 ft., and a shaft 5 ft. in diameter to be sunk to the gravel bar 10 ft. below the surface of the

Fig. 1.

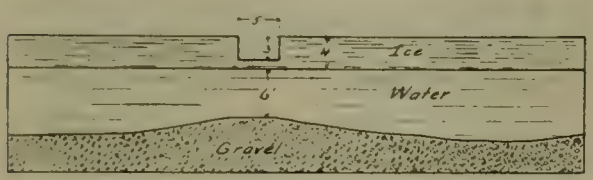


Fig. 2.

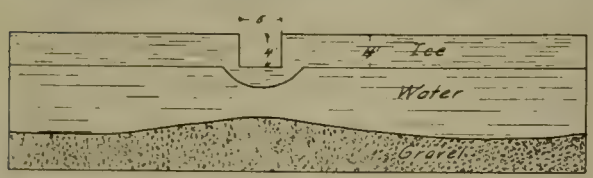


Fig. 3.

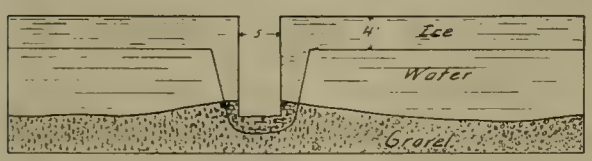


Fig. 4.

ice. Describe a 5-ft. circle on the ice over the point which you expect to prospect. Everything is now ready to start excavating. By the use of bars and picks the ice is removed, chipping carefully within the 5-ft. circle. Chipping and shoveling are continued until a depth of about three feet below the surface of the ice is reached. Great care must be taken so that the main body of the ice is not cracked, in which case the water would flood the shaft. At this point work is stopped to allow nature to do her part. The shaft is then as shown in Fig. 2.

After 24 hours' exposure to the cold air, work on the bottom of the shaft may be resumed. Perhaps under some conditions it would be best to resume work only after two or three days' freezing. Local conditions will determine the best time. However, chipping is again started and another foot of ice is removed from the bottom of the shaft (Fig. 3). These operations of freezing and chipping are continued until the shaft has been completed (Fig. 4).

In deep shafts it is sometimes necessary to set up an air-chute to send the cold air to the bottom of the shaft. This chute may be constructed of cloth or any other suitable material and of a type similar to the ventilators on a steamship. The positions of the shafts must be so arranged that the flow of water in the stream will not be impeded, for under such conditions the water pressure will break the walls of the shaft and flood the excavation.

The Sam Yet Prospecting Mill

By ALGERNON DEL MAR

On the Sam Yet mine, near Searchlight, Nevada, there lives an Anglo-Chinese who has mined in the western states for many years. The accompanying photograph

SAM YET AND HIS STAMP-MILL.

shows a one-stamp mill erected and used by Sam Yet. It will be noticed that the cam is made from a wagon wheel, the spokes being cut in the form of an involute shod with band iron. The tappet is an old cog-wheel, with others of miscellaneous character to add weight. The boss and shoe, not shown, are made from the plunger of a pump. The mortar-box is of wood, double-discharge pattern, with 40-mesh screens. The stamp is driven by a gasoline engine. Sam says the stamp weighs 500 lb., but I think it under this weight, and he claims 800 lb. of ore can be crushed per day and that he obtains from 80 to 90% extraction from his free-milling ore.

Increasing the Use of Steel Supports in Mines

By FRANK H. WAGNER

*Steel supports are now supplanting wooden timber in many mines, especially in places requiring strong permanent sets such as the foot of slopes and shafts, pump-rooms, main intakes and returns, and other similar places of a more or less permanent character.

The objections offered to the use of steel supports, however, are: (1) that it takes longer time and greater skill to handle and erect them; (2) the length of the legs cannot be readily or easily altered to fit the hitches, for the legs must be especially prepared to offer a firm foundation for the cement and base plate; (3) the feet of the struts and base plates, in wet localities, are subject to the corrosive action of mine water; (4) should a slight movement of the roof or bottom of the tunnel or gangway occur, the collar or legs of a steel set, because of their lack of resiliency, are often bent so as to necessitate their replacement; and this (5) is in itself another objectionable feature because it takes considerable time and skill, especially so if the bolts and nuts have been bent or corroded.

STEEL SUPPORTS WITH REMOVABLE WOODEN BUTTS.

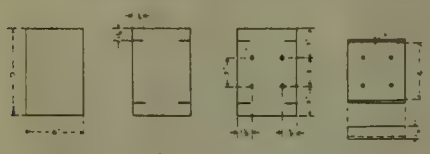


FIG. 1. STEPS IN MAKING BASE PLATES.

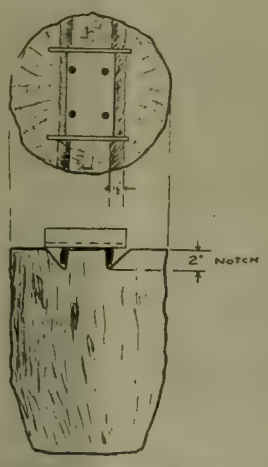


FIG. 2. WOODEN BUTT.

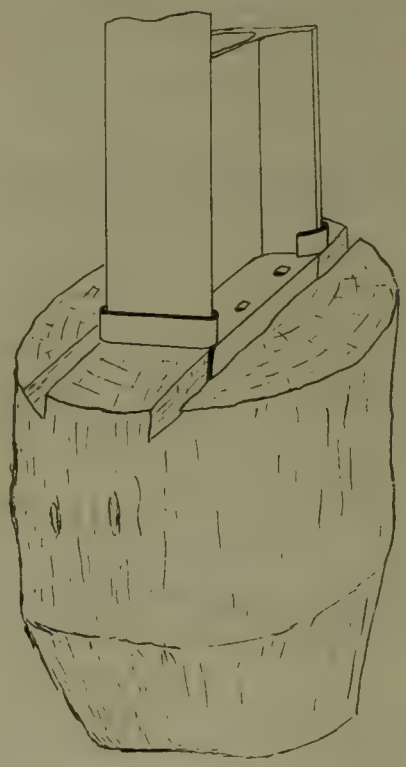


FIG. 3. WOODEN BUTT ATTACHED TO STEEL LEG.

To overcome all of the foregoing difficulties, the introduction of a wooden block or timber butt is suggested by J. M. Humphrey. These blocks or timber butts are found in plenty as waste in the timber yards, and could easily be shaped to take any hitch and be cut to any desired lengths, thus eliminating at once the inconvenience of a fixed leg length, or the cutting of steel, or making new hitches. These timber butts or blocks would also act somewhat as cushions for the steel legs, and under heavy pressure would crush or give way before the steel collar or legs would bend, and thus save the steel. The action of mine water along the bottom would be spent on the wooden butts and not on the iron base or foot of the steel legs. Wood will resist the corrosive action of mine water much better than iron or steel. However, even if the wooden butts do begin to corrode or rot, they could more easily be replaced than a base plate or a leg, and at less cost.

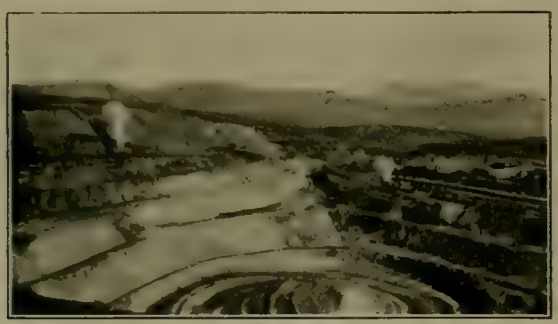
In renewing butts the collar can be jacked up, the old block knocked out, and a new one easily fitted and inserted. A piece of $1\frac{1}{4}$-in. flanged sheet steel could be used as a base plate to join the leg and block. The design of the plate is shown in Fig. 1, from which it can be seen that a 6-in. I-beam leg would take a standard plate of 6 by 9 in., as indicated by (a) Fig. 1. In (b), (c), and (d), Fig. 1, are shown the gradual steps in making the base plate, from stamping the four $\frac{1}{4}$-in. slots to drilling the spike holes and shaping the ends for holding together the blocks and leg. Fig. 2 shows the plates spiked or screwed to the butt ready to receive the end of the leg, and Fig. 3 shows the base plate flanges bent around the end of the leg to hold it firmly in position.

*Abstract from *Employes' Magazine* of the Lehigh Valley Coal Company.

A DEPOSIT OF CINNABAR is reported to have recently been found at Pulganbar, 30 miles from Grafton, New South Wales, and a plant of 20-ton capacity is being erected. The prospectors of the deposit are to apply for the government reward of £500 for the first 20 tons of cinnabar mined in the state. The deposit is said to be the most important in the British Empire, but the yield will show its value.

Safety Powder-Boxes

*In the bank blasting at the open-pit steam-shovel operations at Copper Flat the material moved, ore as well as waste, usually contains large boulders. Many of these are too large for the shovels or cars to handle, and have to be broken up by bull-dozing or 'dobe' blasting. To accomplish this it is necessary to have on hand at or near each shovel a small field supply, usually only one box or part of box, of Hercules dynamite, with necessary quantity of fuse and detonators. The question of the safe handling of this supply, and of safeguarding it in the field, has always been a serious one. In extensive operations, with several steam-shovels engaged at widely separated points, unless there is some definite point or place of storage at each machine, the field supply is likely to become scattered. Men get careless and



OPEN-CUT AT NEVADA CONSOLIDATED.

sometimes leave a stick or two of dynamite lying around, safely (?) tucked under a convenient rock, or in the open, here, there, and everywhere. The capman, that is, the cap and fuse magazine keeper, has charge of stock, and prepares fuse for use by crimping the detonators and making up all primer cartridges. It is also his duty to deliver fuse and primers to the blasters in the field. In the absence of any definite place or facility for field storage, the capman in making his daily deliveries is likely to leave his supply at any place 'nearby' or convenient, an extravagant and dangerous practice, to say the least.

To meet the demands of 'safety,' and to protect employees from the unnecessary dangers involved in the careless and haphazard manner of handling this field supply of explosives, a safety powder-box has been designed and is used. Two of these boxes, one for dynamite and the other for fuse and primers, are kept at each steam-shovel, at a safe distance from it, in charge of the blasters, but under the supervision of both powder and level foremen.

The box is constructed of 2-in. fir lumber, entirely covered with No. 24 galvanized sheet iron. The bottom is arranged to securely fasten a box, original package, of powder thereon, the remainder of the box, four sides and top, constituting the lid, which is hinged to the bottom. The box, painted a bright red, is easily seen from a distance, and is so constructed that there can never be any question as to whether or not it is closed, or left open so as to expose the contents. The fuse and cap box is of the same construction, with a box or tray divided into compartments in which are kept the fuse, caps, and primers.

The prime feature of safety of this box is that explosives are not exposed to the danger of ignition and possible explosion which might be caused by sparks and live cinders from passing locomotives, and from the steam-shovels and churn-drills operating in the immediate vicinity. Explosives are also protected from the possible danger of flying rocks from blasts.

Of equal value as a safety measure, perhaps, is this, that explosives are kept securely under cover at all times, protecting same from exposure to the sun on hot summer days, thus obviating the danger of possible leakage of nitroglycerine; and to a certain extent, preventing freezing in the cold winds of the winter months and the consequent risk and danger of handling frozen dynamite.

A secondary, though highly important, feature of safety lies in the fact that the use of these boxes tends to the culture of caution. They are a practical and ever present sermon on the text of 'safety first.' The inherent risks and dangers involved in handling explosives are kept constantly before miners, and the example set by the Company in thus making provision for safety against these hazards has a compelling influence on the thoughts of all employees. Order and system are evolved out of that chaos and carelessness which familiarity breeds with danger in the use and handling of explosives. This one feature alone is worth all the cost in money, time, and trouble in the use of the safety powder-box, leaving out of consideration the economy resulting in the saving of explosives which would otherwise, in careless distribution and lack of attention, be a waste and a loss.

*Abstract from *Safety First* of Nevada Consolidated Copper Company.

Kali Situation in 1914

*The turn-over of the German Kali Syndicate in 1914 amounted to approximately 156,000,000 marks, a decrease in comparison with 1913, when the amount of 192,000,000 marks was recorded.

In view of the fact that in July 1914 an increase of 11,000,000 in comparison with other years was noted, an annual turn-over of 210,000,000 marks would probably have resulted but for the war.

From the foregoing it can be concluded that the loss on account of the war can be figured at 50,000,000 marks. In consequence, the overhead charges in the operation of the works has risen considerably, to which fact should be added the increase in price of raw materials and the difficulty in obtaining proper help. The war has retarded the negotiations in regard to prolongation of the Syndicate, and at a meeting in the near future, steps will be taken in this direction.

*From the *Weekly Report*, January 30, 1915, published by the American Association of Commerce and Trade, Berlin.

DISCUSSION

Readers of the MINING PRESS *are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.*

Molybdenum

The Editor:

Sir—Apropos to the editorial in the *Press* of February 6, I wish to call your attention to the one commercial valuable molybdenum mine of New Mexico. It has received little publicity, but, according to its owner, has had an ever ready market in Philadelphia and New York at $1.50 per pound. I have not had an opportunity to examine this mine nor investigate the ore treatment process through which the ore is said to be successfully separated, but am in the possession of whatever information is given out by the owner and also have received excellent samples of the concentrated molybdenite.

The properties are owned by Margarito Romero and are in the El Porvenir Mountain mining district, 16 miles northeast of Las Vegas, San Miguel county and eight miles from the A. T. & S. F. railroad. In the group are 16 claims with shafts in various places disclosing ore in place. A hundred-foot shaft has been sunk on a commercially valuable vein containing molybdenite, tungsten, copper, and silver. An 800-ft. adit has just been completed, and the main vein of the property has been reached. A concentrating mill is situated one and a half miles from the portal of the main tunnel.

A successful method of treating the ore has been invented and put into practical use, but only after a long period of unsuccessful trials with oil and electrical concentration. According to Margarito Romero, the inventor, the process is as follows: The ore is crushed on a flat mortar, after which it is roasted and screened through 20, 30, 40, 50, and 60-mesh screens, the tailing being treated in a flume of running water. Sizing seems to be the key to the separation, after which water currents carry off the oxidized copper. Owing to pending patent applications, Mr. Romero would not make the minor details of the process public. Copper, the interfering element, is cleanly separated from the ore, leaving a product assaying 70 to 90% pure. Mr. Romero advises me that he receives on an average of $1.50 per pound for the pure molybdenite f.o.b. New York city.

FARIS V. BUSH.

Lordsburg, New Mexico, February 13.

[Removing the copper is one of the difficulties that has stood in the way of concentrating molybdenum. In our editorial of February 6 we mentioned a method based upon surface oxidation of the copper sulphides prior to flotation and ascribed the idea to James Aston. The method is in fact in commercial use at the works of Henry E. Woods of Denver, who worked it out independently. Mr. Woods treats the concentrate by flotation, using the surface-tension method and ingenious machinery invented by him, and described in the *Trans.* Amer. Inst. Min. Eng., Vol. XLIV, pp. 684-701. There is a good market now for molybdenum, and if a steady supply could be assured the metal would find many new uses.—EDITOR.]

Patents and Metallurgists

The Editor:

Sir—After a careful reading of your recent issues of the *Press*, I am sure your metallurgical subscribers must be mentally divided into two divisions, one of which finds its expression in saying: "Go it, boys! By the time we get a few more 'Near to Dorr' classifiers and thickeners, 'Near to Trent' agitators and replacers, and 'Near to Merrill and Kelly' filters, we will have the old standard devices with their outrageous prices knocked into a cocked hat." The other division finds its expression in saying: "How many more poor designers are going to inflict financial loss, grief, and legal troubles upon unsuspecting companies? Why don't they change the patent laws to protect the men who have labored long to develop a standard machine?"

The metallurgists in the first division will say: "Look at this unit in my mill. It consists of a combined steel shafting and simple castings and was billed at a price that equals 16c. per lb. for the metal. I can stand all the expense of new patterns and turn it out here locally for one-half the money. Here is one of pipe and castings that was billed at a price equaling 25c. per lb., and I can build it for a third of that. The margin of profit is outrageous! Here is an unpatented article, the tube-mill, requiring very large and costly manufacturing units to produce it, yet its cost was only 4c. per lb. Here is a ten-stamp battery with its many units with only a cost of 4c. per pound!"

However, the metallurgist of this class usually pays the price of the patented devices, knowing full well that the performance of these particular units will add to his own reputation as a designer and operator and pay back their higher cost to his company in savings made. Later, when he goes to order renewal parts and finds that he is still paying a price that includes patent rights and original selling costs, he patronizes his nearest foundry. Other more venturesome and usually less experienced metallurgists, or others more skilled in patent office lore than practical mill experience, design new and 'wonderfully efficient' machines much exploited by local papers that soon find their proper place 'behind

the mill or in the courts alongside the model and earlier patent papers of their parent machine. Instances of this kind are common among metallurgists, but not so among the college students. The technical press continues to herald the birth notices with loud acclaim, but fails to publish the dismal obituaries, for the reason that the authors of the first never supply the latter and the kindly metallurgical fraternity hold silently to their medical brothers' oath of Hippocrates.

The metallurgists of the first division can argue in self defense that even accepted standard mill units are not free from patent troubles to the user. It is no wonder the metallurgist hesitates before adopting any unit when it is common knowledge that many large companies paid four times the manufacturing costs of certain patented articles, to be faced years later with the proposition of defending themselves from out of their own treasuries or paying a second bonus to a previous process patent.

The metallurgists of the second division appreciate not only the spark of genius that planted in the mind of the inventor the conceptions of the principles of a new machine or process, but also the wiser ones can picture the long days of designing and building, the part failures, reconstruction, and improvement, with their cost in persistent concentrated effort and hard cash. After the advent of the Dorr thickener, many a metallurgist indignantly said, "That is too simple to even deserve a patent." A few months before he would have said, if such a wonderful automatic labor-saving idea had entered his 'made to order' brain cells, "Moving arms in a settling pulp—impossible!"

The careful thinker will realize that the greatest cost to a patentee, along with constantly improving and developing his machine, is that of convincing his fellow-metallurgists of its worth and securing his orders. At last when a patentee has about emerged from his trials into financial success and believes himself a benefactor to his profession, he must get a hard jolt when a half dozen close imitations of his patent spring up, most of them representing discarded steps or ideas of his own or a design that follows the principles but escapes the wording of his patent.

My acquaintance has brought me in contact with those who would alter or adopt at financial loss any unit in the plant that would dodge a commonly accepted valid patent, and with those who would patent the proverbial left-hand monkey-wrench and cry to the heavens from a house-top against wilful infringers. A common-sense discussion of this subject could never shake the rooted convictions of the above extremes, but it would at least give the younger members of the profession a fair perspective of the subject before later circumstances tend to throw them into one division or the other.

JAY A. CARPENTER.

Tonopah, Nevada, February 7.

[Pirating patents is an all too common matter, due in large part, as we believe Mr. Carpenter truly points out, to the failure of buyers of patent machinery to realize the cost not only of manufacturing but of perfecting, popularizing, and selling even the best devices. Another important factor is the admitted imperfections of our patent laws and patent system. When so many invalid patents are issued by the government, it is no wonder that the ordinary layman comes frequently to the conclusion that it is not only possible but proper to compel a patentee to establish his right to royalty, or high selling price, in the courts. The result is a situation that is little short of disgraceful, but one in which, it must be said in fairness, miners and metallurgists are not alone involved. We doubt if there will be any substantial change until the patent laws themselves are changed. If only valid patents were issued, both patentee and public would be protected against the enormous cost of the present system of trial by lawsuit. Probably Mr. Carpenter is right that mere argument will have little effect upon those who have already committed themselves on this question, and that it is the young men entering the profession who should be asked to consider the situation before they line up with either party. To these men we suggest that the field is one calling for the application of the good old rule that miners ought especially to honor since it is called golden. —EDITOR.]

IN the *Transactions* of the A. I. M. E. for February, 'The Mining and Reduction of Quicksilver Ore at the Oceanic Mine, Cambria, California,' is the title of a paper read by C. A. Heberlein, of Los Angeles. Operations at this property date from 1876, when rich 'sand' ore was discovered. Up to two years ago various attempts had been made by the Oceanic Quicksilver Co. to mine the more refractory 'mud rock,' which was encountered lying beyond the 'sand rock.' Mud and sand rock in varying quantities were treated together with poor results, but operations were successful with sand rock of fair percentage. About two years ago, when all the sand rock had been exhausted, Murray Innes purchased the Oceanic mine. He found large quantities of low-grade mud rock, varying from 6 to 8 lb. of quicksilver per ton, which at the prevailing low price of quicksilver demanded very cheap mining costs, in conjunction with high but cheap metallurgical extraction. At that time the extraction of quicksilver from mud rock ranged between 40 and 50%. The method of mining is as follows: The whole orebody between two main levels 100 ft. vertically apart, for a longitudinal distance of 300 or 400 ft., is attacked by two raises, which are connected by intermediate levels 25 ft. apart. Long holes are drilled with hammer drills from below and above on one end of the slice and shot. The slicing proceeds from one end of the block, and the ore is trammed to the other raise. Shooting from above and below at the same time, the intervening slice is completely broken up. What broken ore falls into the drifts is dumped into the chute; most of the ore is handled from the level below. The cost of driving in the mud rock with hammer drills ranges from $1 to $2 per foot; and mining the ore costs $1 to $2 per ton.

CONCENTRATES

Readers of the MINING PRESS *are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.*

ALKALI is a term applicable to any substance having well defined basic properties. A base is a compound capable of combining with an acid to form a salt, plus water.

ABSORPTION infers chemical or cohesive action. Thus a block of charcoal may be said to absorb gases, but as a matter of fact the gases are *adsorbed* on the surfaces of the carbon particles.

WORKING COSTS at Mt. Morgan, Queensland, totaled $11.35 per ton, during the last half-year, compared with $14.44 in the previous term. These included development and realization charges.

ONE OF THE GREATEST DETRIMENTS to the more complete realization of the thermal values of fuel in boiler-furnace practice is the impairment of efficiency due to the excess air which is permitted to pass through the furnace in such enormous quantities, according to D. F. Nisbet. The losses from this source may absorb, of the heat value of the fuel, anywhere from 8%, with a 10% excess of air; to 30%, with a 200% excess, and 200% excess is not infrequently encountered in practice.

MILL OR CYANIDE SUPERINTENDENTS are seldom responsible for the design of the plant over which they have control, but they are responsible for a rise or decline in costs. They should be afforded every opportunity for explanation in the one case and should have due credit in the other. For this reason, they should be thoroughly conversant with all expenses incurred and should be periodically furnished with statements of working costs in those instances where they are unable, from lack of data, to compile these for themselves.

A SINGLE SUGAR PINE TREE which was cut in trespass in the Stanislaus national forest, California, yielded more than enough actual lumber to build a good sized suburban house, and in settlement the government has received $99.40. The tree scaled 18,933 board feet, and was valued at $5.25 per 1000 ft. Not many trees contain enough lumber to build a two-foot board walk nearly two miles long, and this is believed to be the first case on record in which a single tree felled in a national forest was valued at almost $100 on the stump, although national forest timber is frequently sold at considerably higher rates.

REVISION of the United States mining law is needed chiefly because of the following reasons, according to Courtenay De Kalb, in the *Transactions* of the A. I. M. E.: (1) the conceptions as to the characteristics of orebodies that were held at the time the statute of 1872 was enacted have since proved to be in many respects erroneous (especially the 'law of the apex'); (2) the operation of the existing law has been found to work unnecessary hardship on many claimants to mineral land; (3) the existing statute fails in large degree to encourage development of mineral resources; (4) the existing law often produces conflict between placer and lode-claim rights, working unnecessary injustice to placer claimants; and (5) the methods of establishing the rights of locators on United States mineral lands are defective, and are not uniform throughout the states within which such lands exist.

NICKEL-PLATING ALUMINUM is practicable, according to M. Le Chatelier, who has made a communication to the Académie des Sciences, stating he has succeeded in nickel-plating aluminum, which has not been accomplished by the ordinary methods. This has prevented the extensive employment of the metal on account of its dull appearance. This difficulty has been surmounted by a preliminary scouring of the aluminum in a bath of hydrochloric acid containing a certain proportion of iron. The iron precipitated on the surface of the aluminum forms a kind of network, and when the metal is passed into a nickel bath the nickel gets entangled in this network and adheres strongly to the aluminum. This process, which is based on a physical action, appears to solve the problem which had hitherto been considered insoluble.

A FACTOR IN GOOD WIRE ROPE SERVICE of equal importance to the selection of the right quality and construction of rope, is the correct handling of the rope, both before and during its use. One very common cause of wire rope trouble is kinking, with the invariable result of shortened service, if not a sudden breakage; however, this can be readily prevented by exercising due care in handling a rope. Another important factor is correct lubrication. A wire rope needs lubrication the same as any piece of machinery, for there is constant friction between the outer wires and the sheaves, drums, etc., as well as friction between the inside wires and strands rubbing against one another. Moreover, the right kind of lubricant will prevent internal and external corrosion. It is essential that care be used in the selection of a lubricant, as some so-called lubricating substances contain elements that cause a chemical action upon the steel, and their use is an actual detriment. If a rope is not to be placed immediately into service when received, it should be stored away in a place protected from the weather and any acid fumes.

MINING IN THE FAR NORTH*

Hot Springs, Gold Mountain, Koyukuk, and Andreafski Districts

By EMIL EDWARD HURJA

Hot Springs District

The first mining in the Hot Springs district was done in 1908, after a stampede following the first discovery of gold there in 1907. Hundreds of miners flocked to the diggings, and the gold-bearing gravel area was roughly demonstrated to be 25 miles long and from 5 to 10 miles wide. The first finds were on Sullivan creek, but later gold was found on neighboring streams, a part of the lower Tanana watershed. Since then mining has been carried on successfully each year.

The 1914 output of the Hot Springs district of the Tanana will exceed that of any previous year, according to prediction of mining men. The season's clean-ups should total in excess of $1,000,000, because of the great amount of gold being taken from the new Bock discoveries on lower Sullivan creek near the mouth of Woodchopper.

Adolph Bock, after several years of prospecting and the expenditure of $70,000, found 'pay' on Hokeley gulch, a tributary of Woodchopper creek, which runs into Sullivan creek on the left limit about three miles below the town of Tofty. The find was made on the Wild Goose claim, and immediately preparations were made to mine the ground on an extensive scale. During the past summer he expected to work out from 40,000 to 50,000 ft. of bedrock. The depth of the ground is 130 ft. Most of the gold is found on bedrock. The gold is mixed and shows great range in both fineness and wear. Work is being carried on from two shafts 200 ft. apart. One plant furnishes power. Three 50-hp. boilers are being used. Fifty men are employed. The ground averages from $3 to $6 per sq. ft. and the weekly clean-ups amount to $20,000. Water for sluicing is obtained from a lake one-quarter mile distant. After using, the water is returned to the sluice-boxes from the sump and re-used. The sluice-boxes are 150 ft. long. Pole and Hungarian riffles are used. Difficulty in saving gold is experienced because of the presence of clay.

BUCKET DUMPING ON SULLIVAN CREEK, MANLEY-HOT SPRINGS DISTRICT.

Sylvester Howell and Jenny Cleveland are operating on Miller gulch, a left-limit tributary of Sullivan creek four miles from Tofty. The ground averages from 80 to 120 ft. in depth. Gold is found mostly on bedrock, although in places it is scattered through a good quantity of gravel. Three plants are working on the claim, and a Keystone drill is being used to find additional 'pay.' Another year of work is in sight. Seventy men are being employed. The 'pay' averages $3 per sq. ft.——William Stewart is working on Miller gulch on the same spot of 'pay' that Howell & Cleveland are mining. He employs 25 men. Jack McKenzie employs 12 men at his plant farther upstream. The ground is from 45 to 60 ft. deep. Water for sluicing is obtained by pumping.——Dick Richards has a small outfit at work on Cache creek, and is reported to be taking out good 'pay.'——Kemper & McVicar finished working out their block of 'pay' on Discovery claim early in the spring, and since that time the claim has been idle.——The Koebsch outfit on the Midnight Sun claim, situated on the left limit of Sullivan creek one-quarter mile above the town of Tofty, is working in wet ground. Their shaft was put down in a small block of frozen ground and drifts run into the pay-dirt. This winter it will be necessary to pump water in order to keep the drifts clear.

American creek is a tributary of Fish lake, is 10 miles long, and has been worked since 1910. In 1911 the output was $4000; in 1912, $85,000; in 1913, $60,000; and in 1914 probably will be $60,000. William Brown and George Heldman are working with two men on the Chicago claim. The ground is 18 ft. deep. Nine men are employed on the Tanana claim by D. G. Hostler, layman. The ground is owned by Mike Murray. Above the Tanana claim, Ed. Ness is working a 'lay' on the Hill claim, using a 40-hp. boiler and employing 10 men. Hastings, Kinnalley, Spencer & Quinn are working on the Sourdough claim, using a 12-hp. boiler. Lockhead & Kinnalley are working on the Nebraska claim, about a quarter of a mile below Discovery claim. They have only a windlass outfit, but expect to increase their plant soon.

On Thanksgiving creek, Frank Stevens has a small crew of 10 men at work, while several other outfits are ground-sluicing. On Eureka, Johnson & McCormick employ eight men and operate a Bagley scraper. Frank & Graham operate a small hydraulic plant on Seattle Junior creek, a tributary of Pioneer. On Gold Run creek, also tributary to Pioneer,

*[Previous articles in this series by Mr. Hurja on mining in Alaska and the Yukon have been 'Mining Revival in the Ketchikan District, Alaska,' July 4; 'Wrangell, Alaska,' special correspondence, July 11; 'Developments of the Alaska Gold Mines Co.,' July 18; 'Juneau, Alaska,' special correspondence, July 25; 'Cordova, Alaska,' special correspondence, August 8; 'Valdez and Prince William Sound,' August 15; 'Seward and the Kenai Peninsula,' August 29; 'The Koyukuk Mining District,' September 12; 'Operations of the Yukon Gold Co.,' October 10; 'Skagway-White Horse Mining District,' October 17; 'Operations of the Canadian-Klondyke G. M. Co., November 14; 'The Klondike, the Treadgold Placers, and Outlying Districts,' November 28; 'The Upper Yukon: Circle City, Eagle, and Woodchopper,' December 5; 'Placer Mining in the Fairbanks District,' December 19 and January 2; 'The Outlook for Quartz Mining in the Fairbanks District,' January 16; 'The Iditarod District—Dredging and Placer Operations,' January 30; 'Ruby District: Prospecting, Gravel Washing, and Gold Production,' February 13.—EDITOR.]

Lane & Stevens operate a small plant and employ six men. An outfit of Bulgarians on the same creek employs seven men.

The tin production of the Hot Springs district promises to be more this year. Stream tin or cassiterite has been found in the sediments of the district in great abundance, and some of the operators are now making a point to save the tin ore from their sluice-boxes. One outfit in particular, Cleveland & Howell, are saving it with a subsidiary string of sluice-boxes connected to the main string by a gate. Every few hours, when the riffles of the main string have become clogged with the tin ore, the connecting gate is lifted and the water turned in to wash the accumulated cassiterite into the subsidiary box, from which it is sacked for shipment. They have gathered already a total of 32 tons and expect to make a shipment soon. The tin production of the district in 1912 was 20 tons; in 1913, 14 tons; and so far in 1914, 15 tons has been shipped.

The Gold Mountain District

The Gold Mountain, or Gold Hill district as it is sometimes called, is situated from 20 to 40 miles below Tanana, on the right limit of the Yukon. It embraces the watersheds of several small streams which enter the Yukon from the north. The principal stream is Grant creek, which has been the objective of several small stampedes during the past seven years.

Gold was first found there in 1907, and the stampede that followed resulted in the staking of all the ground in the form of association claims of 180 acres each. This tied up mining development effectually. The Gold Mountain district embraces some 600 square miles of territory. The mountains of the district have an average altitude of 3000 ft. above sea-level. The Yukon has an elevation of 300 ft. above sea-level in the Gold Mountain district. Probably the first lode mining in Alaska was attempted at a locality known as Gold Hill. A 110-ft. adit has been driven on a two-foot lode of broken quartz. Placer prospecting has been confined largely to the stream beds, but because of the abundance of water in the gravels; difficulty has been encountered in working the deposits so far discovered.

Gaudette & LeManager are the only mining men who spent the past summer in operations in the Gold Mountain district. They own a group of claims on Grant creek. The 'pay' is from 10 to 14 ft. deep. It averages $1.25 to the square foot of bedrock. Grant creek was the subject of an investigation by dredging engineers several years ago. Nothing definite has been done since that time, however. The most recent stampede to the district occurred in 1911, when an army cook returned to Fort Gibbon (Tanana) with specimens of coarse gold taken from the Grant Creek gravels.

Red Mountain (Koyukuk) District

The output for 1914 from the Red Mountain district in the Koyukuk watershed is estimated at from $75,000 to $80,000. Between five and eight outfits have been at work fairly continuously all summer. Water conditions have been excellent and operations are said to have been very satisfactory. Jack Felix is operating on Indian creek, as are O'Brien & Swanson, and Tate & Marsan. The ground is from five to six feet in depth. Wood costs from $8 to $9 per cord, so that working costs are fairly high. The Indian River district was discovered during the summer of 1910 by Felix and associates, who went up Indian creek from its confluence with the Koyukuk and found gold at the mouth of a small gulch which was named Felix gulch. A small stampede to the district that summer and the following year ensued. The supply point of the district in summer is Hughes, 40 miles distant, at the mouth of Indian creek; and, in winter, Tanana, about 150 miles by trail.

TANANA, ALASKA; WATERFRONT AND MAIN STREET.

Andreafski Gold Fields

The Andreafski gold district is one of those in which the most recent successful search has been made for gold. The district is situated 244 miles upstream from the mouth of the Yukon river on the north bank. A. C. Rohde, a prospector from Nome and other parts of Alaska, for three years since 1910 had known of the existence of a mineral-bearing zone in the section of the Yukon lying about 100 miles due inland from St. Michael. He induced Andrew Edgar, also a Nome man, to go prospecting in the section, and they accordingly set out from St. Michael. They mushed to the head of the Atchulunuk river, there built a boat and floated down to the Yukon river. They poled up the Yukon to Wilson creek, a stream which they named. In August 1913 they found rim prospects on Disappointment creek, getting 10c. to the pan. A stampede followed, and 250 men came to the district before the close of navigation.

No real mining work was done on any of the streams comprising the district until the spring of 1914. There are 25 men in the district now, engaged in active mining. The first gold, $8000, was taken to St. Michael for shipment to the United States mint by Frank H. Waskey, United States commissioner, late in August of 1914.

A. C. Rohde expects to take out $3500 this season on No. 1 Disappointment creek. He is employing six men. The ground is from three to nine feet in depth, of which 20 in. is 'muck.' 'Pay' lies immediately above and on bedrock.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

LORDSBURG, NEW MEXICO

NEW RAILWAY INTO LORDSBURG.—S5. BONNIE, SILVER GLANCE, CHINO, MEMPHIS, BUFFALO-NEW MEXICO MINING COMPANIES' OPERATIONS, AND NEW MINES.

A branch line of the Arizona & New Mexico railroad may be built from the ore-loading station south of Lordsburg, known as 'oil siding,' to the mines in the Shakespear and Virginia districts, according to a note of that Company filed with the State Corporation Commission at Santa Fe. Shipments average 150 cars per month, consigned to the El Paso and Douglas smelters. Construction of the spur has been under consideration by both the A. & N. M. and Southern Pacific lines, and the filing of intention may only be precautionary measures. It is also reported that the construction of a narrow-gage line from Duncan, Arizona, to the Utter mines at Steeple Rock, New Mexico, is under consideration by capitalists.

The 85 mine, in the Lordsburg district, is employing over 200 men, and is the second largest producing copper mine in the state.——The Bonnie Mining Co. has all machinery in place, and is sinking the new shaft at the rate of five feet per day, at the same time continuing work on No. 1 shaft and shipping occasionally. One of the richest veins in the district was discovered about 20 ft. from the surface during the initial work on the new shaft. It is five feet wide and should average $35 per ton in copper, gold, and silver. The vein will be fully developed when the new shaft is down 500 ft.——It is reported that California people having interests here have commenced sampling and experimenting on ore near the Atwood mine, with the object of erecting a reduction plant in the district if the tests are successful.

Incorporation papers have been filed at Santa Fe by the Silver Glance Mining & Developing Co., of Silver City. The capitalization is given at $25,000, and the object is to develop and operate claims in the vicinity of Cliff. Baylor Polk and Barnes and Royall of Silver City are the incorporators.

A lease has been taken on the McDaniel mines at Cook's Peak, Luna county, by A. O. Ihlseng, and a few men are preparing the property for shipping. A large number of miners will start work in the region early in March.

In Sierra county, a large amount of development is under way in the Hillsboro and Kingston districts.——A contract has been let for 350 ft. of driving in the Eureka mine, by F. W. Moffett.——The Fox property is being put into a workable condition by John Sears of the Placers.——P. H. D. Bendixen is another who is opening good ore.——Prospects throughout the area are encouraging.

The Chino Copper Co. is installing a turbine engine in its power plant at Hurley, Grant county, which will produce more power for the mill and mines at Santa Rita.

THREE PEAKS OR BIG BURROS IN BACKGROUND. HILLS IN FOREGROUND SCENE OF MINING.

PORTAL WAY AND HAULAGE ADIT, BURRO MOUNTAIN COPPER CO., TYRONE.

The Memphis Mining Co., in the Organ district of Dona Ana county, held its annual meeting and election of officers last week, and plans were made to do general development work in addition to the two leases at both ends of the property. J. I. McCulloch, president of the Company, has secured an option on the Torpedo mine, which has been the subject of litigation for many years.

The Buffalo-New Mexico Mines Co., at Red River, Taos county, has received a carload of mining machinery, which will be removed to the property and development started. The shaft is now down 150 ft., and will be extended 250 ft. deeper.

Reports from the Pecos Valley oilfield are to the effect that several new companies are entering the region, and a large acreage is being taken up for test drilling.

The Santa Fe Gold & Copper Mining Co., at San Pedro, is to begin new financing through the issuance of $250,000 7% convertible first mortgage real estate bonds, to be offered the stockholders at $95. A number of new companies have been formed in this state lately, indicating revived interest in mining.

NEW YORK

ANACONDA FINANCIAL AFFAIRS, AND AMALGAMATED.—SOME OPTIMISTIC NOTES ON COPPER.—SPELTER.—AMERICAN ZINC, LEAD & SMELTING CO.—LAKE COPPER NOTES.—DIVIDENDS.

Another wheel within wheel has been added to the already complicated financial mechanism of the Amalgamated, Anaconda, United Metals Selling, and International Smelting & Refining organization. Four years ago, the Amalgamated Copper Co. made an issue of $12,500,000 5% notes, which matured on March 15, 1913. These were refunded in 1913 and extended to March of the current year. The proceeds of this note issue were used to purchase the United Metals Selling Co. Now a further step is taken toward making the Anaconda the great holding as well as operating company of this group. The National City Bank and the Guaranty Trust Company of New York have just sold $16,000,000 of two-year 5% notes of the Anaconda company at 99¾. The cash derived from this sale is to be used to purchase the United Metals Selling Co. from the Amalgamated, which latter Company will in turn retire its own notes of $12,500,000, maturing March 15 next. Anaconda now owns every agency connected with its own operation, controlling all details from the ore deposit to the point of delivery of refined copper to the customer, while 'Copper,' as the Eastern markets designate Amalgamated, is now left with its holding in Anaconda as its chief asset. While there is nothing to justify a prediction that Amalgamated is eventually to disappear as an entity in the copper world, yet the fact cannot be ignored that all of the recent moves made in the formation and enlargement of the new Anaconda have resulted in the taking away little by little, or rather 'much by much,' of the importance of Amalgamated except as a stock-market leader. It has been said that there are those who would be glad to see 'Copper' pass into history, and while such may or may not be the intention, the way for such a move is being opened. The money raised at this time for the Anaconda, in excess of that required for the shift of the ownership of the United Metals Selling Co. is to be expended in betterments and improvements. This matter is dealt with editorially in this issue.

There could never have been a better demonstration of the strength of the position of the copper producers than the current market. The metal has been marked up to 15c., in spite of curtailed production, which is a state of affairs so infinitely better than that of having a surplus production pile up to drag prices down, that everyone must applaud, and most of all, those who would make the most of the country's natural resources. It is a popular belief that every man 'cusses his own trade;' probably the belief is justified, but certainly one of the exceptions that proves the rule is to be found among the copper producers. Their faith in the future of the industry, in the world's need for copper, seems boundless. It was once the fashion to point to the so-called 'porphyries' as about to pour out such streams of copper as would allow the user to fix the price for all time to come—all of which is now much changed. No one disputes the position of the producer, and they are still bending every energy toward increase of output, not momentarily, to be sure, but for the future. One of the interesting figures in copperdom, who has made history in this direction, Don Marco Chiapponi, is now in New York. It was Mr. Chiapponi who made the first examinations of the Braden, and later sold it to the original group of owners, who expected to develop it as a high-grade property. Mr. Chiapponi also had a great deal to do with the early development of the Chuquicamata. His life work all over the world in mining has but served to solidify his faith in copper. Commenting on the possibilities latent in the treatment of oxidized ores containing copper not now recoverable, Mr. Chiapponi brushed aside the old bugaboo of too much production as nonsense. The world will need all the copper that can be turned out, and the next decade will see production at figures that will make the highest records now standing seem small enough, is his prediction. The efforts that are being made everywhere to work out successful leaching processes are, of course, in a way, proof of his assertion. Mr. Chiapponi has had some interesting experiences in his explorations of the *antiguas* of South America. One of these was the discovery in the Chuquicamata of the body of a native child, who had been imprisoned by a cave-in centuries before. The body in perfect outline, a little basket in one hand, had been transformed into a stalagmite. It was removed from the mine, exhibited in all the principal museums of South America, and as a final resting place is now in the Museum of Natural History in New York. It is said the face assumes a scornful expression when anyone in hearing distance sings or whistles "It's a long way, etc., etc." Natural enough, to be sure, but hardly to be credited.

The ruling price difference between Lake and electrolytic copper, at one time almost eliminated, has returned to the market. Owing to the greater ease with which Lake can be drawn in making shells, buyers working on ordnance contracts are discriminating in its favor.

The spelter situation is claiming nearly as much attention as copper. It has long been somewhat a matter of mystery to the layman that the domestic output of zinc seemed to have so precarious a footing. The turmoil in Europe has shed light on many trade conditions, this being one. The smelters on the Continent, no longer taking the Australian output, heretofore handled under long-time contracts, cannot now make an import price that rules the market. Consequently there exists a 9½c. spelter market, and an opportunity is created for some such market stabilization as has been accomplished in copper. Spot supplies have all been taken up and a bid of 9½c. for 1000 tons failed to find a taker. As spelter is absolutely necessary to the brass manufacturers, who are now all working overtime, where they can get orders for cartridges and shells, there is a prospect for some interesting developments in the spelter market. If the war works a cancellation of the German contracts with the English-controlled zinc mines, there is something more than a possibility that the industry in this country can win its way to a permanently better basis. Germany has placed an embargo on all shipments, even to friendly nations, except by special government permission; her production is far below normal rate.

The American Zinc, Lead & Smelting Co. is extending operations as fast as the somewhat hysterical market conditions will permit. The production from its Mascot property in Tennessee, which is a high-grade spelter, commanding a premium in the trade, is to be increased from 1200 to 1800 tons per day. Operations in Missouri and Wisconsin are also being speeded up, and the Kansas smelters are doing a greatly increased business in custom ores.

The United States Smelting Co. is said to have curtailed some of its development work on the Ebner at Juneau, Alaska, war-time conditions making retrenchment temporarily necessary.

The Calumet & Hecla is making a large shipment of silver to the Philadelphia mint this week; the first being made in January. The Quincy is also making a shipment to Philadelphia. There is some expectation that the White Pine property of the Calumet & Hecla, which will begin mining and milling operations in April, will produce some gold and platinum, drilling operations on the Nonesuch lode, in Ontanagon county, having shown cores with appreciable quantities of both metals. A description of this property will be published in a future issue of the *Press*.

Dividends have been declared by the following companies, payable March 31: Butte & Superior, 75c.; Chino, 75c.; Nevada Consolidated, 25c.; and Utah Copper, 75c. per share. That of the Ray Consolidated was deferred. Quincy has increased its distribution to $1 per share.

WASHINGTON, D. C.

Experiment Stations and Rescue-Car Bill—Leasing, Radium and Mining Law Bills. Timber Cutting. Regulation—The Oil-Land Withdrawal Decision.

The only legislation on mining that had a chance in the closing days of Congress was the Foster bill to create 15 mining experiment stations and establish new rescue-cars, and on this bill the mining people concentrated their efforts. The bill had already passed the House, and the Senate committee agreed to report it to the Senate at once, with the recommendation that it pass, and to suggest amendments only in the event that they could be added and yet the bill pass in time. The mining men of the Senate wanted the number of rescue-cars increased by seven instead of by two as arranged in the House bill, making the total 20, but the attempt was not to be made at the risk of imperilling the enactment of the bill. The U. S. Bureau of Mines recently published the assignment of personnel of mine rescue-cars and stations in the country. They are scattered through Alabama, California, Colorado, Indiana, Illinois, Kansas, Michigan, Montana, Oklahoma, Tennessee, Pennsylvania, Washington, and West Virginia.

It was early concluded that the leasing bill was dead and also the radium bill, on both of which measures there has been much debate and many hours of hearings, and all for naught. Even the bill which had already passed the Senate for the creation of a commission to codify the country's mining laws, was given up in the House by Congressman Foster, chairman of the mines and mining committee. There was not any enthusiasm on the House side for this commission.

A bill reported favorably in the Senate, and on which action may be expected in the session of Congress, relates to cutting timber for mining purposes by corporations organized in one state and conducting mining operations in another. The legislation embodied in the bill more specifically permits mining companies, when organized in one state but doing business out of the state, to cut timber standing on its mining property for use in the development and prosecution of mining operations. The measure has been approved by the Department of the Interior, A. A. Jones, the first assistant secretary, saying that he could see no objection why the bill should not be enacted.

California men have heard of the decision of the Supreme Court of the United States finally declaring that the President of the United States has had power to withdraw vast tracts of oil lands in California and Wyoming, and it is thought that the decision may affect coal and phosphate lands as well. The case grew out of the withdrawal of great tracts of valuable oil lands by ex-president Taft for conservation by the government. He at the time doubted his constitutional right to do so, and asked Congress to validate his deed, which that body did, but the Supreme Court rules that the withdrawal would have stood through the long acquiescence by Congress in such acts by the Executive of the nation. An immediate result of the opinion is that oil companies which obtained entries after the Taft withdrawal, but before legislation by Congress, a few months later, providing for withdrawal, lose their claims on lands which are said to be valued at immense sums. Justice Lamar pointed out that for 80 years the presidents had made such withdrawals, hundreds in number. "Nothing was done by Congress," he said, "which could in any way be construed as a denial of the right of the Executive to make temporary withdrawals of public lands in the public interest. Considering the size of the tracts affected, and the length of time they remained in force without objection, these orders by which islands, isolated tracts, coal, oil, and phosphates were withdrawn in aid of legislation, furnish, in and for themselves, ample proof of Congressional recognition of the power to withdraw." About 2,871,000 acres are involved in the decision, which was not a unanimous one by the court, three justices dissenting, Van Devanter, Day, and McKenna, the two former being the western representation on the court. A large sum of money that has been impounded from oil taken from this land goes to the national treasury, and it is said that development work estimated at $10,000,000 is forfeited by the entrymen. Titles claimed by more than 100 companies are made void. Suits over Kern County oil lands involving $20,000,000 are said to hang on this decision. Appeals to Congress for relief are being heard talked about.

SAN DIEGO, CALIFORNIA

Mining Exhibits at the Panama-California Exposition.—Ygnacio Mining Company.

The Panama-California Exposition, which opened in this city on New Year's day, contains much of interest to mining men. In the various state and county buildings there are some fine exhibits of different ores.

In the New Mexico building there is, possibly, more attention given the mining exhibit than in some of the others, as that state has sent one of its best qualified men, the head of the state school of mines, Mr. Jones, to take charge of that part of the display. To visitors are given samples of ores and printed matter discussing the mining resources of that state. Here are also to be found the gold specimens which

MODEL OF GEM MINE, ARRANGED SIMILAR TO A CALIFORNIA TOURMALINE PRODUCER.

took first prize at the Columbian Exposition at Chicago in 1893. They are the property of J. Van Houten, of Raton, New Mexico, and include both nugget and placer gold. One nugget weighs 13 oz. The collection is valued at $2000.

A novel feature of the 'Isthmus,' as the amusement quarter is known, is the model of the famous Pala Chief gem mine. This concession has been patterned accurately after the original mine, which is situated about 70 miles from this city, on Palomar mountain. The adits show how kunzite and other gems are found in the rock, and there is one pocket, protected by heavy plate glass, in which are gems in the rough, to the value of about $20,000. A complete miner's outfit is shown. In connection with the concession there is a room where finished gems are sold, and also a lapidary department where the process of cutting the gems is shown.

Unique among the ores shown is the 'brass ore,' which contains all the metals—tin, copper, and zinc—which constitute brass. This ore comes from Magdalena.

The only meerschaum deposit in America, which is worked commercially, is represented by several large blocks.

Articles of incorporation have been filed with the county clerk by the Ygnacio Mining Co., with a capitalization of $1,000,000. The incorporators are P. M. Price, W. L. Tibbals, S. G. Ames, O. Whitmore, and C. A. Babcock, Jr., all of this city, and Frank C. Everett and L. A. Everett, of Keeler, California.

KALGOORLIE, WESTERN AUSTRALIA

Gold Production in 1914.—Sons of Gwalia Mine.—Edna May to Be Sunk Deeper.—Work in the Calc-schist.—December Returns.

The year 1914 closed with a total gold yield of $26,186,750, against $27,907,985 in 1913, a decrease of $1,721,235. Four mines alone are responsible for a shortage of $1,780,000, namely, Golden Horse-Shoe, $630,000; Victorious, $550,000; Ivanhoe, $450,000; Bullfinch, $150,000; and smaller declines have been made by others. Against this the Edna May, which produced only $216,000 in 1913, increased its output during 1914 by $650,000, to $860,000. The outlook at present is not in favor of any increase in production.

The gold yield of the state in December amounted to $2,182,220, the principal producers being as follows:

Name.	Tonnage.	Value.	Profit.	Dividend.
Great Boulder	15,728	$224,150	$123,750	$328,120
Kalgurli	9,740	101,900	45,700	.....
Ivanhoe	18,326	152,300	45,000	.....
Edna May	2,908	62,800	41,200	32,130
Sons of Gwalia	14,021	108,400	34,300	45,600
Fenian	3,200	53,000	30,500	.....
Golden Horse-Shoe	20,173	146,100	27,800	.....
Sand Queen	2,200	43,500	27,000	22,500
Lake View & Star	16,610	97,300	17,500	60,000
Oroya Links	11,300	65,000	13,470	71,800
Queen of the Hills	4,402	30,600	11,300	.....
Bullfinch	6,676	42,500	11,290	.....
Menzies Consols	2,275	29,300	10,900	28,000
Ingliston Consols	1,800	22,500	10,500	.....
South Kalgurli	9,843	60,000	9,300	.....
Mararoa	2,660	23,900	9,000	25,000
Yuanmi	6,013	58,100	6,300	.....
Ida H.	1,390	23,200	5,200	35,300
Golden Ridge	2,348	15,000	2,500	.....
Kyarra	930	10,500	2,300	.....
Edna May Central	1,956	7,200	820	.....
Associated	10,184	54,900	200	.....
Associated Northern	1,058	10,700	640	.....
Lake View Consols	9,000	5,400	*210	.....
Commodore	540	3,900	*1,100	.....
Victorious	2,300	16,400	*1,300	.....
Great Fingall	3,913	31,400	*12,000	.....

Total yield, $600,589,400. Total dividends, $125,982,300.
*Loss.

During the year the Sons of Gwalia mill treated 160,964 tons yielding $1,257,500, against 162,101 tons and $1,267,000 in 1913. The profit was $383,200, compared with $327,900. Since September 1914 the quarterly dividend has been reduced to $45,600, against $91,200 paid previously. As the alterations and additions to the treatment plant, which were debited to revenue, have now been completed, the old rate of dividend may be resumed. The outlook of the mine is not promising, as the ore in the south end of No. 17 and 18 levels is unprofitable where the lode came into contact with epidiorite. After examining the mine in 1910, and again in 1913, Malcolm Maclaren stated that it all depended whether the intrusion of epidiorite was merely a spur or the main body of rock, whether the gold content would continue or be cut off, at the lower levels. A winze, sunk from No. 19 to 20 level at 1530 ft. south, started in ore worth $8.16 per ton, and finished in ore worth $4.08 per ton only. This is ominous, especially as shareholders were first told by Cyril Wanklyn, chairman of directors, of Mr. Maclaren's report on the epidiorite at the last annual meeting of the Company in April 1914, or four years after Mr. Maclaren had made a full geological examination and report on the mine.

Shaft sinking is under way at the Edna May mine from 225 ft., and it will be interesting to see whether any further granite intrusions are found, and what their effect on the lode is. The second granite bar, passed through in the shaft at 201 ft., was 8 ft. wide, and should penetrate the lode at a depth of 10 to 20 ft. below the 225-ft. level; but, so far as known, no bore has been down to test the result. The 10-shilling ($2.40) shares are quoted at 150 shillings ($36), and if the granite cuts off the lode as it did in its adjoining neighbor, the Greenfinch, there will be a rush to sell.

During 1914 the Oroya Links mill treated 145,130 tons for $794,600, against 139,130 tons and $748,700 in 1913. The profit realized in 1914 was $130,400, compared with $130,600 in 1913. At the end of 1913 there was a bullion reserve of $6450, which has since been absorbed. The workings in the Eclipse mine are entirely in calc-schist, and the ore-shoot still persists at the 900-ft. level, though, as will be seen from the returns, the grade is low; but it always was so in this property.

Both at 2200 ft. of the Perseverance and Lake View Consols mines a good ore-shoot of fair length has been opened, and the managers of both mines are persistently pushing on developments in the calc-schist.

AUSTIN, TEXAS

A Probable Revival in Spring.—Taxes.—Southeastern Mining Co.—Presidio Silver Mine.—Terlingua Quicksilver District.

Although there is comparatively little new mining development going on in the Quitman mountains and other localities of the upper Rio Grande border region, prospects for a revival of the industry when spring opens are considered to be favorable. An effort will be made to have that provision of the state mining law repealed which places a tax of 5% on the gross value of the mineral output of properties located on state land. The law is regarded as oppressive and defective in other respects, and unless it is amended not much prospecting and development on the public lands can be hoped for.

The Southwestern Mining Co., which is operating a mine 10 miles west of Sierra Blanca, is making regular shipments of zinc and copper concentrate to the smelter at El Paso. The workings of the mine are now down 350 feet.

The Presidio Mining Co., at Shafter, kept up its usual steady production during last year, and it is expected that there will be no decrease in its output during the present year. The value of its ore production for 1914 was approximately $200,000. It is considered remarkable by practical mining men that this property, which has a record of having produced a total of about $14,000,000 worth of ore during the thirty and more years of its operation, should be the only mine in the Shafter district.

No plans for further development of the rich quicksilver deposits of the Terlingua district, situated near the Rio Grande, 90 miles south of here, have been announced for the current year. The Chisos Mining Co. is at present the only concern that is operating in that district. This Company had an output of about 3000 flasks during 1914. Its 20-ton furnace is kept in regular operation on the cinnabar ore that is now being obtained from the 600-ft. level. Unconfirmed reports have been current from time to time during the past few months that two or three of the properties which were shut down on account of the flooding of their lower workings, and possibly for other reasons, were to be reopened, but nothing in this direction has as yet been done. It is well known that the cinnabar ore covers a large scope of territory around Terlingua, but the remoteness of the district from railroad transportation has caused it to be given but little attention by mining men. It is reported that the reorganized Kansas City, Mexico & Orient railroad will extend its line from Alpine south to the proposed crossing of the Rio Grande six miles below Presidio, and that it will build a branch line to Terlingua. If this is done, it is thought activity in quicksilver development around Terlingua will quickly result.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press.

ALASKA

Juneau

On February 20 the Alaska Gastineau company's new mill was in full operation, and working smoothly. Ore trains were arriving regularly from the Perseverance mine.

Tanana

On Elephant creek, a tributary of Wilson, entering it on the left limit above Disappointment creek, George M. Pilcher, of Nome, is prospecting. He is using a hand churn-drill. Edward & Shepard, of Nome, have imported a gasoline power drill made by the Flume Dredge Co. of Nome, and are planning to start work on the same stream. William Staples reports having found prospects on No. 9 Above Discovery, Wilson creek, but the discovery has not been confirmed as yet. Robert Henderson and W. C. Freeman are engaged in

YUKON GOLD CO. DREDGE ON FLAT CREEK, IDITAROD.

development on a quartz deposit 15 miles northeast of Marshall City, a settlement that has taken shape on the right limit of the Yukon near the mouth of Wilson creek. They report excellent surface indications. Tom Plunkett and N. Patton are prospecting a deposit of quartz containing free gold, galena, and molybdenite on the divide between Disappointment and Willow creeks. Willow creek is a tributary of the Bear, which enters the Yukon six miles above Wilson creek. Placer prospects have been reported on Willow creek.

Wilson and Disappointment creeks have wide U-shaped valleys. Wilson creek is about 10 miles long, and at the mouth of Disappointment creek has a width of 1000 feet.

ARIZONA

In *The Wickenburg Miner*, J. H. Mulholland, of the Monarch Mining & Smelting Co., discusses the need of a bureau of mines for Arizona, consisting of a state mining engineer, a county mining engineer, an assay and analyzing laboratory, and a publicity department, costing about $132,000 per year.

Cochise County

Work under the Phelps-Dodge management has progressed so well at the Tombstone mines that it is probable that the stamp-mill will be working in about 60 days.

All traffic from Douglas into Sonora *via* Agua Prieta has been stopped again by General Calles, who is probably trying to keep secret the movements of his forces. Six Americans, employees of the Nacozari railway, were arrested on February 26, also the superintendent, E. O. Llano. A *fake* charge has been made against them.

Gila County

The assistant secretary of the American Mining Congress, E. L. Wolcott, has been in Globe to interest people in the organization of a local chapter, as has been done in other mining counties. L. D. Ricketts was present at the meeting held, and urged those present to further the project. The Gila County section was formed on February 26 with F. F. Towle as president and W. H. Keegan as secretary.

Greenlee County

The International Mines Development Co., which has four properties in Sonora, Mexico, but is not able to develop them, has a 5-year option on the Ash Peak silver claims in this county, and is about to secure title to them. According to the general manager, Herman J. Wendler, 23,000 tons of ore worth $100,000 net has been opened down to 500 ft., where there is a wide lode containing up to 16 oz. silver and $1.20 gold per ton. The 7 by 11-ft. shaft is to be sunk 300 ft. deeper. After further development, a mill will be erected.

CALIFORNIA

According to the Independent Oil Producers' Agency, the oil production of the state in January totaled 7,698,316 bbl., a decrease of 127,665 bbl. compared with December. The total of shipments was 7,233,766 bbl., an increase of 926,568 bbl. There were 136 wells drilling and 5861 wells producing.

Amador County

The 100-stamp mill at the Kennedy continues to be worked. A description of the new tailing restraining dam will be published in this journal.——The Bunker Hill company is the defendant in suit for $30,000 damages by Mrs. R. Matthews for the death of her son, who was electrocuted at 800 ft. in the mine on May 4, 1913. According to the superintendent, E. H. Hampton, the deceased had no right to be in the pump-room where the fatality occurred. The mine foreman, Robert Christianson, corroborated this evidence. A verdict for $5000 was returned, which is to be appealed against.

Forty stamps are now crushing ore at the Keystone mine at Amador City. C. R. Downs is superintendent, and the mine is opening satisfactorily.——Work has been resumed at the Defender, between Pine Grove and the Mokelumne river.——The Plymouth was visited by Albert Burch and W. J. Loring last week, and they stated that development is to start at the Montezuma mine at Nashville, which the Plymouth Consolidated has under bond.

Butte County

The value of the estate of the late Joseph Gardella, well known in dredging circles in Oroville, has been filed as worth $188,729.——In dispute over the value of gravel from the Success mine, at Thompson Flat, near Oroville, and an arrest for grand larceny, the court appointed two mining men to pan some of the gravel. One-eleventh of a yard was washed, yielding equal to 5c. per cubic yard. The case was dismissed, but the plaintiff was later arrested for perjury.

Calaveras County

At the Royal mine at Hodson the water is being lowered at the rate of one foot per hour. Eight samples of ore exposed in stopes, drifts, ore-bins, in cars, standing on tracks, and broken in drifts, averaged $4 per ton, excluding two high assays. Good progress is being made with the tramway and mill.

It is reported that the Finnegan mine at Carson Hill has been bonded for $75,000, and the Lindsay at Angels has been sold to the Utica for $10,000.

Eldorado County

The owners of the Marble Valley lime quarry, near Clarksville may increase the capacity of their plant this year. The output in 1914 was 16,000 bbl., the property being worked nine months in the year. Fred Dixon is manager. The Portland Cement Co. operates near here at Cool.——The water rights and ditches of the San Francisco-Oakland Terminal Power Co were sold by the sheriff of Placerville on February 23 to the Placerville Gold Mining Co., the former owner, for $56,248. The former concern has a year in which to redeem the judgment. There are 33 miles of canals and 100 miles of laterals, the intake being on the American river, just below Kyburz. The main ditch was constructed in the early seventies to carry water for hydraulicking, and when this was stopped, for irrigation. The property has changed hands several times

Inyo County

During 1914 the Wilshire Bishop Creek company spent about $72,000, making over $250,000 to date. The 10-stamp mill and cyanide plant is ready, and has a capacity of 65 tons per day. Ore reserves are estimated as 24,138 tons valued at $397,000; but about 90 days will be required to make preparations for extraction.

Kern County

In the Randsburg district, the Sunshine mine in February produced bullion worth $6250 from 100 tons of sulphide ore, also four tons of concentrate assaying $900 per ton. This ore was from the 500-ft. level.——A clean-up at the Red Dog custom mill from the King Solomon yielded $3150 from 50 tons.——The Baltic mine was sold at a sheriff's sale last week for $50,075 to A. M. Sweeney of Indianapolis. This is said to be a good property.——The Atolia tungsten mine used to be worked on the leasing system, and since the Company has been operating it has not made as much profit as from the lessees.

Nevada County

The Ragon Development Co., which has bonded the Ragon Flat and Mt. Auburn quartz claims from Robert Nye, is repairing the incline shaft, which is in bad condition after 44 years. Lumber has arrived for the work. Sinking will be started as soon as possible, and an electric hoist and pump installed. M. Gallagher is in charge.——Rain had flooded the shaft of the Major gravel mine near Nevada City last week and covered a pump with 20 ft. of water. The pump would not work, so James Proctor dived into the water, released a valve, resulting in its starting again, and the mine saved from being flooded.

The Golden Center of Grass Valley will hold its annual meeting at Sacramento on March 20, and it is probable that a dividend may be declared. The president, Rodney McCormick, has given hopes to this effect. The mill is working continuously.

Shasta County

The Hydrovacuum Smelting Co. has contracted with the Balaklala Copper Co. to install a 100-ton unit of the Heslewood process at the smelter. F. C. Herrmann is consulting engineer.

Trinity County

(Special Correspondence.)—A shoot of rich ore has been cut in the Democrat mine, about two miles from Weaverville. The main formation is from 12 to 24 ft. wide, with the oreshoots generally a few inches wide. Walls are of porphyry and serpentine. Two adits, connected by a rise, have been driven on the orebody, the lower one cutting it about 50 ft. below No. 1 level. A small rotary mill is operating. E. E. Harrigan is managing owner.——The Horseshoe Mining Co. is arranging to resume operations at the Tunnel placer mine early in April. The sections of the cement dam destroyed by water last fall will be rebuilt.——The Trinity Development Co. plans the resumption of prospecting in the Carrville-Trinity Center field in the early spring. The Company holds options on ground extending for approximately 10 miles along the Trinity river and tributaries. Extensive areas of the land have been prospected with Keystone drills, and it is understood dredging operations are contemplated.——The vein in the Enterprise mine, at Helena, has widened to eight feet. Some free gold shows and the 10-stamp mill is kept busy. R. A. Skinner is manager.—High-grade telluride ore has been opened in the Yellow Jacket, near the Enterprise. This is the first time telluride has been found in the district and has created much interest. The property is owned and operated by Boyd, Carter, and Tourtellotte.

Weaverville, March 1.

There is 15 ft. of snow at the Globe mine at Dedrick, but the mine and mill are worked as usual, every protection being arranged for this.——The Trinity River Mining Co.'s dredge is also operating.——Three giants are sluicing at the Trinity Consolidated company's Union Hill gravel claim. The year's output was about $417,000.

COLORADO

The thirteenth biennial report of the commissioner of mines, T. R. Henahen, transmitted to the governor on December 15, 1914, is now to hand. It consists of 228 pages, with illustrations and an index. Inspectors in the four districts are as follows: No. 1, Central City, W. H. Parenteau; No. 2, Cripple Creek, James T. Stewart; No. 3, Leadville, John R. Curley; and No. 4, Montrose, Samuel Treais. Reviews of each of these districts are given under each inspector's name. Subjects discussed include cement, clays, acid manufacture, conservation (leasing), Colorado Metal Mining Association, legislation, geology, labor troubles, accidents, safety first, metal production, laws, the Cresson mine, and papers by W. F. Raber, W. G. Haldane, G. E. Collins, Fred Carroll, John Tait Milliken, R. R. Bryan, T. B. Crowe, C. H. Hanington, Philip Argall, Ott F. Heizer, C. R. Wilfley, Henry I. Seemann, J. A. Becker, Carroll M. Carter, C. F. Lake, Bulkeley Wells, A. R. Livingston, W. E. Tracy, C. E. Anderson, R. M. Henderson, R. E. Schirmer, J. M. Flannery, B. S. Revett, J. D. Endicott, and J. F. Manning. Miscellaneous information shows the altitude of mountains in the state, men employed in mining (22,409), recommendations made by the commissioner's department to mining companies, what each county produces, quarries, and radium-bearing ores. Colorado mining activities are thoroughly covered, and all should secure the publication.

Clear Creek County

Lessees in the Capital mine are all working in ore and making good shipments.——The Onondaga company is mining both milling and smelting ore, a 200-ton lot being treated at the Capital mill. Above the Capital tunnel the Company has 6 to 14 in. of ore for a length of 75 ft.——Lessees at the Seven-Thirty are opening lead-silver-zinc ore.

Gilpin County

The Iron City mill is working full time, and there are over 20 cars of ore on the siding awaiting treatment.——The May County, Hampton, and War Dance mines in Lake and lower Russell districts, have been examined by W. B. Milliken, of Cripple Creek, and he thinks that the $4 to $6 ores can be profitably treated. The Hampton-Clay County Consolidated Mines Co. was organized to operate these properties. John Larson is mine manager, and a number of men have started work.——The owners and lessees at the Chase, Pozo, Prize, Frontenac, First National, Ute, and Pittsburg Extension mines are all busy.

Teller County (Cripple Creek)

There is renewed talk of the sale of the Golden Cycle company's properties.——Control of the El Paso Consolidated is

to be an interesting feature of this Company's affairs.——The Copeland Sampling Co. paid the Cresson company $468,637.29 for the rich ore passed through its plant on January 27. Another recent shipment of 68 tons averaged 65 oz. per ton, which returned $82,000 net. More ore is being extracted, but the Golden Cycle mill and smelters will not accept the very rich ore so it is to be mixed with lower-grade material to bring the average to about 50 oz. per ton.

IDAHO

Idaho County

(Special Correspondence.)—The three principal properties at Profile have just recently made test shipments of one ton of ore each by parcel post, through the newly established office at Profile, and the Butte smelter returns were satisfactory, considering the fact that nothing was paid for lead, and only 95% of the gold and silver. However, the mines are preparing to make more extensive shipments by parcel post next season, but in the future the ore will be sent to a Salt Lake City smelter. It is estimated that $75 ore can be made to yield a good profit by shipping by this method, and there is a fair tonnage of surface ore of this grade that can be obtained by close hand sorting.

The Big Creek district as a whole is not very active this winter, but the prospects are good for a lively stir next season.——The Eagle Mining Co., at Edwardsburg, has again resumed operations after a six months' shut-down, and it is thought that more development will be done than before.——It is reported that the Probiglo Mining Co., of Profile, is planning the installation of a two-stamp mill and concentrator tables on its property next season.

Profile, February 11.

The Center Star mine, owned by Murphy, Tiedemann & Brown, has been sold for $50,000. The Mineral Zone, of the estate of the late Mrs. Parr, and the Blue Ribbon, have also changed hands.——Considerable activity is expected in the Elk City-Newsome district this summer. The Black Pine will add five stamps to its mill.

Shoshone County (Coeur d'Alene)

The owners of the Maher and Hearn claims, Eugene R. Day, Harry L. Day, and M. J. Maher, have filed suit against the Marsh Mining Co. The plaintiffs allege that on January 1, 1914, and prior thereto, they owned and were in possession of the Iron Queen claim in the Lalande district, and that the Marsh company, claiming to be the owner of the December lode, has caused it to be surveyed for patent, so that it overlaps the Iron Queen lode, the area in conflict being 1.159 acres. It is also alleged that the plaintiffs are owners of the Blue Jay lode and that the patent survey of the December lode also overlaps this claim, the conflicting area being 3.335 acres. The plaintiffs ask the court to quiet their title to the conflicting areas.

On March 4 the Bunker Hill & Sullivan company will pay dividend No. 210, of $81,750, making a total of $15,955,500.

The new Nordberg electric hoist at the Marsh mine is working satisfactorily. The only work being done at this lead producer is in shaft-sinking. At 685 ft. the drift is out 350 ft., all in milling ore.——The Interstate-Callahan zinc mine's mill is to be increased by 30% in capacity. One or two aerial tramway routes are under consideration for the delivery of ore and concentrate. During January the mill produced 4022 tons of 50% zinc concentrate.——A large pump is being installed at 900 ft. in the Hypotheek. The shaft is to be sunk from 900 to 1100 ft. when it is working.

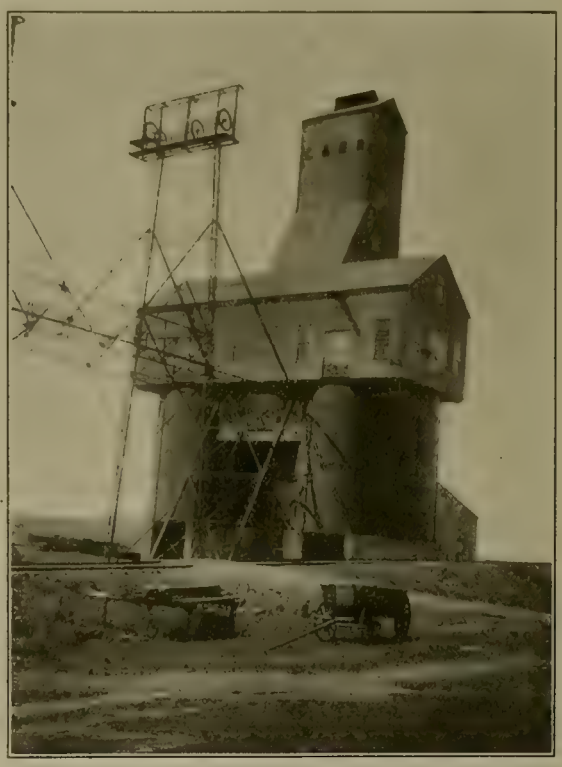
MICHIGAN

Houghton County (The Copper Country)

The annual report of the Victoria Mining Co. includes the following data: copper produced, 1,486,242 lb.; value of metal sold, $133,867 ($163,668 in 1913); total revenue, $282,311 (including assessment No. 6 of $74,234); surplus, $29,938, but comparing value of copper produced, etc., and operating costs there was a loss of $30,388, copper on hand, $62,205, and net assets, $40,624.

The Wolverine company will pay $1 per share on April 1, an increase of $2 over the dividend on October 1, 1914.——About 80% of the steel for the Isle Royale mill is erected and machinery is to be installed at once. The three stamps are to be sent to Milwaukee for repair.——The Franklin mill is being prepared to crush 'rock' from the Hancock, South Lake, and New Arcadian mines.——According to the superintendent of the Trimountain, Richard Bowden, the great 'mass' copper in this mine is still being cut up. Last week 30 tons of metal was extracted and sent to the smelter. Air-chippers are used to cut the mass.

Work is to be resumed at the Hancock mine, about March 1, which means the employment of over 200 men. The Franklin mill may be used to crush 'rock' from this mine. Old employees will be given preference over others on application for work.



SHAFT AND ROCK-HOUSE AT THE HANCOCK MINE.

MISSOURI

Jasper County

A 2200-ft. flume, the largest in the district, has been constructed by the Saginaw Mining Co., southeast of Joplin. Its use is to convey water pumped from the mine so that it cannot flow back into it. A 6-in. centrifugal pump is already in operation on this land, and two 11-in. walking-beam pumps are being installed.

MONTANA

Granite County

The Wasa claims, at the head of Dunkelberg and Douglas creeks, between Philipsburg and Drummond, have been sold by John Zundel to eastern people for about $75,000, M. N. Johnson, of Salt Lake City, putting through the deal. About 2400 ft. of adits has been driven, and a large tonnage of ore

developed. A 250-ton mill is to be erected, using a flotation process.

Lewis and Clark County

Results of the Helena Mining Bureau's activities are showing in several directions. At the Wayside claims in the Scratch Gravel hills, the Blue Bird shaft is down 45 ft. in a strong mineralized quartz vein, assaying from $11.65 to $30.30 per ton.——At the Hawkeye the shaft has reached a depth of 260 ft. This will be sunk to 350 ft. At 80 ft., three feet of oxide ore was cut, which will be opened later.

Lincoln County

Development at the Missouri claims on Leigh creek, 15 miles from Libby, has resulted in three gold-bearing veins being cut, and prospects generally are good.——Development in the St. Paul claims, 18 miles from Libby, has opened some silver-lead-copper ore in an adit, which is 600 ft. long.

Silverbow County

The state engineer, A. W. Mahon, has compiled a list and areas of the counties of this state. There are 41 in all, with a total area of 147,182 square miles. Of this, Silverbow county consists of only 698 square miles, but is the most important from a mining point of view.——Between 175 and 200 men are working on the many claims and leases in that part of the Butte district in which is the Anaconda company's Alice claim. Some are stripping ore.

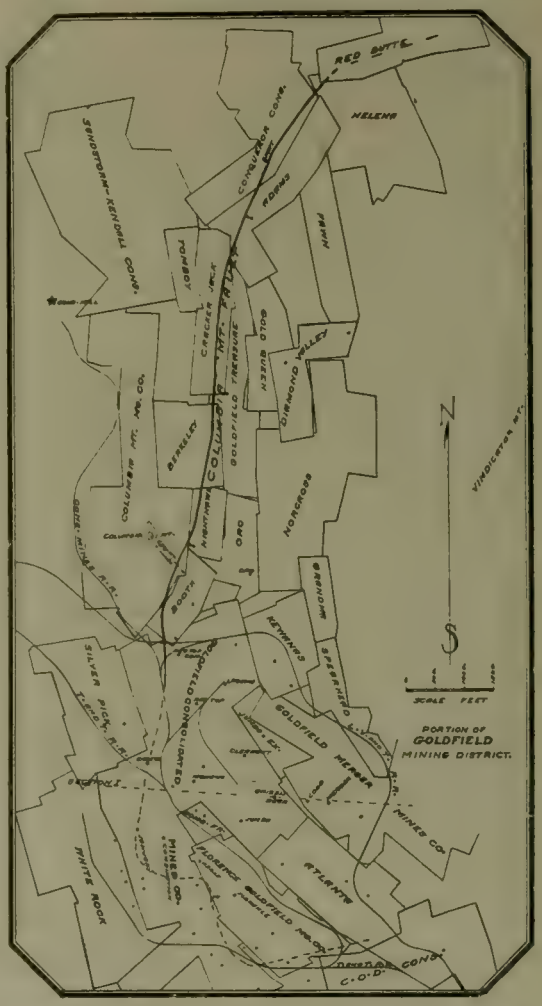
Among the information in the Butte & Superior company's report for the last quarter of 1914 is the following: Approximately 500 ft. of the shaft between the 240 and the 725-ft. level was carefully and thoroughly retimbered with the best material and in a manner which will probably protect the shaft at this place for several years to come, though the shaft above this point may need some further attention, probably not extensive in character, within the next two years. The principal development during the period was the cutting of the Deadwood vein in the 1228-ft. cross-cut on the 1200-ft. level. This is the same vein that has been developed for some distance on the 1000-ft. level, and will be given particular attention on the 1200-ft. level in the effort to explore it as rapidly as possible. No commercial ore is shown at the point at which it was cut. A large addition was made to the miners' change-house in order properly to care for the large number of men that are now working underground. The hoisting skips were increased from 3½ to practically 5-ton capacity, and this is proving of great advantage in hoisting. The copper and mine ore-bin grizzly were also remodeled, and give improved results. A new drill-sharpener for water-drills was installed, and a safety device attached to the small hoist similar to the one which has proved so satisfactory for the large hoist.

Lessees at the Reliance company's mine in the Moose Creek district, 20 miles south of Butte, have cut 12 in. of rich silver-copper-lead-gold ore, and some will be mined and hauled to Butte.

NEVADA

Esmeralda County

Litigation is to have a turn at Goldfield, and two suits of great importance were filed last week in the United States district court at Carson City, one being an apex suit by the Reorganized Booth Mining Co. against the Jumbo Extension Mining Co., in which the Booth company claims the apex of the Jumbo Extension orebodies, alleging that the ore recently taken from the Velvet claim of the Jumbo Extension can be followed to an apex in the Booth ground. The other suit is by the same plaintiff, which demands restitution for the extraction of 15,000 tons of ore of an average of $60 per ton, amounting to $900,000, and to restrain the Jumbo Extension company from further trespassing on or removing ore, or paying dividends or disbursing any money received from ore extracted from the Velvet claim. A temporary restraining order was issued by Judge Farrington, and formal hearing on the application was set for March 5. In the equity suit the Goldfield Merger Mines Co. is made a defendant with the Jumbo Extension, but only as to the Velvet claim, because some of the minority stockholders of the Merger have questioned the legality of the sale of the Velvet claim by the Merger company to the Jumbo Extension. The Merger company is made a defendant to this extent in order to quiet title to the orebodies. It is understood that work in the Booth mine has for some



time been directed for the purpose of determining that the Booth property covers the apex of the orebody in the Velvet claim of the Jumbo Extension, and continues into the claims of the Merger property. These suits may have an important bearing on the settlement of a suit recently started in Seattle by minority stockholders of the Merger company for the appointment of a receiver for the Merger company on the grounds that the sale of the Velvet claim to the Jumbo Extension was illegal, and which may be the forerunner of a suit for the recovery of the Velvet claim for Merger stockholders. As a result of the receivership suit, and other litigation which would probably ensue, various propositions have recently been under consideration by controlling factors for the consolidation of the Merger Mines, the Jumbo Extension, the Kewanas, and the Reorganized Booth, on some basis that might be finally agreed upon. Conferences have recently been held in San Francisco to discuss the situation, also, the hearing on the application for a permanent receivership for the Merger company and the Goldfield Deep Mines Co. has been continued

until April 10, in an effort to adjust all pending differences.

The temporary restraining order issued against the Jumbo Extension company enjoins it from disbursing any funds, and from distributing the dividend of 5c. per share which was to have been paid on March 1. The mine has been closed, but it will be kept drained and in good condition.

Ore worth $15 per ton is being shipped from the Atlanta, being extracted from a rise above 1750 ft.——The Florence is sending 50 tons every other day to the local sampler from the 250-ft. level.——In the Kewanas a drift is prospecting in the shale contact.

The Goldfield Consolidated company will pay 10c. per share on April 30. The yield in January gave a net return of $243,-973 from 30,569 tons of ore. Costs totaled $6.01 per ton. Development amounted to 3079 ft. at $6.12 per foot. On the 230-ft. level of the Combination, 100 ft. northeast of the shaft, the 292-Z sill gave 123 tons of $77.30 ore. At 450 ft. in the Laguna, 700 ft. south of the shaft, 253 drift produced 72 tons of $25.01 ore. Lessees extracted ore worth $26,100, the Company receiving $14,169 gross.

Humboldt County

In 1914 the Seven Troughs Mining Co. had 22 lessees working on its property, who paid royalties amounting to $5032. Development totaled 2238 ft., and 565 tons of ore yielded $29,192. The orebodies in general are pockets of small size, according to the manager, C. W. Poole, and there is no ground at present warranting Company work.

Lyon County

There are 25 men working on the Pittsburgh-Dolores mill, which is nearly complete. E. J. Schrader is general manager and C. R. Olson metallurgist.——Development at 200-ft. in the Nevada-Progressive mine has opened 4 ft. of gold-bearing ore.

Nye County

Pipe for the Round Mountain company's placer ground in Smokey valley is being delivered, and it is hoped to start sluicing in June. Six mines at Tonopah yielded 10,367 tons of ore worth $212,566 during the last week of February.——On April 1 the Extension will pay 7½c. per share, a total of $70,749.——A promising development has taken place at 850 ft. in the Monarch Pittsburg, and it is too early to give definite results, but it is hoped to be an extension of the Murray vein.

OREGON

The Oregon state legislature last week passed an appropriation bill for the mining bureau, amounting to $25,000, which is $16,000 less than that voted in 1913. The sum of $10,000 was also allowed to be spent on a mineral exhibit at the Panama-Pacific Exposition.

Jackson County

An interesting dispute is taking place between the Public Service Corporation and the California-Oregon Power Co. over the possession of a transmission line which runs up Kanes creek to the Braden mine.

Josephine County

The Waldo copper mine has been sold to J. F. Reddy and A. H. Gunnell of Grants Pass. The last work done on the property was in 1912, when 1980 tons of ore yielded about $60,000. This was hauled to Grants Pass, 42 miles, and then railed to the Tacoma smelter. The output to date is $250,000, and underground workings cover 4000 ft., while a large tonnage of ore is ready for extraction.

UTAH

Beaver County

In the Leonora mine, in the Star district, the silver-lead orebody has been opened 195 ft., assaying 107 oz. silver, 35% lead, and $3 gold per ton. A vein of ore containing from 24 to 45% zinc occurs next to this shoot. Shipments of ore are soon to start.

Juab County

It is now found that the deep mines of Tintic cannot be drained by the proposed tunnel mentioned in the *Press* of last week. Ore shipments from 13 mines in the week ended February 26 totaled 90 cars.

CANADA

British Columbia

In the provincial mineralogist's preliminary review of British Columbia for 1914 are notes on the various districts. The Cariboo and Quesnel divisions are restricted almost entirely to placer mining. Generally the clean-ups were satisfactory in the former. The gravel on Williams creek and Willow river was tested for dredging.——In Quesnel the larger hydraulic properties were not worked on account of litigation and waiting until the railway has reduced freight charges, two lines having been constructed.——More activity is evident in the Omineca division, which will be described in the *Press* next week, and rich gravel was sluiced by the Kildare Mines Co. on Slate creek. Lode mining was also done, but some of the ore was not shipped. On the Rocher Déboulé Copper Co.'s property the leasing company drove a long crosscut adit, and made a large expenditure on surface improvements.——The Atlin division of the Cassiar district produced gold worth $322,000, equal to 61% of the provincial output.——The Engineer mine's 2-stamp mill, on Taku arm, produced about $20,000 by amalgamation of a high-grade antimonial arsenide ore occurring in a quartz-calcite gangue. This ore assayed up to $6800 per ton in places.——In the Skeena division, the important property is the Granby company's copper mine at Anyox, where about 9,500,000 tons of 2.2% ore has been proved. The smelter, which was blown in on March 15, treated 260,000 tons to the end of 1914, containing 12,000,000 lb. copper, 2800 oz. gold, and 130,000 oz. silver.——The Granby Consolidated and Tonopah Belmont companies did a lot of work on Princess Royal island.——In the east Kootenay district, the Sullivan group produced 35,500 tons of ore containing 24,183,000 lb. lead and 474,500 oz. silver. Three coal companies operate at Crowsnest and the output was 972,000 tons of coal and 237,931 tons of coke.——The west Kootenay region is still one of the most important in the province, and includes the Bluebell, Consolidated Mining & Smelting, and other mines in the Ainsworth division; Rambler-Cariboo, Slocan Star, Surprise, Standard (with a yield of 890,000 oz. silver, 12,000,000 lb. lead, and 4,000,000 lb. zinc), Van Roi, and others in the Slocan divisions; the Nelson division; and Trail Creek with an increase of $200,000 over the previous year, the Trail smelter's output being worth $6,000,-662, although ore came from all of the divisions mentioned in the west Kootenay area.——The metal yield of the Boundary district was 83,830 oz. gold, 328,276 oz. silver, and 16,383,-629 lb. copper, decreases of 18, 17, and 43% respectively, due to the closing of smelters owing to the war. Apart from the Granby and British Columbia companies' operations, which are well known, the Jewel-Denero Mines, Ltd., 15-stamp mill, eight miles from Greenwood, treated about 16,000 tons of ore, yielding 6500 oz. gold and 33,000 oz. silver.——In the Vancouver division the Britannia company milled 240,272 tons of ore containing 250 oz. gold, 70,000 oz. silver, and 12,000,000 lb. of copper. A large number of improvements were made to the equipment.

Dating from February 1, wages of the Granby Consolidated employees at Phoenix and Grand Forks were raised 10%. When work was resumed in December a 25% reduction was made, and in January a 5% raise was given.

Yukon

Recent reports from the Mayo district state that development of the silver claims on Galena creek is yielding good results, and ore is being placed on the dumps, and hauled to the landing. The McWhorter mine employs 10 men, where there is 4 ft. of ore at 130 feet.

PERSONAL

W. H. Howard has been spending a holiday at Tacoma.

William A. Prichard returned from London on Monday.

William Braden is on his way from Chile to New York.

H. Foster Bain expects to leave for London on March 28.

T. A. Rickard sails from England today on his way to San Francisco.

C. W. Purington sailed on the S.S. *Tuscania* for Liverpool from New York on February 20.

John W. Pack, of Berkeley, has been appointed chief assayer at the San Francisco Mint, a position he formerly held.

James J. Ormsbee, manager of the Hayden plant of the A. S. & R. Co., will be at the Tacoma plant for a few weeks.

Leslie H. Webb, secretary of the Wedge Mechanical Furnace Co., of Philadelphia, is in San Francisco for a few days.

August A. Busch, head of the Busch-Sulzer Bros.-Diesel Engine Co., of St. Louis, is in San Francisco inspecting his firm's exhibit at the exposition.

Frederick G. Farish has recently been made manager for the Lluvia de Oro Gold Mining Co., of Chihuahua, Mexico, and is on the way to the mine to take charge.

A. C. Selby, formerly with the Union assay office of Salt Lake City, has been appointed chief chemist for the new mill at Rochester, Nevada, which is nearing completion.

C. H. Repath, senior member of Repath & McGregor, smelter builders and supervising engineers, was at Douglas, Arizona, recently, after a visit to the Arizona plants built by his firm, which has just completed the Clarkdale plant of the United Verde company.

The Mining and Metallurgical Society of America will give a farewell dinner to H. Foster Bain on the eve of his departure for London, where he is to assume the editorship of *The Mining Magazine*. This, a joint dinner with the A. I. M. E., is to be given at the Hotel Bellevue, corner of Taylor and Geary streets, on March 9, 1915, at 6:30 p.m. All are earnestly invited to attend the dinner and the meeting of the section at 6 p.m. to elect a chairman for the local section of the Mining and Metallurgical Society.

Obituary

A solution of the mysterious disappearance of Michael Cooney, of Socorro, New Mexico, well known mining man and member of the board of regents of the New Mexico School of Mines, was found with the discovery of his body, on February 14, by a posse, in a remote spot in the Mogollon mountains. Captain Cooney left his home at Socorro on October 26, answering the call of the West for a last prospecting trip. Strapped to the horn of the saddle of his horse was a small handbag in which was found his diary which told the story of his wanderings and death. Out of respect to him the House of Representatives at Santa Fe adjourned on the afternoon of February 19. He leaves a wife and son and many friends.

Thomas Henry Oxnam, one of the best known mining engineers on the Pacific Coast, died at his home in Los Angeles, February 16. He was born September 17, 1854, at Pool, Carn Brea, Cornwall, England, and as a young man began his mining career in the tin mines of Cornwall. In 1875 he left England and spent two years in South Africa contracting railroad tunnel work for the British government, and in 1877 came to America and settled at Virginia City, Nevada. From 1877 to 1884 he worked in the various mining districts of California, Arizona, and Colorado. In 1884 he entered the employ of the London Exploration Co., of London, and remained with that concern until 1895. During this period Mr. Oxnam was at Marysville and Elkhorn, Montana, De Lamar, Idaho, and Harqua Hala, Arizona. He rose from foreman to mine manager of the famous De Lamar mines at De Lamar, Idaho. In 1895 he left the employ of the London Exploration Co. and became manager and consulting engineer for J. R. De Lamar. In 1901 he was made manager of the Palmarejo & Mexican Gold Fields, Ltd., at Chinipas, Chihuahua, Mexico. While in charge of this property Mr. Oxnam made practical application of the cyanide process for silver ores. Ill health caused him to leave Mexico, and in 1907 he became associated with the Consolidated Arizona Smelting Co. as vice-president and general manager. From 1908 until his death he had devoted his time to private practice. He is survived by his widow, three sons, and one daughter.

Schools and Societies

The Illuminating Engineering Society, Chicago section, held a meeting on February 25, when a lecture was given on the various phases of vision.

The Canadian Mining Institute had 1015 members at the end of 1914. During the past year the revenue was $9898, not including a balance of $3638 from 1913. The amount on hand on January 1, 1915, was $4836.

The Northwest Mining Association of Oroville, Washington, has recently been formed with the main object of giving publicity to the mining resources of the region. All news given out by this Association will be carefully censored by its publicity committee.

The Mackay School of Mines reports that 25 men registered for the short course in prospecting which extends through the month of February. Of these men, 10 registered as prospectors and 4 as miners, so the registration shows that the majority of those entering the course belong to the class of men for which it was intended.

The Utah branch of the A. I. M. E. held its first annual dinner at Salt Lake City last week. There were 47 members present. Speakers were Karl Eilers, of the American Smelting & Refining Co., a guest; Walter Fitch, C. W. Whitley, Ernest Gayford, D. A. Lyon, B. F. Tibby, J. H. Winwood, Lafayette Hanchett, William Wraith, and R. C. Gemmell of the Utah Copper Co., who acted as toastmaster. It was decided to hold a meeting at Tintic in July.

The annual meeting of the Montana branch of the A. I. M. E. was held at Butte on the evening of February 5. More than 50 members and guests enjoyed a dinner at the Silver Bow club, preceding the business and technical session. The following officers were elected for the ensuing year: chairman, F. M. Smith, manager East Helena plant of the A. S. & R. Co.; vice-chairman, J. L. Bruce, manager of the Butte & Superior Copper Co.; secretary-treasurer, D. C. Bard, professor of geology, Montana State School of Mines; and executive committee, Frederick Laist, chief metallurgist of the Anaconda Copper Mining Co. and W. C. Siderfin, manager of the W. A. Clark interests in Montana. The secretary's report shows an active membership in the state of 160. Arrangements were considered for having the branch represented at the San Francisco meeting of the Institute next September. Two technical papers were presented and discussed, (1) 'The Concentrator of the Timber Butte Milling Co.,' by Theodore Simons, and (2) 'The Boulder Batholith of Montana,' by Paul Billingsley. This last paper is to be read at the forthcoming meeting of the Institute in New York, but was presented at the local meeting as well, because of its interest to the local community. The Montana members meet twice a year. It is growing in membership, and its usefulness is being increased as interest in the organization grows among mining men.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, March 4.

Antimony	.20 —20¾
Electrolytic copper	.15½ 15¾
Pig lead	4.15— 5.10
Quicksilver (flask)	$70.00
Spelter	.10¾—11
Tin	.38 39½
Zinc-dust, 100-kg zinc-lined cases	12

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, March 4.—Copper is quiet, and lead and spelter strong.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Feb.	25	Jan. 20	13.53
"	26	" 27	14.00
"	27	Feb. 3	14.50
"	28 Sunday	" 10	14.29
Mch.	1	" 17	14.30
"	2	" 24	14.42
"	3	Mch. 3	14.38

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	....
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	....	Sept.	12.02	....
Apr.	14.19	....	Oct.	11.10	....
May	13.97	....	Nov.	11.75	....
June	13.60	....	Dec.	12.75	....

Exports during the third week of February totaled 13,285,854 pounds.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Feb.	25	Jan. 20	3.70
"	26	" 27	3.70
"	27	Feb. 3	3.80
"	28 Sunday	" 10	3.80
Mch.	1	" 17	3.85
"	2	" 24	3.85
"	3	Mch. 3	3.87

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	....
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	....	Sept.	3.82	....
Apr.	3.86	....	Oct.	3.60	....
May	3.90	....	Nov.	3.68	....
June	3.90	....	Dec.	3.80	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
Feb.	25	Jan. 20	6.13
"	26	" 27	6.88
"	27	Feb. 3	7.58
"	28 Sunday	" 10	7.75
Mch.	1	" 17	8.24
"	2	" 24	8.25
"	3	Mch. 3	9.05

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	25	9.05	Aug.	4.45	....
Mch.	5.12	....	Sept.	5.16	....
Apr.	4.98	....	Oct.	4.75	....
May	4.91	....	Nov.	5.01	....
June	4.84	....	Dec.	5.40	....

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.		Average week ending	
Feb.	25	Jan. 20	48.98
"	26	" 27	48.77
"	27	Feb. 3	48.52
"	28 Sunday	" 10	48.20
Mch.	1	" 17	48.42
"	2	" 24	48.70
"	3	Mch. 3	49.02

Monthly averages

	1914	1915.		1914	1915.
Jan.	57.58	48.85	July	54.90	....
Feb.	57.53	48.45	Aug.	54.35	....
Mch.	68.01	....	Sept.	53.75	....
Apr.	58.52	....	Oct.	51.12	....
May	58.21	....	Nov.	49.12	....
June	56.13	....	Dec.	49.27	....

Silver has shown an upward tendency. Shipments from San Francisco to the Orient during the past two weeks amounted to about 320,000 oz. The Cobalt district, Ontario, is only making small shipments to England.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Feb.	4	55.00	Feb. 18 62.50
"	11	60 00	" 24 62.50
			Mch. 3 70.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60.00	Aug.	80.00	....
Mar.	39.00	....	Sept.	76.25	....
Apr.	38.90	....	Oct.	53.00	....
May	39.00	....	Nov.	55.00	....
June	38.60	....	Dec.	53.10	....

London prices are £12 15s. per flask, and are rising.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	....
Feb.	39.76	37.23	Aug.	50.20	....
Mch.	38.10	....	Sept.	33.10	....
Apr.	36.10	....	Oct.	30.40	....
May	33.29	....	Nov.	33.51	....
June	30.72	....	Dec.	33.60	....

On March 4 New York prices were up to 41 cents.

A shipment of tin which arrived at New York direct from the Far East on February 13 on the steamer 'City of Bristol' is believed to have been the largest on record. It consisted of 775 tons from Singapore and 600 tons from Penang. In the few days preceding February 18 a good-sized speculative business was done in the selling of spot by those who immediately replaced the metal they had sold by purchasing early futures, and thereby cleared a profit. When a condition was reached where the holders of nearby deliveries were no longer willing to sell, prices advanced. Spot tin in warehouse was difficult to buy under 40c. on February 19. On that day London advanced £6 on spot and £4 on futures, spot closing at £185 and futures at £159 per ton, c.i.f., London. On February 22 there again were sharp advances in London, but on the following day there were equally sharp declines. The decline on spot Straits on that day was £8. February 24 there was a further decline in London of £3. With these declines in London the domestic market became dull and heavy. It is reported, and believed, that the Dutch government has recently sold to Germany a large quantity of the Banca tin which was stored in Holland. Arrivals up to February 25 totaled 3110 tons, and there was afloat on that day 2510 tons. By February 25 the London quotations had dropped to £178 for spot Straits and £157 10s. for futures.

ANTIMONY

With no English antimony coming here, the indications are that these brands may soon be unobtainable. Business does not appear to have been large in any direction, but the scarcity, coupled with occasional inquiries for export, have sent prices up and they are strong at the higher levels. At the beginning of the month quotations were 18 to 19c. for Cookson's, 17 to 18c. for Hallett's, and 16 to 17c. for Chinese; and on February 26 the nominal quotations were 21c. for Cookson's and 20c. for Hallett's while Chinese was quoted at 18c. duty paid.

ALUMINUM

The market was stationary and without feature at 19 to 19.50c. per pound.

New York Metal Review

The consumption of Lake copper by manufacturers of munitions of war continues on an enormous scale, and prompt deliveries, except on contracts previously placed, are practically unobtainable. Under the circumstances, quotations for spot or early delivery metal are nominal. Electrolytic, though higher in price than it was a month ago, shows evidence of weakness, as it is not sustained by domestic demand. Some industries, which ordinarily consume great quantities of copper, are not busy. Lead holds up well, and the price was advanced $1 per ton on February 16. London is following the United States lead market more closely than has been usual. Spelter and all the products into which it enters have advanced sharply in an excited market. Exports of spelter have been record-breaking, and this, coupled with the demand here, has created a scarcity of choice brands. Tin, under foreign influences, has been up and down continually, though the domestic demand has not been great. Antimony is firm at higher prices. Some tremendous orders for war supplies have been placed in this country for shrapnel, projectiles, cartridges, and the like, and the machines for making them. While in the main confined to a comparatively few channels, this business is radiating to other lines, and there are noted also an increasing number of orders which cannot be associated with the war. Two of the busiest industries in the country are the building of automobiles and ships. Of the latter, over 50 have been ordered in less than three months, and more orders are pending. A slow but positive improvement, one that is in keeping with the general spirit of economy, is noted in business. On February 23 the increase of 5% in the freight-rate schedule of the Eastern railroads became effective, and this should stimulate buying on their part. In fact, some quiet purchases already have been made. Advances of $1 per ton on such steel products as plates, shapes, and bars are announced, effective on March 1.

COPPER

Two things stood out prominently in February, the heavy consumption of prime Lake in the manufacture of munitions of war, and the light domestic demand for electrolytic. Quotations for the latter were sustained mainly by the sympathetic influence of Lake. The New York price of prime Lake at the opening of the month was 15c., but at the end of the first week it had reached 15.25c., cash, and it remained there. Now and then sales were heard of at lower prices, but such transactions were few, as the producers of high-grade brands were reported to be sold out of near delivery metal, and to be only considering deliveries to be made after the opening of navigation on the Great Lakes. There were a few sales of prime Lake out of New York stocks as high as 15.75c. cash. Of course, less favored brands commanded a lower figure, and there were sales reported at 14.87½ to 15.12½c., while arsenical copper was sold as low as 14.62½c. Electrolytic was quoted until about February 10 at 14.75c., cash, New York, after which it dropped to 14.62½c. Second hands led the way in offering concessions. Near the close of the month a weaker trend developed, but prices were practically unchanged. Complaints were heard from the copper-wire mills, and the operations of the electrical industry were far below normal. By order of the Secretary of the Treasury, announcements of exports from day to day were resumed February 15, and figures can now be had which afford a basis for comparison. It is understood that the average production is now 65 to 70% of capacity. Exports in January amounted to 26,193 tons, against 36,018 tons in January 1914. The total of exports in 1914 was 360,229 tons, against 383,810 tons in 1913. Exports in February, to the 26th, amounted to 9584 tons, which indicates a radical decline in foreign shipments, but it is difficult to draw conclusions from export figures now, as shipping conditions are so unusual.

LEAD

In late January and early February a large business in lead was done both on foreign and domestic account, and one result was an advance of 10 points on January 28, to 3.80c., New York, and 3.62½c., St. Louis. Early in February some of the producers asserted they had sold their output for the month, and also said they were disinclined to sell further ahead. About the middle of the month the demand abated to a considerable extent, but consumers continued to talk in a bullish manner and this is said to have been practically the only reason for a further advance of five points on February 16, making the New York quotation 2.85c., and that at St. Louis 3.72½c. Then buying started again and the Western market became stronger and worked up to 3.77½c., although the New York market was unchanged. The European market was firm, as it is expected to be while the war lasts. An interesting phase of the London market is that it shows a greater disposition to follow this market than has ever before been manifested. Requests have come from London for prompt cable advices whenever there is any change in the quotation here. A further advance is believed to be impending. Up to February 25 the exports totaled 934 tons for the month.

SPELTER

The situation is serious. On February 25 the quotations for Prime Western spelter were 9.55c. to 9.75c., New York, and 10.50c. was asked by some producers. On February 1 the quotations were about 7.75c. New York, and 7.60c. St. Louis. One advance followed another in quick succession. Extra choice brass-mill spelter was nominal throughout the month at quotations that mounted as high as 14c. Two influences sent the market up, the heavy exports and the extent to which the brass mills absorbed the metal, both of which may be classed as war demands. A steamer which sailed near the end of January for Vladivostok carried 1950 tons, which was a record shipment. Large shipments to Europe had been made for some time prior to this date. In December, 18,316 net tons of domestic spelter was exported, and 1877 tons of foreign origin. In December 1913 only 68 tons was exported. In the 10 months ended December 1914, 64,802 tons of domestic spelter was exported, against 7783 tons in the same time of 1913. Over 15,000 net tons was exported in January. Exports in February, to the 25th, totaled 4960 tons. Toward the end of February the market was excited, consumers having been roused to the necessity of covering their needs. The prices of galvanized sheets were repeatedly advanced, and sheet zinc kept pace with the cost of spelter. Quotations of the latter product this year have been as follows: January 2, 9c.; January 19, 9.25; January 21, 9.50; January 26, 10; February 2, 10.50; February 4, 11; February 8, 11.50; February 12, 12; February, 19, 12.50; and February 25, 12.75c. At the close of the month the market was uncertain and excited.

TIN

The domestic demand for tin was not great in February, and the reason lies in the upset conditions created by the war. At times, of course, a moderate amount of business was done, and on one day there was good activity. The average prices for spot metal on various days of the month were as follows: February 2, 37.80c.; February 4, 36.50; February 5, 37; February 9, 36; February 13, 35.85; February 16, 36.12½; February 18, 37.25; February 19, 39.45; February 20, 39.50; February 23, 38.60; and February 25, 38c. per pound. The foregoing prices indicate how lively the fluctuations were. On February 1 at least 300 tons changed hands. On that day the lowest price of spot was 37.30c., and the market closed at 38.37½c. The London market was seriously affected by the congestion of freight in that port, and prices were strong. In the first week in February a peculiar situation existed here in that at times the New York price was more than 2c. under the London parity, and 2½c. under import cost.

Current Prices for Oils and Candles

(Corrected monthly by Standard Oil Co. California.)

All prices are f.o.b. San Francisco except where otherwise specified, and are subject to change without notice.

Granite Mining Candles	Per set, cents	Granite Mining Candles	Per set, cents
6s-12 oz.-10s	8¾	6s-14 oz.-20s	9½
6s-12 oz.-20s	9	6s-16 oz.-40s	10
6s-14 oz.-40s	9¼	6s-16 oz.-20s	10¼

Extra hard 1c per set higher than the above.

The following prices are for oils (Calol) in wood barrels; cases (2-5 gal.) 3c. per gallon higher.

	Per gal., cents		Per gal., cents.
Compressor oil	40	Light gas engine oil	28
Amber gas engine oil	40	Red compressor oil	26
Castor machine oil	20	Red engine oil	17
Dynamo and motor oil	24	Turbine oil	30
Engine oil	24	Turbine oil, heavy	30
Gas engine oil	26	Diesel engine oil	40
Heavy gas engine oil	45	Cylinder oil	37
Heavy red engine oil	19	High-pressure cylinder oil	50
Heavy red journal oil	21	Low-pressure cylinder oil	37
Ice machine oil	28	Valve oil	44

The following prices are for oils in iron barrels, cases (2-5 gal.) 7c. per gallon higher, except on Eocene, which is 8c. per gallon higher.

	Per gal., cents.		Per gal., cents.
Pearl oil	9	Engine distillate	7
Headlight oil	10	Aroturps	15
Eocene oil	11	V. M. and P. naphtha	10½
Red Crown gasoline	11½		

	Per bbl.
Star fuel oil, f.o.b. Richmond Refinery	$0 85

	Per ton.
Petrolastic cement X	$13.00
Petrolastic cement XX	12.00
Asphaltum	$5.50 to 12.50

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted, except as noted, f.o.b. San Francisco. Buying prices marked *.

	Min.	Max.
Antimony ore, 45 to 55%, per ton	$32.50	$42.50
Arsenic, white, refined, per lb	0.05	0.06
Arsenic, red, refined, per lb	0.12	0.15
Asbestos, chrysotile	100.00	350.00
Asbestos, amphibole	5.00	7.50
Asphaltum, refined, per ton	11.50	20.00
Barium chloride, commercial, per ton	50.00	60.00
Barium sulphate (barytes), prepared, per ton	20.00	30.00
Bismuth ore, 15%, per ton	*250.00	upward
China clay, English, levigated, per ton	15.00	20.00
Chrome ore, according to quality, per ton	7.50	10.00
Cobalt metal, refined, f.o.b. London, per lb	1.90	....
Coke, foundry, per 2240 lb	12.00	15.00
Diamonds (according to size and quality):		
Borts, per carat	2.00	15.00
Carbons, per carat	55.00	80.00
Feldspar, per ton	5.00	25.00
Firebrick:		
Silica, per M	50.00	55.00
Snowball, per M	40.00	45.00
Flint pebbles for tube-mills, Danish, per 2240 lb	24.00	28.00
Fluorspar, per ton	10.00	15.00
Fuller's earth, according to quality, per ton	20.00	30.00
Gilsonite, per ton	35.00	40.00
Graphite:		
Amorphous, per lb	0.01	0.02½
Crystalline, per lb	0.04	0.13
Gypsum, per ton	5.00	7.50
Infusorial earth, per ton	10.00	15.00
Iridium	55.00	....
Magnesite, crude, per ton	5.00	7.50
Magnesite, dead calcined, per ton	20.00	25.00
Manganese ore, oxide, crude, per ton	10.00	15.00
Manganese, prepared, according to quality, per ton	30.00	70.00
Mica, according to size and quality, per lb	$0.05	$1.00
Molybdenite 90% MoS_2 per ton	1000.00	1500.00
Monazite sand (5% thoria), per ton	150.00	200.00
Nickel metal, refined, per lb	0 45	0 60
Ochre, extra strength, levigated, per 100 lb	2.00	3.00
Osmiridium, per oz.	30.00	40.00
Platinum, native, crude, per oz.	30.00	45.00
Silex lining for tube-mills, per 2240 lb	35.00	45.00
Sulphur, crude, per ton	25.00	30.00
Talc, prepared, according to quality, per ton	20.00	50.00
Tin ore, 60%, per ton	425.00	450.00
Tungsten ore, 65%	400.00	425.00
Uranium ore, 10% min.	25.00 per unit	
Vanadium ore, 15% V_2O_5 per ton	150.00	180.00
Wolframite (see tungsten ore).		
Zinc ore, 50% up, per ton	*15.00	20.00

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Heimann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are f.o.b. San Francisco and subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66°, drums, per 100 lb.	$ 0.80	$ 1.10
Acid, sulphuric, com'l, 66°, carboy, per 100 lb.	1.25	2.00
Acid, sulphuric, C. P., 9-lb. bottle, bbl., per lb.	0.13	0.18
Acid, sulphuric, C. P., bulk, carboy, per lb.	0.09½	0.12
Acid, muriatic, com'l, carboy, per 100 lb.	1.60	3.00
Acid, muriatic, C. P., 6-lb. bottle, bbl., per lb.	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, per lb.	0.10½	0.15
Acid, nitric, com'l, carboy, per 100 lb.	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., per lb.	0.16	0.22
Acid, nitric, C. P., bulk, carboy, per lb*	0.12½	0.15
Argols, ground, bbl., per lb	0.10	0.20
Borax, cryst. and conc., bags, per 100 lb.	3.00	4.35
Borax, powdered, bbl., per 100 lb.	3.38	4.50
Borax glass, gd. 30 mesh, cases, tin lined, per 100 lb.	11.50	14.50
Bone ash, 60 to 80 mesh, bbl., per 100 lb.	0.50	6.50
Bromine, 1-lb. bottle, per lb.	0.55	0.65
Clay, domestic fire, sack, per 100 lb.	1.50	2.00
Cyanide, 98 to 100%, 100-lb. case, per lb.	No quotes	
Cyanide, 98 to 100%, 200-lb. case, per lb.	"	"
Cyanide, 129%, 100-lb. case, per lb.	"	"
Cyanide, 129%, 200-lb. case, per lb.	"	"
Lead acetate, brown broken, casks, per 100 lb.	9.00	10.50
Lead acetate, white broken, casks, per 100 lb.	10.50	10.75
Lead acetate, brown broken, casks, per 100 lb.	9.00	10.50
Lead acetate, white, crystals, per 100 lb.	12.50	13.25
Lead, C. P., test., gran., per 100 lb.	13.00	15.00
Lead, C. P., sheet, per 100 lb.	15.00	18.00
Litharge, C. P., silver free, per 100 lb.	11.50	13.50
Litharge, com'l, per 100 lb.	8.00	9.50
Manganese ox., blk., dom. in bags, per ton	20.00	25.00
Manganese ox., blk., Caucasian, in casks, per ton (85% MnO_2—¾% Fe)	65.00	120.00
Nitre, double ref'd., small cryst., bbl., per 100 lb.	12.00	14.00
Nitre, double ref'd., granular, bbl., per 100 lb.	11 50	13.50
Nitre, double ref'd., powdered, bbl., per 100 lb.	12.25	14.25
Potassium bicarbonate, cryst., per 100 lb.	14.00	16.00
Potassium carbonate, calcined, per 100 lb.	15.00	30.00
Potassium permanganate, drum, per lb.	0.30	0.40
Silica, powdered, bags, per lb.	0.03	0.05
Soda, carbonate (ash), bbl., per 100 lb.	1.45	1.75
Soda, bicarbonate, bbl., per 100 lb.	2.00	2.50
Soda, caustic, ground, 98%, bbl., per 100 lb.	2.75	3.25
Soda, caustic, solid, 98%, drums, per 100 lb.	2.50	2.75
Zinc shavings, 350 fine, bbl., per 100 lb.	16.00	....
Zinc sheet, No. 9—18 by 84, drum, per 100 lb.	No quotes	

*Extra charge for packing nitric acid for shipment to conform to regulations.

Roessler & Hasslacher quoted as follows on February 17:

Ammonia, anhydrous, in 50-lb. cylinders, per lb.	$0.27
Arsenic, white powdered, in 500-lb. bbl., per lb.	0.05
Cobalt oxide, black, in 10-lb. tins, per lb.	1.05
Cyanide, potassium, 38.4% cyanogen, per lb.	0.27
Cyanide, sodium, 51% cyanogen, per lb.	0.25
Sodium, metallic, in 1-lb. tins, per lb.	0.40
Zinc dust, in bbl. 1600 lb.	0.12

Owing to uncertain conditions a number of chemicals are not quoted.

BOOK REVIEWS

THE CYANIDE HANDBOOK. By J. E. Clennell. P. 601. Ill., index. McGraw-Hill Book Co., New York, 1915. For sale by the *Mining Press*. Price, $5.

This is the second edition of Mr. Clennell's well known treatise on the chemistry and practical application of the cyanide process. The volume under review contains 81 pages more than the previous one, and every effort has been made to bring the matter up to date. It was not considered advisable to omit any great part of the descriptions of the older methods, these being generally still in use; and new arrangements often need the adoption of systems previously discarded. Section III of Chapter I covers in short the tendencies of modern practice. The chemistry of the process is given practically the same as before. In part III of the preparatory treatment of ore for cyaniding, the comparative utility of various crushing and grinding machines is new, including Lane slow-speed Chilean and Hardinge mills. Also, the following discussions are in addition to No. 1 edition: factors influencing rate of settlement of slime, diaphragm cone classifier, Merrill cone, Dorr classifier, Dorr thickeners, amalgamation in conjunction with cyanidation, skimming tailing dumps, continuous agitation and decantation; the Parral, Patterson, Trent and Dorr agitators; the Merrill press; the modified Butters filter and Oliver filter; zinc-dust and aluminum-dust precipitation; smelting precipitate; treatment of antimonial and arsenical ores; new applications of aluminum in ore treatment; electrolytic regeneration of cyanide; sources of error in assaying ore; assay of silver ore from Cobalt; additional notes on ore analysis (copper, tin, zinc); method for valuation of caustic lime; and tests to determine value of zinc-dust for precipitation, valuable additions to the existing literature. Cyanide workers will always find something useful in this excellent study of a world-wide used process.

SAN FRANCISCO FOLIO. By A. C. Lawson. Geologic Atlas of the United States, No. 193. U. S. Geological Survey, Washington, 1914. For sale by the Geological Survey. Price, 75c.

The making of a geological map of the United States is a huge task. It is one which has absorbed the time and energy of many men for many years, and the work will always be, in any large sense, incomplete. From time to time, however, important parts of the work reach such a stage of completion as to permit publication, and in the various folios of the Geological Survey, most of such material is summarized. The Pacific Coast is young, not only geologically, but is one of the parts of the country that has been studied relatively few years. It is at the same time one of the most complex of the geological provinces. Such areas can only be interpreted correctly upon the basis of long-continued, detailed work, and outside the oilfields and the Mother Lode region there has been little such work done in California. The San Luis Obispo and the Santa Cruz areas are almost the only ones directly on the coast. Lawson's folio, therefore, is of great importance, not only because it illustrates and explains the geology near San Francisco, but because it affords a ready key to the interpretation of a much larger area. It is too long and too detailed to review in full. It is sufficient to say that the formations described range from the Montara granite to the sand dunes of Golden Gate park. Each is described with admirable clearness and detail. There is nothing startlingly new in the interpretation offered, at least to specialists familiar with the literature of the subject, but the whole constitutes the best general summary yet written, and a most effective starting point to serious study of the coast ranges. It is written in terms easily understood by the intelligent layman, and should serve, as it doubtless will, as an important guide to further building and development in the region. As usual in the folios, the accompanying maps represent the highest skill both in the field and office. As examples of what a map should be they may well be cited. Mr. Lawson discusses, with admirable clearness and frankness, the earthquakes of the area and their proper influence on building. He points out that 99% of the shocks are harmless, and that of all the fault lines in the area only two are known to mark zones of active stress. He indicates the possibility that stresses along the San Andreas rift may have been completely relieved in 1906, and suggests methods not only of determining whether earth stresses are accumulating along any line, but also of building in such manner as to safeguard against damage from such shocks as may occur. For the present only the large library edition of the folio is available, but it is announced that a more convenient octavo form is being prepared.—H. F. B.

RECENT PATENTS

1,122,861.—ALLOYED STEEL. James Churchward, Mount Vernon, New York, assignor to Churchward International Steel Co., New York. As an article of manufacture, an alloy steel containing nickel, chromium, tungsten, vanadium, manganese, and silicon.

1,123,685.—PRECIPITANT FOR RECOVERING METALS FROM SOLUTIONS. Galen Howell Clevenger, Palo Alto, California, assignor to Merrill Metallurgical Co. A precipitant for recovering metals from cyanide solutions, consisting of a binary brittle alloy of zinc with alkali or alkaline earth metal.

1,123,966.—METALLURGICAL FURNACE. Utley Wedge, Ardmore, Pennsylvania. A furnace having outer walls, and hearths forming a row of furnace units disposed end to end, rabble arms for the hearths of said row of furnace units, a structure extending alongside of the row of furnace units and carrying the rabble arms of the row, and means for reciprocating said rabble arm carrier.

1,118,012.—PROCESS OF SMELTING ZINC ORES. James M. Hyde, Berkeley, California. The process of smelting zinciferous ores, which consists in heating the ore mixed with flux and reducing agent in an externally heated retort to a temperature sufficient to reduce the metallic constituents, collecting the molten materials in a bath beneath the charge, removing the zinc vapors from the retort above the molten bath, and keeping the bath molten by heat directly applied to the surface thereof outside said retort.

1,124,174.—PROCESS FOR THE PRODUCTION OF TIN OR TIN COMPOUNDS FROM PYRITIC OR OTHER TIN ORES, TIN-ORE CONCENTRATES, TIN-WASTE, TIN-PLATE WASTE, STANNIFEROUS SLAG, TIN-SLAG, AND THE LIKE. Jan Rueb, The Hague, Netherlands. The process for the production of tin compounds from materials containing tin mainly in an oxidized condition, which consists in smelting said materials with a heavy metal sulphide and with slag-forming substances, so as to convert such tin compounds into tin-iron matte.

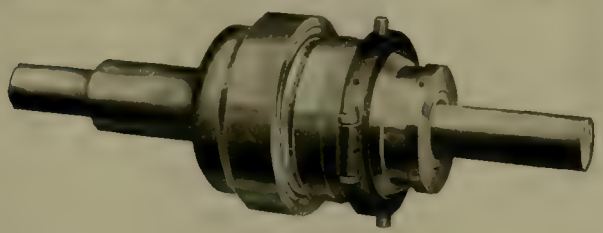
1,126,456.—ORE-BELT EDGER. Albert W. Harp, Angels Camp, California. A vulcanizing outfit for conveyor belts, comprising a frame extending crosswise over the belt and having means to grip the frame on which said belt travels, at the two sides of the belt, a vulcanizing element with heating means supported from beneath the belt and on which the belt rests, and a vulcanizing element with heating means on top the belt and held down thereon in opposition to the underneath vulcanizing element by means carried by said frame.

New Machines and Devices

A Safety Self-Oiling Clutch

After considerable experimental work, the Dodge engineers have originated and developed an improved solid multiple-disc friction clutch, which retains all the good points of the present Dodge clutch with the addition of the important features of safety, efficiency, and durability.

All moving parts of the mechanism of this new apparatus are concealed, making a perfectly smooth contour. There are no projecting moving parts to catch clothing or injure workmen; no cumbersome or unsightly guards or screens are necessary. It is claimed that the design and materials of the multiple friction discs, combined with the new roller toggle operating mechanism, make this the most powerful clutch of its size that has yet come under the observation of mechanical engineers. The rolls on the toggle levers travel on conical surfaces arranged to give high pressure on the friction discs, with a minimum amount of mechanism friction. The use of rollers in place of sliding parts makes the clutch easily operated. The action of centrifugal force tends to keep the clutch disengaged when thrown out. The clutch is self-lubricating,



DODGE SAFETY SELF-OILING CLUTCH.

this being accomplished by an oil ring revolving in a large oil reservoir, giving every satisfaction. The clutch is easily adjusted with a single nut arrangement which is simple and positive. Backing off this nut permits removal of the operating cone, which exposes the toggle mechanism and also permits the removal of the entire inside mechanism for repairs. It takes little space on the shaft, less attention in operation, has a good appearance, and is considered a worthy addition to the Dodge line of power-transmission machinery. This clutch is made by the Dodge Manufacturing Co., of Mishawaka, Indiana, and will be distributed by the Dodge Sales & Engineering Company.

Mounted Jackhamer Drills

The Jackhamer drill was originally designed for drilling down-holes of various depths up to about 12 ft., but due to the light weight of this machine, which is about 40 lb., it was found feasible to employ it for drilling flat holes also. When such holes are to be drilled intermittently, the regular unmounted Jackhamer is a practical tool, but where continuous drilling of flat holes has to be carried on, the effort of holding the drill to the work is apt to tire the workman.

Realizing the need for a mounting that would not be cumbersome, but at the same time would be heavy enough to withstand rough usage, the Ingersoll-Rand Company, 11 Broadway, New York, developed, after considerable testing, the mounting shown in the accompanying illustration, which is known as the 'JM-6' type. The Jackhamer, used in conjunction with the 'JM-6' mounting, has been found thoroughly practical for such flat-hole work as driving and underhand stoping in metal mines where shallow holes are required, and for breaking down coal and driving gangways in coal mines. It takes a very short time to clamp the standard unmounted Jackhamer in the car-

INGERSOLL-RAND JACKHAMER MOUNTING WITH CONE IN EXTREME BACK POSITION, AND MACHINE IN EXTREME FORWARD POSITION.

riage of this mounting. Therefore, a single drill may be used conveniently for the two-fold purpose of drilling flat holes in the heading and down-holes on the bench without loss of time in making changes. A water-feed device of the Leyner type has recently been developed for use with the Jackhamer whenever trouble from dust arises. The 'JM-6' mounting is adapted for use with both plain and water-feed types of Jackhamers. The clamp which grips the handle of the drill is provided with a cushion spring to take up the shock when a steel is being pulled out of a hole. The forward clamp on the carriage does not grip the machine firmly, but serves only as a support and guide. The mounting is made for use either on the arm of a vertical column or horizontal shaft bar, and the cone on which the shell rests will fit into any 5-in. Sergeant saddle or clamp. The sliding cone gives a quick adjustment when setting up and can be used to increase the length of feed whenever necessary. The length of the screw fed is fully 24 in. Adding to this the slide of the cone on the shell, which is over 19 in., it will be seen that a total travel of over 43 in. may be obtained whenever desired. The total weight of the mounting is 63 lb. Steel castings and drop forgings are employed throughout in its construction.

By Way of Correction

O. Henry has said something about persistent Fate standing in the wings and wildly pulling the wrong strings, which is, perhaps, as good a way as any to account for many otherwise unaccountable mistakes. An error in proofs led us a few weeks since to print the picture shown below under the caption 'Water Drill in a Michigan Copper Mine.' In fact, the illustration is of the 'DR-6,' one of the two new hammer-drills placed on the market last year by the Sullivan Machinery Co. Those familiar with the Michigan mines probably smiled at the looks of the formation illustrated. The DR-6 is one of the new type machines. It weighs but 145 lb., but is capable of drilling 12-ft. holes having a diameter of 1¼ in. Hollow steel is used and the hole is cleared by means of air and water under pressure. Both air and water admission are controlled by a single throttle valve. In its first position, air only is admitted to the drill steel; in the second, both air and water; and in the third, in addition air is admitted to valve and piston motion. In closing, the action is reversed, resulting in a jet of air being blown through the drill and steel last thing, and so cleaning it and preventing any access of water to the cylinder of the drill when pointing upward.

It is unnecessary to close the hose line when changing steel. The valve chest is in the rear head of the machine and not on the top or side of the cylinder; as a result drill steel may be changed without altering the position of the drill saddle.

SULLIVAN 'DR-6' HAMMER DRILL IN OPERATION.

The piston is rotated without separate rifle bar, there is an automatic lubricator in the back head, the piston is one piece, and in other particulars the drill combines the latest designing with the best of material. It has proved its qualities as a fast runner, easily cranked and maintaining true holes through fissured ground. The picture and this description are published through the courtesy of the Sullivan company.

The Fuller-Lehigh Pulverizer Mill

This crusher, pulley or gear-driven, fan-discharge type, is made by the Lehigh Car, Wheel & Axle Works, Fullerton, Pennsylvania, and the manufacturers claim the following characteristics for the machine: rigid construction, no inside journals or bearings, no inside lubrication, uniform feeding device, constant and free discharge, low installation cost, low operating cost, dustless operation, grinds to 200 mesh and finer, requires no outside accessory equipment, requires no overhead shafts or drives, all material in the mill is finished product, a single-stage reduction mill, uniform fineness of finished product, and a complete unit.

The material to be crushed is fed to the mill from an overhead bin by means of a feeder mounted on top of the mill. This feeder is driven direct from the mill shaft by means of a belt running on a pair of three-step cones, which permits the operator to accommodate the amount of feed entering the mill to the nature of the material being pulverized. In addition, the hopper of the feeder is provided with a slide, which permits the operator to increase or decrease the amount of material entering the feed hopper. The material leaving the feeder enters the pulverizing zone of the mill. The pulverizing element consists of four unattached steel balls which roll in a stationary, horizontal, concave-shaped grinding ring. The balls are propelled around the grinding ring by means of four pushers attached to four equidistant horizontal arms forming a portion of the yoke, which is keyed direct to the mill shaft. The material discharged by the feeder falls between the balls and the grinding ring in a uniform and continuous stream, and is reduced to the desired fineness in one operation. Fan discharge mills are fitted with two fans. One of these operates in the separating chamber immediately above the pulverizing zone, while the other works in the fan housing immediately below the pulverizing zone. The upper one lifts the fine particles of pulverized material from the grinding zone into the chamber above the grinding zone, where these fine particles are held in suspension. The lower fan acts as an exhauster, and draws the finely divided particles through the finishing screen which completely encircles the separating chamber. The material leaving the separating chamber is drawn into the lower fan housing, from which it is discharged through the discharge spout by means of the fanning action of the lower fan. All the material discharged from the mill is finished product and requires no subsequent screening. The current of air induced by the action of the lower or discharge fan passes over the pulverizing zone, and out through the screen surrounding the separating chamber, thus insuring cooler operation and maximum screening efficiency. This current of air keeps the screen perfectly clean and enables the mill to handle material containing a considerable amount of moisture without in any way affecting the

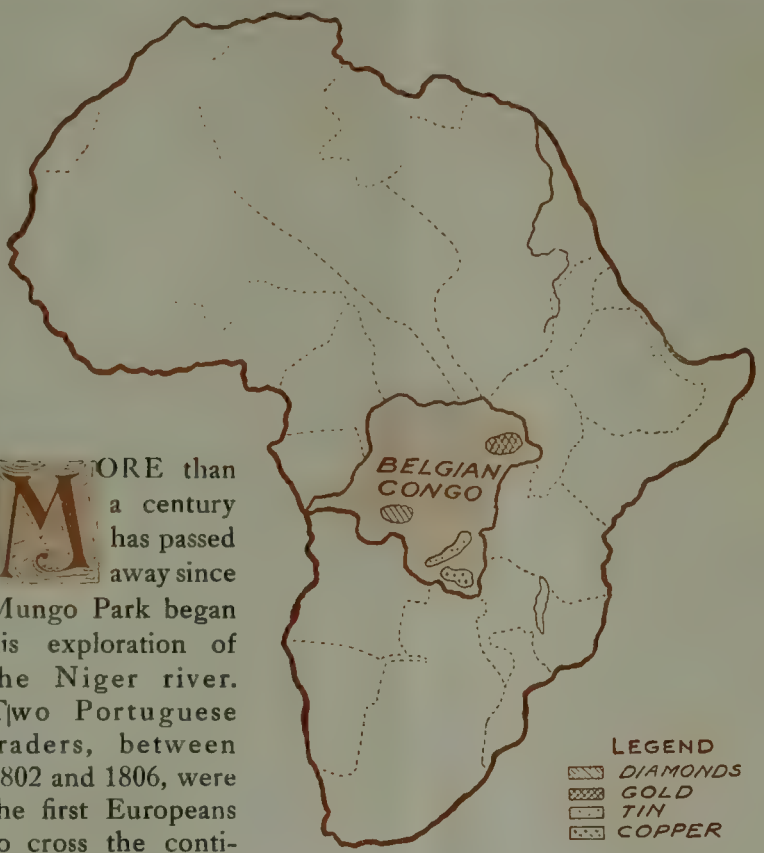
PART SECTION OF A FULLER-LEHIGH PULVERIZER MILL.

efficiency of the machine. When the mill is in operation, it is continually handling only a limited amount of material at any one time. As soon as the material is reduced to the desired fineness, it is lifted out of the pulverizing zone and discharged from the machine. It is therefore evident that, inasmuch as the crushing force is being applied to only a limited amount of material, the power required to operate the machine is reduced to a minimum and is furthermore applied directly to the material being pulverized.

The United States Steel Corporation and subsidiary companies have an extensive and highly educational exhibit at the Panama-Pacific Exposition. Among the subsidiaries are the National Tube Co., American Bridge Co., Universal Portland Cement Co., and Lorain Steel Co. The National Tube Co. is displaying samples of each phase of the welded tubular industry, including material which has been in service for a number of years, showing durability, resistance, and strength; samples of special types of joints; casing and boiler tubes which have been subjected to various tests; threading device; protective coated national pipe; 'Kewanee' products, including unions, brass, cast iron and malleable fittings, and a variety of other tube accessories and apparatus.

MINING PRESS

Volume 110 SAN FRANCISCO, MARCH 13, 1915 Number 11



MORE than a century has passed away since Mungo Park began his exploration of the Niger river. Two Portuguese traders, between 1802 and 1806, were the first Europeans to cross the continent of Africa. In 1816 the ill-fated expedition under Tuckey ascended the Congo for three hundred miles. Now the traveler may go by railway, in two and one-half days, to Lake Tanganyika, which Speke finally attained after years of effort, and only international rivalry serves to prevent the building of a railroad from the Cape of Good Hope to the Mediterranean. Africa, long the Dark Continent, is a treasure house of the future. In this issue Mr. Sydney Ball describes recent progress in Central Africa.

Lake Superior Copper Mining, Present and Future—IV. Page 398

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SAN FRANCISCO, MARCH 13, 1915

Buyers Directory, Page 28
Advertisers Index—Last Page

TABLE OF CONTENTS

EDITORIAL — Page.

Notes 395
Zinc Ore and Spelter Prices 396
Problems of Labor—III 397

ARTICLES

LAKE SUPERIOR COPPER MINING: PRESENT AND FUTURE—IV.
By Thomas T. Read 398

Geographical situation, climate, and transportation facilities are all favorable to continued successful work in the Lake Superior copper region. The labor question is a highly important factor in operating costs. Conditions are actually favorable to the working man; such discontent as exists seems traceable to a less general feeling of democracy, which prevails throughout the district, as compared to other parts of the United States. Much has already been done to insure the welfare of the workingman, and this factor is of enough importance to justify careful scientific study.

MINING IN THE BELGIAN CONGO IN 1914.
By S. H. Ball and M. K. Shaler 403

The war in Europe has had marked effects on operations in the African possessions of European countries. Railroad building has been delayed, some roads already constructed have been destroyed. Copper ore is being mined in the Katanga district with steam-shovels. Three blast-furnaces are in operation and four more will soon be blown in. Coke ovens are in operation, producing 2500 to 3000 tons per day; the cost of producing copper is estimated at 10c. per pound. Go'd production in the Belgian Congo has reached nearly a million dollars per year; diamonds are being produced in considerable amount; tin mining offers much promise, but is little developed as yet. Some changes in the system of taxation have been made.

ANCIENT RIVER CHANNEL MINING IN CALIFORNIA.
By J. D. Hubbard 407

California gold mines have produced nearly one-seventh of the world's stock of gold. Much of this has come from ancient river channels, buried beneath flows of lava. Many areas remained to be worked, and development is hindered by owners who hold claims without doing any work other than the nominal amount required by law. Working costs are in some cases extremely low. Development is showing good results in several districts.

PRACTICAL RULES FOR CUTTING MINE TIMBER.
By Bernard Carr 409

Instructions for beginners are often productive of helpful ideas to experienced hands in other districts. The methods employed in framing timber in a Pennsylvania coal mine are here clearly and simply described.

UNDERGROUND HAULAGE IN THE BUNKER HILL & SULLIVAN MINE. *By J. W. Gwinn* 410

Electric locomotives haul 45,000 tons of ore per month through adits three miles in length. Both direct and alternating currents are used to operate storage-battery locomotives.

CANADIAN MINING INSTITUTE MEETING 411

The seventh annual meeting, held at Toronto, was interesting and well attended in spite of the depressing effects of the war. The stimulation of prospecting was the theme of animated discussion, and many papers of interest were read. New officers were elected.

REGULATIONS GOVERNING PLACER WORKING IN WESTERN CANADA 412

New regulations covering the location and working of placers in Saskatchewan, Alberta, Manitoba, and the North West Territories have recently been issued.

DEPARTMENTS

DISCUSSION:

Who Will Engineer the Engineers?
By KCN Engineer 413

One who has given the subject thought suggests that a committee of the American Institute of Mining Engineers be appointed to consider this problem.

Rhythmic Precipitation of Colloidal Ores.
By E. A. H. Tays 413

An observer in the field thinks that metasomatic replacement is of more importance than is generally assigned to it.

CONCENTRATES 415

REVIEW OF MINING: Special correspondence from Joplin, Missouri; Platteville, Wisconsin; Rochester, Nevada; New York 415

THE MINING SUMMARY 419

PERSONAL 423

SCHOOLS AND SOCIETIES 423

THE MARKET PLACE:

Metal Prices 424

COMPANY REPORTS 425

Tough-Oakes Gold Mines, Ltd.; Premier (Transvaal) Diamond Mining Co., Ltd.; Portland Gold Mining Co.; Nevada Hills Mining Co.; The Exploration Co., Ltd.

MINING DECISIONS 426

RECENT PUBLICATIONS 426

NEW MACHINES AND DEVICES:

Miners' Electric Lamp 427
A Compact First-Aid Kit 427
Use of Electric Furnaces 428
Commercial Paragraphs 428

EDITORIAL

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SCIENTIFIC study of the smelter-fume problem in the Salt Lake district is to be carried on under the joint auspices of the Bureau of Mines and the University of Utah, if a bill appropriating the necessary funds, which recently passed in the Utah State Senate, is finally approved, as is to be hoped.

MINE operators not members of the California Metal Producers Association should get in touch. The Association is not only making important savings for its members through co-operative buying of insurance and supplies, but is watching matters at Sacramento with a view to safeguarding against badly conceived and ill-informed legislation. This is work in which each should bear his part of the burden.

COPPER production in Germany during 1913 amounted to 90,400,000 pounds, while consumption aggregated 570,450,000 pounds, of which 87.5 per cent was imported from the United States, according to the statistics compiled by the Metallbank und Metallurgische Gesellschaft, of Frankfort, just issued. Austria's production in 1913 was 9,090,000 pounds and consumption 76,240,000 pounds, according to the same authority.

THE retirement of Mr. Charles A. Coffin from the presidency of the General Electric Company, which he has so long held, and the accession of Mr. E. Wilbur Rice, Jr., to that office was signalized last November by the presentation to those gentlemen of illuminated testimonials, executed at the Corpus Christi Monastery, at the instance of the Association of Edison Illuminating Companies. Through the courtesy of the General Electric Company, three-color reproductions of these have been sent to the many friends of those gentlemen. It is interesting to see that modern work in the illumination of manuscripts compares favorably with the best work of the middle ages.

READERS of the series of articles describing present conditions in the copper mining district of Lake Superior, which is concluded in this issue, can scarcely escape the conclusion that, far from being on the decline, this so well and favorably known district has just entered a new stage of its development; one which may lack some of the romance of earlier ventures, and which will certainly afford a less margin of profit on the amount of capital involved, but will be a larger and more important factor in the industrial life of its state and the nation as a whole. Mining is commonly regarded as a somewhat precarious industry, but the Michigan operators are making notable strides in stabilizing it.

CONGRESS has finally appropriated the money, $1,500,000, necessary for construction of the badly needed building at Washington for housing the United States Geological Survey, the Reclamation Service, and the Bureau of Mines. Although the building was authorized some time since, the money had never been made available. At the same time, $350,000 was appropriated for Bureau of Mines buildings at Pittsburgh with $57,000 for meeting the expense of removal. Other but minor increases were made in the funds allotted to the Geological Survey and the Bureau of Mines, which is all the more notable in that this year Congress was in little mood to increase the regular appropriations. Evidently the work of these great technical bureaus commends itself to the leaders in Congress, even if an occasional wind-producing statesman does seek transient fame by attacking them.

A LOCAL metallurgical society is to be established at Montreal, Mr. Alfred Stansfield, professor of metallurgy in McGill University, having taken the initiative, and some seventy metallurgists are supporting the movement. The amount of interest exhibited indicates a real need for such an organization, and it may be unhesitatingly said that any move that tends to bring about better acquaintance and closer co-operation among members of the mining profession is to be commended. But this is the age of centralization, and the founders of the new organization could not do better than make it a local branch of the Canadian Mining Institute, which already has thriving branches at Cobalt and in the Rocky Mountain region. Active and prosperous local branches are the best possible support for a national organization, and every means for furthering the excellent work already done by the Canadian Mining Institute should be heartily seconded by our colleagues across the boundary line, which delimits political divisions but happily does not divide professional interests. Elsewhere in this issue we present an account of the annual meeting of the Institute, held at Toronto last week, and of the keen interest exhibited in the proceedings in spite of the depressing influence of the war.

ZINC ORE AND SPELTER PRICES

Joplin producers have been protesting that they are not receiving their due share of the increase in the price of zinc. Specifically it is pointed out that in the same week that spelter rose in value $20 per ton, the price of ore fell $2. To the Joplin producer this seems impossible of explanation on any fair basis, though the matter is really very simple. The normal basis price for blende at Joplin of recent years has been about $40 to $41 per ton. Ore was selling at this price last October. It has since risen to $75, the highest price it has ever touched, and producers protest that on the old ratio of eight to one, it should sell at $80. There is some question as to how much metal, of 'Prime Western' grade, has been sold for 10 cents per pound. Our own average for the week ending March 3 was 9.05, but in times when the market is as uncertain and as excited as at present, it is not easy to get a true average quotation. It might well be supposed that an increase in price from $40 to $75 would be sufficiently satisfactory in itself. However, that is not a sufficient reason for a price of ore lower than the market really warrants, and the real problem is, what is a fair price for ore?

The difficulty lies in the fact that the metal market and the ore market are not the same. It takes a certain time to reduce the metal in the ore and to get it to the market. This period varies somewhat, but 60 days may perhaps be taken as a fair average. In buying ore, therefore, the smelter really pays what he judges the price of metal will be two months later. On the other hand, the quotation for metal is, unless otherwise stated, for spot delivery. It happens just now that the smelters do not believe the price of spelter will stay up long enough for them to treat the ore and get the metal to the market. Therefore they refuse to buy ore on the basis of the spot price of spelter.

The present high price for spelter is due to the withdrawal from the markets of the neutrals and the Allies of the metal made in Belgium, Germany, and Poland. A number of smelting plants have been put out of commission, and others can not ship to their customary markets. The big ore-producing districts, however, are not disturbed. The smelters that delivered to the markets now clamoring for metal, drew their supplies, in the main, from districts untouched by the war. In fact, the world has a surplus of zinc ore available and a shortage of metal. American zinc smelters happen also to have an excess smelting capacity, though not all of it is available to treat the foreign ores now cut off from their normal markets. It is, however, merely a matter of time until Australian ore comes to be smelted in the United States. How extensive the new trade will be, and how permanent, can not be foretold, but it is likely that it will be neither so extensive as feared at Joplin nor so permanent as hoped by the smelting companies. The big Broken Hill companies have been operating since the war began on about a 40 per cent basis, and that has only been possible because credits have been extended to them for storing concentrates. Since August negotiations have been under way for shipment of Australian ore to America, and as early as February 4 it was announced at Sydney that the Broken Hill Proprietary, Ltd., had contracted for delivery of 40,000 tons of concentrate to American works. Another company, having an annual output about equal to that of the Butte & Superior, has a representative in the United States now, negotiating contracts for sale of ore. Still a third big company at Broken Hill happens to have one of its directors in the United States and is carefully considering the possibilities of the situation. Negotiations are also under way for shipment here of ore from other foreign countries that previously delivered to German furnaces. Evidently the smelting companies believe this ore will be available before their own bins are empty, and they should be in a position to know. Certainly the present prices for ore can not hold, and no one would be justified in stocking up just now. The foreign ore seems certain to come to America, and at the present high prices, or even at prices materially lower, it can compete effectively. At $40 per ton for Joplin ore, Australian concentrates have been sold to better advantage abroad, though even here there is possibly a question. In 1911, in examining the possibilities of marketing zinc ore from California, it was found that better returns could be obtained in the Mississippi Valley, with a freight rate of $10 per ton, than from European smelters even on the basis of a possible rate of $3 per ton to Antwerp. Actually the freight rate to Europe even then was more, and now is much higher. It is a question whether the smelters in the United States have not been too ready to assume that they could not compete on an equal basis with those in Europe, and if the instance quoted be any guide, American ore producers have certainly received better prices from zinc smelters than Australians have from those in Europe. So good an authority as Mr. Ferdinand Heberlein has stated that American zinc-smelting costs are lower than in Germany, and it is entirely possible that the United States may become, just as in the case of copper, an important smelter of foreign ores.

This is not likely, in our judgment, to depress prices at Joplin seriously, either now or later. There will always be the matter of freight rates to consider, and the quality of Joplin ore is such as to give it an advantage. The smaller plant necessary to produce a given quantity of spelter working on Joplin ore, the docility of the ore itself, the free market for purchase, and the possibility of maintaining a steady supply of uniform grade, will always work to the advantage of the Joplin producer. In addition, there are just now the further advantages that few American zinc smelters have either the plant or the experience necessary for most economical handling of Broken Hill ore.

The high price of both spelter and ore is temporary, and experience indicates that it will bring in its wake a period of depression and loss, but, taking the long time view, we are optimists as to zinc. The world's con-

sumption is now about 1,000,000 metric tons per year. Ten years ago it was 600,000, but the curve tends steadily to become steeper, in other words, the world is finding new uses for the metal. Estimating on the basis of past increase in demand, the present production must increase from 60 to 100 per cent in the next ten years. It does not seem probable that this will take place, but even a much smaller increase will make heavy demands upon known sources of supply. Zinc is one of the metals the ores of which are frequently not recognized, so that discovery of new districts is probable, in addition to which there is the fact that higher prices and improved technology will bring into the market material now of too low grade to be worked. All in all, zinc producers have every reason for being cheerful.

PROBLEMS OF LABOR—III

From time to time we have reproduced in our columns expressions of opinions on labor problems to show the trend of contemporary thought. Elsewhere in this issue, Mr. Thomas T. Read, in concluding his series of articles reviewing present conditions in the Lake Superior copper mining district, discusses some aspects of the labor problem which seemed to him of importance in that district. As our readers know, the Federal Commission on Industrial Unrest has held sessions throughout this country in an endeavor to draw out the best contemporary thought on the many and perplexing problems concerning employees to which our complex social organization has given rise. Next week we hope to be able to find space for a list of the causes of industrial discontent that have been brought to the Commission's attention. Meanwhile, the following summary from the report of the Commission is worth reproducing:

"Great as is the task of studying the problems reviewed in this report, they do not exhaust the duties which we feel have been placed upon us, for underlying all industrial unrest and discontent there are fundamental causes, which, if ignored in any recommendations which we submit, would make our proposals useless and hopeless. Statesmen, economists, sociologists, employers, and workers have been concerned with certain of these underlying causes ever since the industrial reorganization brought us more or less permanently employing and wage-earning classes.

"The experience of these men and women, and their theories as well as the facts, must be studied in order to gain an adequate conception of the causes and effects of such fundamental phenomena of modern economic life, as the changing distribution of wealth, the world-wide rise in prices and the cost of living, the movement of population from rural to urban centres, the ever-increasing invention of labor-saving machinery, the discovery of new industrial processes, the almost rhythmical recurrence of prosperity and depression, the development of great industrial and financial corporations, and the increasing influence of the working class.

"What is the meaning of the organized array of employers and workers? Is it a temporary phenomenon, an accidental growth, or does it have its roots in the needs of modern economic life? Must we foster the growth of such organizations in order to insure equal protection of the law, a just distribution of the product of industry, improved American standards of living, and an equitable division of the benefits and the burdens of government and taxation?

"Or must we, as some suggest, look to the gradual decline of these organizations and to the development of new agencies for maintaining peace and friendly relations between employers and employees, and justice and prosperity to all classes of our people? Again, do these unions and employers' associations mean a constant and ever growing industrial war? Are we to have increasing class conflicts, or is the organization of labor and capital to be our armament for insuring industrial peace?"

In considering the weighty problems set forth above it is well to keep always in mind that discontent does not argue perversity. There are those, indeed, who believe that discontent with things as they are is the first essential to mental and spiritual growth, as the phrase 'divine discontent' connotes. To our way of thinking, the problems here presented are only one phase of the struggle for personal liberty in which all mankind has been engaged for centuries. It is easy and simple to secure complete personal liberty, all that is necessary is for men to live alone and completely out of contact with fellow human beings. But none of us are willing to secure personal liberty in that way, for we desire the many and great advantages which can be derived from living together. The whole tendency of modern civilization is toward closer association and greater dependence upon each other. And when one man depends upon another the liberty of the one at once comes into conflict with the other. The personal liberty of a locomotive engineer may impel him to go fishing instead of going to work on a spring day, but if he does not show up at the roundhouse to take his train out on time, hundreds of people may be prevented from reaching their offices on time and perhaps may lose a good deal in their business. An employer's personal liberty would cause him to shut down his plant and dismiss his force just as soon as his business fails to show a profit, but he has to consider the effect such an action would have on those who are dependent on him. The vital problem, therefore, is to secure the fullest possible measure of liberty for each without unduly restricting the liberty of others. This will never be completely attained, for each new development of civilization introduces fresh problems of adjustment. We believe that most men are disposed to be kind and considerate so far as they can be without injury to their own interests. We cannot subscribe to that biological theory of civilization which assumes that the weak are necessarily the victims of the strong, and are confident that the theory which asserts that the best interests of any individual can only be attained through fair dealing with others is the one that will ultimately prevail.

Lake Superior Copper Mining: Present and Future—IV

By THOMAS T. READ

In the preceding articles* of this series I have briefly considered how the character of the Michigan copper deposits, the methods of exploration and mining now employed, and present tendencies in milling and metallurgical practice are likely to affect the rate of evolution of that district into one of large-scale, low-cost copper production. It now remains to conclude the analysis by an equally brief discussion of the general working conditions obtaining in the district.

General Conditions

The geographical position of the district deserves at least a moment's consideration. Lying at about 47° north latitude, it is, compared to European latitudes, much farther south than Paris, but its position in the land mass of the North American continent gives to it a more rigorous and variable climate. Its isothermal in winter passes through Norway and Sweden, and in summer through Northern Africa. The region is one of heavy snowfall, and its annual rainfall is 30 to 40 inches per year, or much the same as that of Wisconsin, Illinois, Iowa, and eastern Kansas. The significance of these remarks may not be evident, but it must not be forgotten that an industrial region needs an abundant food supply. The climate just indicated is not especially well adapted for that. Cattle-growing can only be successfully practised in such a region when human labor is abundant and cheap in order to put up hay and feed the cattle during the winter, and labor is not now nor ever likely to be abundant and cheap in this region. The growing season is too short for such crops as corn to reach maturity, but potatoes, other vegetables, and many fruits do well. A hundred years ago the region was thickly covered with conifers and hardwood forest trees. Most of this forest has now been cut, but comparatively little progress has yet been made toward clearing away the undergrowth and draining the land to fit it for agriculture, and beyond a few Finns almost none of the settlers in the region have directed their energies toward tilling the ground. There can be little doubt that almost the whole region would yield abundantly if planted to suitable crops. The situation is one of simple economics, and as long as immigrants to the region can find work which yields them more immediate and greater returns, agriculture is not likely to flourish. The continued prosperity of the mining industry of the region depends in large measure upon an abundant supply of labor at a reasonable wage, and this supply in turn depends on an abundant supply of food at a reasonable cost. It would seem the part of wisdom for the local commercial organizations, such as the Copper Country Commercial Club, to devote much attention toward encouraging agriculture in this region as the best means of protecting themselves against the increasing cost of food, which has been characteristic of the whole United States during recent years.

Another unfavorable feature of the economic situation is the fact that mining and its allied industries furnish almost the only means of livelihood in the district. The best class of employees are men with families, but such men are at a disadvantage in a district where such a condition exists. A rate of wage which furnishes an ample income for a single man is quite a different matter to the man who has a family of six or eight to support. In most industrial regions the greater needs of the large families are met by the contributions which the boys and unmarried girls are able to make toward the family income. The children of such families usually finish their schooling by the age of fourteen and contribute to the family income for several years before marrying and setting up family groups of their own. The laws of the state of Michigan forbid the employment of boys under eighteen in mining and smelting industries, while there is practically no employment open to girls of any age, other than domestic service. Unless the situation can be met, the class of labor available in the district will inevitably tend to deteriorate through the moving away of the better class of families to regions where the youthful members of the family can find employment and help to maintain a high standard of living; and with this deterioration will come labor troubles, from which the district was remarkably free until the outbreak of 1913. It would seem well worth while, therefore, to encourage the development of industries that afford employment for boys and young women.

The fresh, clear, and cold waters of Lake Michigan furnish an abundant water supply for the region. While the rainfall is ample, the 'hummock and basin' topography characteristic of a glaciated region is not favorable to the development of water-power. This is not of great importance, since the comparatively low cost at which coal can be laid down in the district permits the generation of steam and electric power at reasonable rates. Lumber is increasing in cost each year, as the forests of northern Michigan have largely been cut; but, as indicated in the preceding articles, comparatively little timber is used in mining, and it is only as it affects the cost of building construction that this feature is of much importance. Portland cement can be laid down in the district at a reasonable cost, and mining and milling operations furnish an abundant supply of rock and sand, so that the increased use of concrete is likely to counteract any tendency toward increase in construction costs, other than that resulting from the constantly rising cost of labor. And, as I have endeav-

*December 5, 1914, p. 871; February 6, 1915, p. 209; February 20, p. 284.

ored to emphasize throughout, the chief aim of progress in this district must be the reducing of the necessity for labor to a minimum.

Transportation facilities are excellent throughout the district. The Chicago, Milwaukee & St. Paul, the Northwestern, and the Duluth, South Shore & Atlantic railroads run trains into the district, while the Copper Range railroad maintains an excellent local service over its lines. The Calumet & Hecla, Quincy, and other mining companies operate their own railroads to connect mines, mills, and smelters, and the convenience of passengers is served by the trolley line connecting Calumet and Houghton. North of Calumet the Keeweenaw Central railroad maintains a desultory service to the formerly prosperous communities of the northern end of the peninsula. The roads are generally good, automobiles are abundant, and can be operated during eight months of the year. During the months in which navigation on the Great Lakes is open, the Pennsylvania railroad maintains an excellent steamer service between Buffalo and Duluth, stopping at Houghton in both directions, while cargo boats are frequent. Rates for incom-

QUINCY SHAFT-HOUSE No. 6.

ing freight are especially low, as the boats which carry iron ore to the Lake Erie ports are generally obliged to return empty, and are consequently willing to carry freight for little more than the cost of putting it into and taking it out of the boat. This makes the cost of fuel very low and also insures that supplies of all kinds will always be available at prices not much above the Chicago, Cleveland, or Buffalo level. Without going further into detail, the generalization may be made that in cost of supplies, transportation, and other material things the district is at least on a par and generally at an advantage as compared to most mining districts. Nor does there seem any reason to expect any change in this regard; the district will doubtless maintain its favorable position. The problem of decrease in operating costs, outlined in the preceding articles, will not therefore be complicated by changes in the relative position as compared to other districts. Labor cost and its probable effect on operating cost is more of a problem, which merits discussion at some length.

It has been emphasized in the preceding articles that present and future progress in this district must tend toward operations on a larger scale and at a lower cost. The cost of labor is quite certain to increase continually; therefore the only way to lessen the labor-cost factor in operating costs is to decrease the amount of labor required. This may be done in two ways: by replacing manual labor by machinery wherever possible, and by rendering the labor more efficient. Some of the ways in which this is being done have already been indicated. In general, the much-discussed 'efficiency'

QUINCY SHAFT-HOUSE No. 2.

methods of the day can be here applied to good advantage. But the labor problems of today are not a mere matter of motion study, hours of labor, and rates of pay; they are vastly more complex. In order to bring out the points I desire to make, it will be necessary to diverge somewhat, and discuss the question in a wider aspect. During the more than half century in which mining has been carried on in this district there has been almost no trouble between employees and employers. In the summer of 1913 a general strike of the mine workers of the district was called by the Western Federation of Miners, and in the succeeding months the violence displayed by the striking workmen in their attempt to prevent the operations of the mines reached

OSCEOLA SHAFT-HOUSE No. 5.

such a pitch that the governor of Michigan was obliged to call out the militia. This and a skillful publicity campaign by organized labor forces made the strike a focus of national interest. It was discussed extensively in the public press, the Department of Labor at Washington attempted to intervene on behalf of the strikers, without regard to whether such intervention was really justified, and a committee of Congress seized the oppor-

tunity for a display of 'grandstand' politics by conducting an investigation that was productive of no important result. The general features of the strike are too well known to mining men to need discussion. It was fomented by the Western Federation of Miners in an endeavor to regain the ground it had lost by defeat in the Utah Copper-Nevada Consolidated strike and the Homestake strike, and it was lost because public opinion justified the refusal of the operators to have any dealings with an organization of the character of the Western Federation. Some of the 'demands' of the strikers were for changes which the companies were glad to make; such as the eight-hour shift, by which the companies secure a full working day on Saturday instead of the former half day in which little real work was done. The protest of the strikers against the introduction of the light drill had so little justification in common sense that it could not be maintained. When the strike was called off, both operators and miners had gained something by the shake-up, which permitted a readjustment of conditions, and both had, of course, lost heavily during the period of the strike. There has been enough discussion of the rights and wrongs of both sides, much of it prejudiced in favor of the employees; it is not my purpose to add to it here, but to try rather, so far as possible, to examine into the fundamental forces involved, ignoring details.

When a fire breaks out in a warehouse it is usually because inflammable materials have been left lying about that, either from spontaneous combustion or through bringing fire in contact with them, have been set alight. In this case there was no spontaneous combustion—it was a case of arson in which the Western Federation of Miners was the incendiary. What concerns us in this review of the district is that the inflammable material was lying about. In other words, it seems clear that no such violent outbreak could possibly have been produced unless discontent had already been at least latent in the district. What grounds for discontent were there? The miners worked only 45 hours per week, as compared with the much longer hours of labor in other mining districts. The wages of miners averaged $3.20 per shift and of trammers $2.63 per shift, according to the report made by the committee of the Copper Country Commercial Club, which undertook thoroughly to study the existing conditions. Houses can be rented for $1 per room per month, usually with free water service; lots 50 by 100 ft. can in some cases be rented for as little as $1 per year, and average $5 per year ground rent in case the miner wishes to build his own house. The cost of food is only 75% of the cost at Butte, Montana, according to the same report, and the committee estimated that an average miner's family in Butte would require $23 per month more income in order to be on a par with the same family in this district, or more than the average wage difference between the two places. The Calumet & Hecla, which with its subsidiaries, employs nearly one-half the men of the district, has for years maintained an employees' aid fund, and when the Michigan workmen's compensation law went into effect in 1912 the Company was thereby required to do less than it had previously done voluntarily. Employees of the Calumet & Hecla who are over 60 years of age and have been in its employ over 20 years are retired on a pension. Employees of the Company pay 8c. per kilowatt-hour for electricity, as compared with a rate of 12c. charged the general public by the private company which supplies the town. Free pasture is given each employee for one cow, free fuel is supplied needy persons. A public library is maintained by the Company, also a bath-house which is practically free, as the fee charged merely covers the cost of washing the towels. The Calumet & Hecla built and equipped an armory for the state militia, has built and equipped ten schoolhouses, a high school, and a normal training school, and rents these to the state or county on the basis of 3% of the cost. The Company gave a free site for the Y. M. C. A. building, free sites for several churches, and has given them over $35,000 in cash. The Company has organized a band and also a baseball team, the members of which receive their regular wages for the time spent in playing. I might extend the list further, but enough has been said to indicate what the general tone of the district has been; for the other companies have followed the lead of the Calumet & Hecla, so far as their means have permitted. The practice of the Calumet & Hecla has been so far from treating its employees unjustly that, as a matter of fact, the efficiency of that organization apparently suffers a good deal because it has never been the policy of the company to weed out old employees who are no longer efficient workers. The records of the Company show that 111 of its present employees entered its employ over 40 years ago, and some 400 have been working for it over 30 years. These are not mere pensioners, but men who are carried on the payrolls at the highest rate of wage or salary they have attained, and who retain their full degree of authority. Although they do not generally realize it, old employees are usually the greatest obstacles to efficient work in an industrial organization, and if the management of the Calumet & Hecla had really exhibited any of the disregard of the rights of the laboring man which has been so commonly attributed to it, it would long ago have replaced its old employees by younger and more active men.

Why should employees in a district where such conditions prevail be discontented? My personal opinion as to the explanation can easiest be made clear by an allegory. There were once two brothers; one was ambitious, worked his way through law school, went to the city, and was fortunate enough to become counsel for a new enterprise that in the course of a few years developed into a $60,000,000 corporation that paid him a salary of $50,000 per year. The other brother, having less initiative and less aptitude for study, remained on the home farm and at the end of the same period was working as hard as ever for a bare living. The lawyer, out of the goodness of his heart, made liberal presents to his brother at holiday time, paid the cost of his children's schooling, and gave to him all the dis-

carded clothing which was not smart enough for his own wear, but amply good enough for the more modest needs of his brother. From time to time the farmer visited his brother and was received with great cordiality, but could not fail to notice that during the period of his stay none of the members of the smart set to which his brother belonged were invited to the house; also that when his brother took him to some of his expensive clubs he spoke to many acquaintances but did not introduce the farmer to any. The farmer found indeed that he and his brother were no longer very congenial companions, he had little familiarity with and interest in the things which filled his brother's life, and the same was apparently true of his brother. It might be supposed that he was filled to overflowing with gratitude to his brother for all that he gave him, but strange-

C. & H. REGRINDING MILL No. 2.

ly enough that was not the case. He took the things that were sent him with no thought but that they were little enough for one to give who had so much, and he hated his brother because he believed his brother did not think him 'good enough' to mingle with his friends. In short, he resented the apparent inequality between them; and his brother's generosity, instead of creating good feeling between them, only increased the resentment because it was tangible evidence of the inequality.

During recent years various individuals and organizations have instituted more or less profound investigations into the fundamental causes of labor unrest, usually with the net result of the official recording of a great variety of discrepant testimony, so overwhelming in amount and bewildering in variety that no general conclusions can be drawn from it except that nearly everyone seems to be dissatisfied with things as they are. Without any such profound basis to go upon, I dare venture my opinion that such a condition as in the allegory is *a* fundamental cause, if not *the* fundamental cause of discontent among laboring men. Various people attribute such discontent to the inequality of the wages paid to the employee and the profits made by the employer. I do not believe this has anything like the importance commonly attached to it. The laboring man is no fool and is keen to recognize that wages should vary in proportion to the responsibility involved; the laborer at $3 per day has no objection to his foreman being paid $5 per day. Nor does the employee of, say, a subway contractor object to his employer making $25,000 on a contract in a year, because he can himself see how his employer, with less skillful management or a little bad luck, might have lost money, instead of

OSCEOLA-CENTENNIAL MILL.

making it. It is only when operations become more involved, when a large corporation is the employer, that these personal relations become obscured, and the laborer begins to think he is being injured by being paid only $3 per day while the corporation is paying large dividends to stockholders who never give a moment's attention to the work from whence their profits are derived.

ELECTROLYTIC REFINERY AT HUBBELL.

There is no real injury involved, just as the farmer in our allegory was not injured but rather benefited by his brother toward whom he felt a sense of injury and resentment. The real trouble is the apparent lack of equality. The farmer knew that his lawyer brother was his equal, they used to sleep in the same bed, and the laborer knows that the directors and the stockholders are his equals, for does not the Declaration of Independence say that it is a self-evident truth that all men are created equal? The farmer resented the fact that he was not welcome in the society in which his brother moved; the laborer resents the fact that the director of the company for which he works belongs to exclusive

clubs of which he could not pass the doors, and dines at expensive hotels where he would not be served because he does not wear the proper kind of a coat. A great many other conditions are involved in the present complex relations between employer and employee, and it is hard to determine which are of real importance and which only superficial. But I am firmly of the belief that the present social unrest is primarily due to the fact that men who believe that they are, and of right ought to be, the equals of other men, see that they are not equal and are without the means of establishing their equality. There are thinkers who hold the view that men are not and never can be equal, but with the further discussion of the topic we have nothing more to do here, having developed the point that the ideals of democracy generally held in this country are a source of discontent; because present conditions are so far from attaining these ideals.

The forces indicated act with more than ordinary power in the Lake Superior district, I believe, for at the end of a recent visit of a month to this region, I came away with the feeling that life there, in spite of its many and obvious advantages, was less democratic than in any other district of the western United States. The general tone of a district can often be traced to some strong personality; just as the personality of Queen Victoria imparted to the national life of England much of her qualities. No doubt the life of this region still retains much of the influence of the personality of Alexander Agassiz. That remarkably brilliant man gave much personal attention to the direction of the Calumet & Hecla, which exerts a dominant influence in the district. I, of course, never knew Alexander Agassiz, but I am told that he was a natural born aristocrat, and certainly the great number of honors and decorations which were conferred on him must have tended to make him less democratic in his viewpoint. If so, his spirit still lives. One day I happened to pass by one of the shafts just as the men came up at the end of the day shift. The shift boss stopped to speak with the topman and stood leaning on the bar which is used to close the doorway of the shaft-house, gazing out over the landscape, as I passed by. In a somewhat extended experience with hotel clerks and other supercilious persons, I have never seen a more marked expression of haughty disdain than the countenance of that shift boss bore. The incident may seem a trivial one, and yet it is generally through trivial remarks and actions that underlying impulses and beliefs are revealed. I do not mean to intimate that the people of the district are conscious of a lack of democracy: most people do not know what is the matter with them or their daily life any more than an ill person knows what ails him; they merely know they are dissatisfied, and even if they recognize certain symptoms, they rarely perceive the cause of them. Without claiming any profound knowledge or insight, I venture to state my belief that the cause of the unrest in this district, where conditions are in many respects so favorable, is a lack of real democracy, which had its beginnings in the relations of master and man, and has spread through the life of the whole community.

If the foregoing is true, then it may be expected that the discontent in the district will become greater as time goes on, unless something is done to diminish it. Two means of meeting this situation are possible. One is to gradually replace the present workers of the district with fresh arrivals from Europe and men who have gained their experience along the Atlantic seaboard where conditions are generally less democratic than west of the Alleghanies. Such a method is like robbing Peter to pay Paul. Men of this character are less efficient and more apt to become the disciples of professional agitators. Indeed, in many respects the labor situation in New York and the nearby industrial cities presents more critical problems than anywhere else in this country. Such a course of action would lead out of the frying pan into the fire. The other method, and the only one that will produce permanently satisfactory results, is to endeavor to remold the life of the community along more democratic lines. How this should be done only one versed in such problems could say. In my opinion the problem is one that is of enough importance in its potential effect on future operations to warrant its receiving the same kind of expert study which is being devoted to the perfecting of mining and metallurgical operations.

One even more elusive factor remains to be considered, namely politics. Legislation in the United States is the outgrowth of politics, and politics in this country, unfortunately, does not engage the energies of the best type of citizen. Much of the legislation that is initiated is either unnecessary or unwise, some of it is actually harmful. Whenever legislatures are in session no industrial organization is safe from the possibility of laws which hamper its operation without producing a corresponding amount of benefit to the state. As an example of such legislation, the proposal to tax the ore reserves of the mines in Michigan may be cited. The true benefit of the state lies in having the mines operated in such a way that their operations will be as stable as possible, and therefore afford employment to as large a body of citizens as possible. When the question of raising additional revenue through taxation arises, such fundamental factors as this should be given due consideration, so that mining properties shall not bear an undue proportion of the burden. Fortunately the mines in the region are not threatened at any vital point, such as the campaign against smelter fume which has proved so troublesome to mining operations in some western states. So far as can be foreseen, politics does not seem likely to be, in a large way, an important factor in the economic future of the district. The general subject of politics in relation to mining operations is too indefinite, however. I cannot close without expressing my indebtedness to the engineers of the district who afforded me many courtesies and facilities, but especially to Messrs. James MacNaughton, Charles L. Lawton, F. W. Denton, and the members of their staffs, and to my friend, Mr. Alton L. Dickerman.

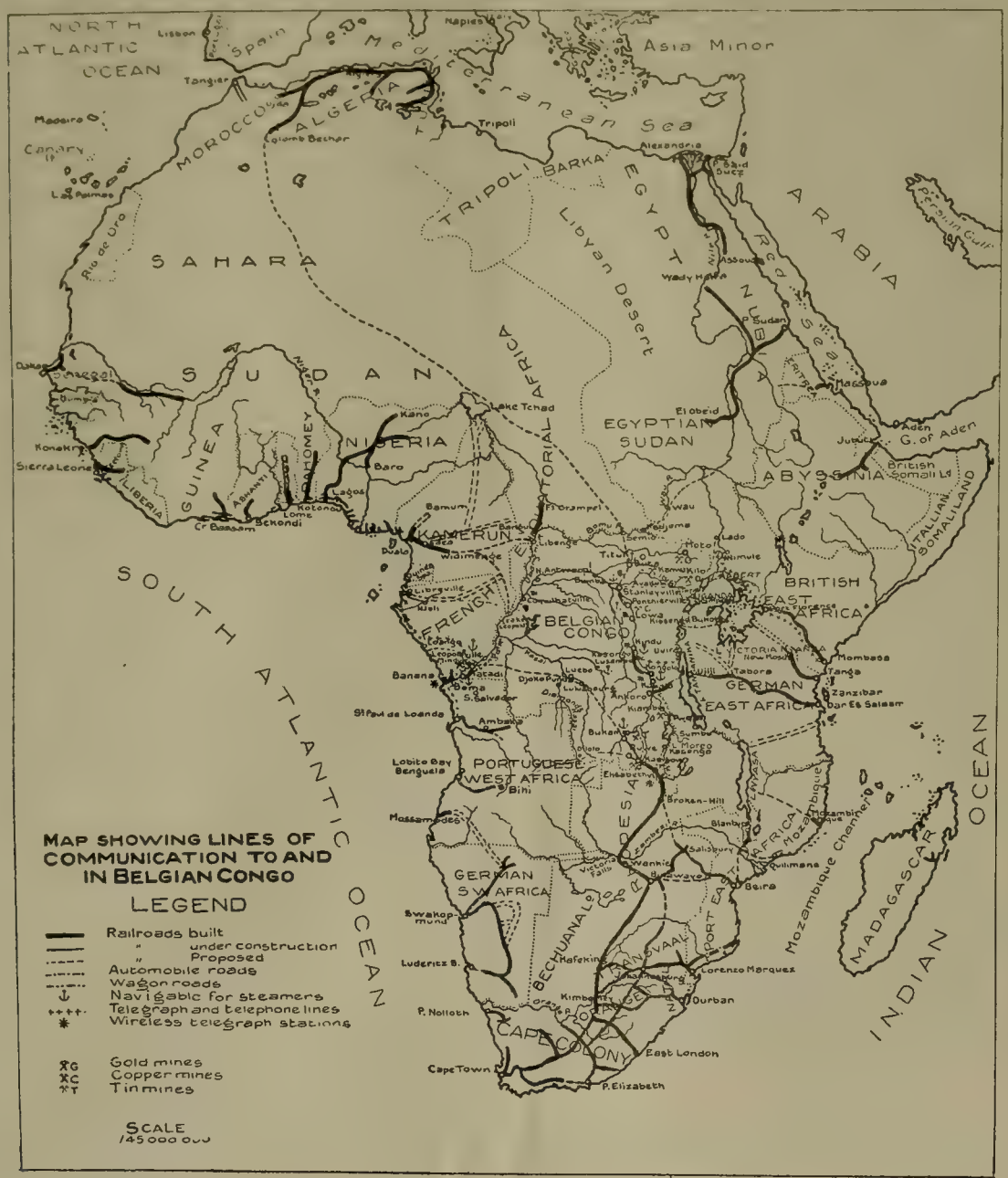
Mining in the Belgian Congo in 1914

By S. H. BALL and M. K. SHALER

*Notwithstanding the unfortunate condition of the mother country, the mineral production of the Belgian Congo appears to have increased, the gross production for 1914 being about $3,850,000, as opposed to that of some $3,000,000 in 1913. This results from enlarged productions of copper in Katanga and diamonds in the Kasai region, and a slight increase in the gold output.

One of the remarkable features of the war is the world-wide character of the fighting. Upon news of the outbreak of war in August, Belgian Congo troops using a converted 'cruiser,' the river boat *Luxemburg*, began

*In addition to previous reviews in this journal, see 'Mineral Resources of the Belgian Congo,' by S. H. Ball and M. K. Shaler, *The Mining Magazine*, July 1914, and 'Economic Geology of the Belgian Congo,' by S. H. Ball and M. K. Shaler, *Economic Geology*, October 1914.


NORTH ATLANTIC OCEAN
Asia Minor
Mediterranean Sea
SAHARA
ARABIA
Red Sea
SUDAN
NIGERIA
EGYPTIAN SUDAN
ABYSSINIA
BRITISH EAST AFRICA
GERMAN EAST AFRICA
BELGIAN CONGO
FRENCH EQUATORIAL AFRICA
CAMEROON
PORTUGUESE WEST AFRICA
GERMAN S.W. AFRICA
BECHUANALAND
CAPE COLONY
SOUTH ATLANTIC OCEAN
INDIAN OCEAN
MADAGASCAR
Mozambique Channel
Libyan Desert
Lisbon
Tangier
Tripoli
Alexandria
Naples
Khartoum
Kano
Lake Tchad
Lagos
Elobeid
Aden
G. of Aden
Nairobi
Mombasa
Zanzibar
Dar Es Salaam
Beira
Lourenco Marquez
Durban
East London
Cape Town
P. Elizabeth
Luderitz B.
Swakopmund
Walvis B.
Broken Hill
Salisbury
Bulawayo
Johannesburg
Pretoria
Kimberley
Loanda
Benguela
Lobito Bay
Bihe
Bonga
Banana
Matadi
Leopoldville
Stanleyville
Coquilhatville
Bukama
Elisabethville
Kasenga
Albertville
Kisenyi
Mahagi
Lado
Juba
Wau
Bahr el Ghazal
Fashoda
Khartoum
Wadi Halfa
Assouan
Alexandria
Cairo
Suez
Port Said
Tripoli
Barka
Fezzan
Ghadames
Algeria
Morocco
Tangier
Fez
Rabat
Casablanca
Mogador
Madeira
Canary Is.
Las Palmas
Rio de Oro
Dakar
Bathurst
Bissau
Conakry
Sierra Leone
Liberia
Monrovia
Gold Coast
Ashanti
Dahomey
Lagos
Togoland
Lome
Cr. Bassam
Sekondi
Kumasi
Bamum
Duala
Victoria
Kribi
Libreville
Loango
Port Gentil
Ogowe
Kusi
Ubangi
Uele
Semio
Tondjema
Toro
Mahagi
Albertville
Kivu
Ruanda
Urundi
Tabora
Kigoma
Ujiji
Nyasa
Kilwa
Lindi
Mikindani
Port Amelia
Beira
Mozambique
Quilimane
Chinde
Blantyre
Zomba
Nyasaland
Tete
Sena
Zambesi
Victoria Falls
Wankie
Gwelo
Bechuanaland
Kalahari
Hafekin
Transvaal
Orange River Colony
Basutoland
Natal
Pietermaritzburg
Kimberley
Bloemfontein
Pretoria
Johannesburg
Lorenzo Marquez
Durban
Port Elizabeth
East London
Cape Town
Walfisch Bay
Luderitz B.
Swakopmund
Walvis B.
Damaraland
Ovamboland
Kaokoveld
Angola
Portuguese West Africa

operating with the French columns against the Germans in the Kamerun. Fighting has also taken place between Belgian and German forces at Kisseni (at the frontier near Lake Kivu) and on the extreme southeastern boundary of the colony. Naturally, however, the future status of the map of Africa will be decided by the outcome of the war in Europe, and only an indecisive result will obviate the change of proprietorship of many African colonies.

Africa more than any other of the continents is dependent upon Europe for development, and in consequence is, next to Europe, most affected by the war. The war will so thin the ranks of young Europeans that African possessions will be less needful to absorb the surplus. The home governments had decided to spend for railroads and transportational improvements in the colonies of Belgian Congo, Angola, Portuguese East Africa, French Equatorial Africa, British East Africa, German East Africa, German Southwest Africa, and the Kamerun, during the next ten years, between $100,000,000 and $200,000,000. Hereafter when peace is declared, the needs of each of the home countries for setting its own house in order will be such that presumably but little of this money will be available.

The map shows the present status of railroad construction in Africa, with the proposed extensions and new lines decided on. As the development of colonies, and particularly mining progress, is largely dependent upon the betterment of lines of communication, the delay in the railroad building program is particularly unfortunate. Not only is railroad building delayed, but unfortunately in the military operations, some of the railroads have been partly destroyed. The advantage of rail transport is well illustrated by the fact that a traveler can now reach Lake Tanganyika by the Dar-el-Salaam-Kigoma railroad, in from 50 to 60 hours, a journey once requiring by caravan route many laborious months. Were the times peaceful, this road would give Germany commercial control of a narrow strip of Congo territory on the west shore of Lake Tanganyika, and would presumably further the development of certain mineral deposits in the north Katanga.

In July the Belgian Congo was linked with Ostend by direct cable, thus reducing notably not only the time of transmission, but also the cost. During the year the use of fuel oil on river steamers and railroad engines became more general. Satisfactory progress is reported in wireless construction, and in river transport. Some one hundred miles of railroad was completed in 1914, and at present the Belgian Congo has well over 1000 miles of railroad. Prior to the war the colony's proved richness in copper, diamonds, gold, rubber, palm oil, copal, and other resources was sufficient to warrant a much more comprehensive campaign of railroad building, which would have resulted doubtless in a profitable development of other resources scarcely now thought of.

Copper

The Union Miniére du Haut Katanga, operating copper mines in the southeastern part of the colony, from January 1 to June 30, had produced some 4500 tons of copper ingots. In August orders curtailing the output somewhat were sent from Brussels, but notwithstanding this, the year's production was approximately 10,700 tons, making it one of the 25 largest copper producing companies.

The production of copper by this Company has been as follows:

	Tons.		Tons.
1911	786	1913	7,245
1912	2,460	1914	10,700

The Star of the Congo mine, situated nine miles from the Lubumbashi smelter, produced in 1913, after sorting and washing, 50,000 tons of ore. The mine has been worked for some three years as an open-cut with hand labor. Most of the ore is soft, but the fluxing dolomitic ore is broken up with 3¼-in. Ingersoll drills. Whites, employing gangs of negroes, contract some of the work; about 60 whites and 800 blacks are employed. The ore is now milled through to a haulage level from which the loaded cars are drawn to the adit mouth by cable. The coarse ore is dumped directly into railroad cars, the rest is washed, the coarser being then loaded, the rich middling briquetted, and the 'fines' stored for future treatment. Talcose ores are treated in a special washing plant. Since January 1914, two small Bucyrus steam-shovels have, in addition, been stripping overburden and mining soft ore. The buckets are one-half cubic yard and the shovels have a capacity of 200 tons per ten hours.

At the Kambove mine, opened in June 1913, there was produced, after sorting in the last six months of that year, over 11,000 tons of ore. Two steam-shovels, one a 48-ton Bucyrus, and the other a Koppel of 49 tons, each with dipper of 1½ cu. yd. capacity, have been shipped and were to have been ready to work early in 1915. Each has a rated capacity of from 500 to 600 tons per ten hours. The mine is now worked by a main underground haulage-way to which the ore from the surface is shot down chutes. From this the ore is trammed by natives to a loading station, where the hard and soft ore is loaded direct into cars, the slightly cupriferous quartzite, on the other hand, being set aside for later treatment. The ore is sent by railroad to the smelter, where the soft is briquetted. About 30 white men and 400 negroes are employed.

Mining at the Luishia mine was retarded in 1913 by the inadequate labor supply, but nevertheless some 20,000 tons of ore was produced. As it is a powdery ore containing considerable cobalt and iron, the greater portion is briquetted. As the labor supply permitted, development was carried on at several of the mines, the next one to be opened presumably being the Likasie.

As noted above, much of the ore is soft, and to render this a satisfactory furnace product it is briquetted at Lubumbashi. The ore is compressed in a plant consisting of six presses, with a capacity of 250 tons per 20 hours, the pressure being six tons to the cubic inch. The cylindrical briquettes, which contain no binder, are about 6 in. long and of 4-in. diameter. Concentration

of the other ores now consists principally of hand-sorting, although some ores are screened and washed, and the talcose ore is treated in log-washers. A 50-ton mill is en route to Africa, and will be used for mill tests. A third water-jacket furnace was blown in on June 27, and in midsummer the three furnaces were simultaneously in operation, giving a daily production of about 48 tons of ingots, containing from 96 to 97% copper. It was expected prior to the war that four more would be

runs 15 years. The coke price is satisfactory, and low freight rates have been obtained from the Rhodesian railroads. The copper company engages to take at least 100,000 tons of fuel (at least 40,000 tons of coke, and not over 60,000 tons of coal) per year. The Wankie coal contains about 15% ash and 2% sulphur, and is washed to 10% ash and 3½% sulphur. The coke recovery is reported to be about 70% and contains 15% ash and about 1% sulphur. Clay and refractory bricks are also ob-

MAP OF THE BELGIAN CONGO.

blown in during 1915, and the two now *en route* and at Beira will presumably soon be erected.

The second battery of 22 Coppée coke ovens was completed in March 1914, and now from 3000 to 3500 tons of coke are made from Wankie (Rhodesia) coal. The waste gases are used to heat two Stirling boilers. As a little under three tons of coke is used per ton of copper produced, it is evident that these furnaces are sufficient for the present production, although the Company also obtains coke from Wankie. A contract made early in the spring of 1914, intended to cover fuel necessary to feed further smelting units, dates from July 1, 1915, and

tained at Wankie. Jean Jadot, chairman of the board, states that the cost for 1914 would be about 9.6c. per pound, delivered at Antwerp, plus approximately 0.4c. for general expenses in Europe. This price of 10c., of which 6.7c. is for mining and smelting, does not include debenture or amortization charges.

The labor situation is much less critical than a year ago, as late in 1913 a contract was entered into with the Nyasa Consolidated Co. to supply Nyasa natives, and natives are also being obtained from Portuguese West Africa. As early as May 1914, over 600 Nyasa natives had arrived. The supply for the moment at least ap-

pears adequate, although the Congo itself cannot supply the needed labor for its own future development. P. K. Horner is general manager in Africa, and A. E. Wheeler consulting engineer. A number of other American engineers, including Messrs. Snow, Kehen, and Johnston, are in the employ of the Company in Africa.

Gold

But few reports are at hand on account of the war, as to progress at the placers in the northeast part of the colony—Kilo, Moto, Babeyru, and Kanwa. The production for 1914 should, however, be about $900,000.

In February and March 250,000 gold 20-franc pieces were coined at Brussels from Congo gold. The colonial authorities at that time showed a disposition to reserve the right to purchase all gold produced in the colony, and in the decree granting the Kasai company the right to prospect in certain parts of the Aruwimi watershed, and in the new draft of the mining laws of the Katanga, is a clause giving preference to the colony and the Belgian government as buyers of gold.

Diamonds

During the year the Kasai diamond fields' production was satisfactory. More diamonds were recovered from the gold placers in the northeast part of the colony, some fifty stones being found.

The Kundelunga-Lualaba Exploitation Co., with 13 white and 250 black employees, continued on a large scale the washing of the 'yellow' ground of its pipes. Robert Williams reports that in 1913 at Luanza 4390 loads were washed, producing 218 small diamonds, the largest weighing three carats. From the commencement of work in 1911 to December 31, 1913, a total of 9315 loads yielded 369 diamonds, weighing 187 carats. This is an average of about 0.02 carat per load. The Société Belge Industrielle et Miniére du Katanga in March 1914, sent a number of engineers to test its kimberlite pipes in the same region, some seventeen in number. The discovery of several more supposed pipes was made in 1914.

Tin

Tin mining apparently advanced but little during the year. The Union Miniére du Haut Katanga did nothing at Busanga beyond a small amount of testing, but now that the railroad is opposite the mine, distant some 38 miles, work would have been pushed were it not for the war. The Société Belge Industrielle et Miniére du Katanga's operations at Muika were considerably embarrassed, since, on account of the exceptionally low water in the Luvua river, new machinery did not reach the mine. Early in 1914 it produced about ten tons of concentrate per month with its 5-stamp mill. The force consists of 11 Europeans and 450 blacks.

Miscellaneous

Up to May 15, 1914, 510 mining claims had been staked in the Katanga, of which approximately 400 are for copper, those for tin being second in number. Some seventy-four of the earliest claims staked have been extended for two years, the first period of four years given for development having elapsed. The principal exclusive prospecting rights in the Katanga, all held by large companies, have been extended to April 15, 1915, at which date it is hoped that the new mining law now before the King will become effective. This draft of the Katanga mining law, applicable only to mines in the southeastern part of the colony, changes certain of the more unfavorable articles digested in one of the earlier numbers of this review. The chief changes follow: Ten years instead of six are permitted to develop a claim into a mine; the old royalty of 1% upon the gross production (5% in the case of precious stones and precious metals) due the Special Committee of the Katanga (in reality the colony) is suppressed, and instead of receiving 33% of the profits, the colony participates in the profits on a sliding scale, according to the success attendant upon mining. This rather interesting form of taxation will be understood from the following table:

Profits in francs on 100 francs.	Former law, 1910.	Proposed law. Diamonds and precious stones.	Proposed law. Other minerals.
5	1.65	0.60	0.60
7	2.41	0.84	0.84
10	3.30	1.44	1.44
15	4.95	2.69	2.69
20	6.60	4.69	4.69
25	8.25	6.69	6.69
30	9.90	8.69	8.69
35	11.55	10.69	10.69
40	13.20	13.69	13.19
50	16.50	19.69	18.19
60	19.80	25.69	23.19
80	26.40	37.67	33.19
100	33.00	49.69	43.19

The Société Belge Industrielle et Miniére du Katanga (a consolidation of the Belgo-Katanga and the Industrielle et Miniére du Katanga) absorbed during the year the Société Anversoise pour la Recherche des Mines au Katanga, and the Société de Recherche Miniére Lufira-Katanga. Its capital was raised to $2,700,000. The Company owns the Muika tin deposit, about seventeen pipes of kimberlite, some of which at least are diamondiferous, and numerous other mining claims.

Tungsten in the form of hübnerite, wolframite, and scheelite, the tungstate of manganese, iron, and lime, respectively, is widely distributed in Nevada, according to *Press Bulletin* 10 of the Mackay School of Mines. In addition to that mined at Round Mountain and the Bonita district, White Pine county, it also occurs at the following localities: Hübnerite is found near the state line, west of Lida, in Esmeralda county; at Redlich, Mineral county; at Tonopah, with gold ore, Nye county; and at Regan, on Mt. Wheeler, White Pine county. Wolframite and hübnerite occur together in the Gold Run district, 15 miles south of Golconda in Humboldt county. Hübnerite and scheelite occur together at Ellsworth in Nye county and at Hub, 12 miles southeast of Osceola in White Pine county. Wolframite is found 12 miles south of Pioche in Lincoln county. Scheelite occurs at Browns and Rebel creek in Humboldt county; near Oak Springs in Nye county, and in Washoe county.

Ancient River Channel Mining in California

By J. D. HUBBARD

More attention is being paid of late to drift mining in California, and deservedly. This long neglected branch of a great industry has paid so well in the past that it is no wonder enterprising men have re-entered this field and the prospect for a revival of this class of mining is good. The argonauts, whose indomitable spirit is so badly needed these days in mining, traced the gold-bearing sands and gravels of their day to the principal source, that is, to the 'break-outs' of the ancient river channels. These lava-capped sluice-boxes of nature have yielded a large part of the gold recovered in this state. At least one-third came from the ancient river channels. There is little doubt that three times the amount of gold already produced remains locked up in these treasure houses below the lava cap.

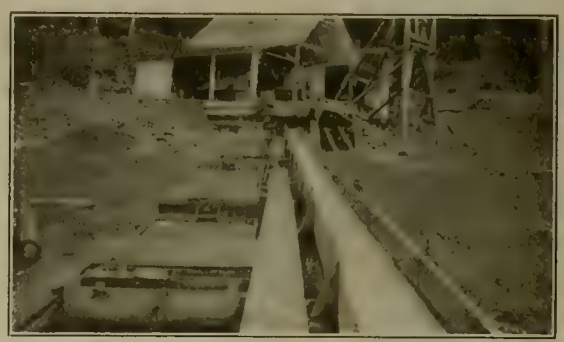
California has produced to date in gold approximately $1,600,000,000, or one-seventh of all the total won in the world since 1492 has been mined in California since 1848. How much gold is left will remain the unsolved mystery for ages, perhaps, but the estimate must be based on the known unworked compared to the known worked areas. Some of the ancient channels worked as drift mines have had exceptionally rich areas. In the Perschbecker or Magalia, and the Indian Springs mines in Butte county, old miners tell of gravel shoveled off the bedrock that contained $80 to $100 to the shovelful. And balancing this extraordinary statement with the known production and areas worked in these mines, they seem to have some basis. Unfortunately, miners as a class are regarded as something of prevaricators, but while scorning to associate with amateurs in their line, their 'historical romances' often have foundation in fact.

The ancient river channels contain more gold for a given area than the later channels because they were the result of a vastly longer period of erosion.

After working 'pan' and 'Long Tom' to their limits in the shallow gravels, the early miners were compelled to adopt new methods as the banks of gravel grew higher and steeper. The hydraulic giant came into wide use, and by that method the Tertiary gravels were washed out in many places well under the lava cap. After that, speaking strictly of the Tertiary channels, the limits of the hydraulic giant having been reached, it became necessary to drive farther in on the course of the streams and mine the gravel out on a smaller scale. This became known and classed as drift mining.

After determining the trend of the channel as correctly as possible by tracing the lava flows and rim rocks and by whatever geological features are available, the important thing is to find the pay-streak. All the channels have this, although some of them pay from rim to rim. But always there is the richer 'run'—generally but not always on the bedrock in the lowest part of the channel, and generally following the short side at a turn. Again, nearly all channels have their poor spots and their rich ones. Many a drift mine has ceased operations because the owners too often celebrated the working out of a rich spot and set nothing aside to tide them over a poorer one. On the whole, the upper reaches of these channels are profitable. The dredges are taking care of the deep low-grade gravel in the valleys and are adding several million dollars to the world's wealth every year. Coarse gold does not travel far, and if the valley gravels pay so well to the dredge, it is a safe conclusion that the lava capped gravels higher up must contain the greater amount of gold.

The next, which had better be the first, difficulty to be



ARRANGEMENT OF UNDERCURRENTS AT THE NUGGET MINE.

considered is the mine owner himself. Many of the men who think themselves mine owners, have in fact but insecure hold on the properties they profess to own. Titles are generally in poor shape. Much of the assessment work is not done at all after the first flush of the mining fever is over, and some of it is mere pretense. Some claim owners, to avoid trouble, give the required $100 to somebody to do the work. The man supposed to do the work may look at the claim in question on his way fishing, or may put in a couple of days' work there, in due course filing the 'proof' of labor at the county seat. This is more serious than it may seem, for it is responsible for the holding up of a lot of mining property that otherwise might be worked. The law plainly states that $100 worth of work must be done on each claim or location, and the mere fact of paying the amount required and then filing proof of labor is not sufficient to protect the title. The deep seated prejudice of the 'old timer' against 'claim jumping' is responsible for this condition which is a stumbling-block to the mining industry.

The only way to settle the title question is for the owner to get, and keep up to date, his abstract of title, which facilitates the handling of his property in case of sale. Also the price must be reasonable and the terms reasonable. The owner cannot expect another to do a lot

of development work to prove the value of the ground. It would be like betting the owner the actual price of the development work against nothing. The days of the 'sucker' and the big cash price are over, and the first essential to further revival of this branch of mining is a reasonable attitude on the part of the owner. The operator is the one who really takes all the chances and is deserving of every consideration. A fair plan is to set a price and then take the payment from a certain percentage of the gross output, depending on the richness of the mine. In case of forfeiture the owner has the benefit of the development work done, and so has nothing to lose by this arrangement.

The cost of drift mining varies greatly according to the conditions. At the Mayflower mine in Placer county, according to F. Chappellet, mining cost is $1.19 per ton, and milling with steam power, 25c. per ton, or a total of $1.44 per ton. This was in cemented gravel and more expensive to mine and treat. At the Big Dipper mine, the same class as the Mayflower, according to G. B. Hobson, the total cost was $1.85 per ton. At the Hidden Treasure mine, where the gravel is not milled and the work is done on a large scale, the cost per ton is as low as 92c. At the Mineral Slide mine, near Magalia in Butte county, where the face is blasted down and then the gravel hydraulicked out by water under pressure, the cost is as low as 65c. per ton. This is about the lowest figure recorded. At the Nugget mine at Toadtown, in Butte county, where an incline was run under the lava cap and all gravel hoisted and water pumped, the total cost was $1.37 per ton, increasing to $1.73 per ton as further depth was gained. This shows that under unfavorable conditions drift mining is profitable. The gravel in the Nugget mine averaged $6 per ton (or yard) for 110 ft., and $3.08 per ton for 496 ft. Some of the gravel went as high as $50 per ton. The gravel in the Nugget mine is all free washing, no cement gravel being found. The following details of costs for an average month at this mine may be of interest:

Tons of gravel mined	604	573
Dynamite	$ 33.60	$ 80.96
Fuse	5.64	11.30
Detonators	3.06	4.92
Rails	14.00	16.00
Ties	2.16	0.88
Lagging	1.92	0.96
Timber	2.67	1.80
Candles	3.45	5.27
Power and lights	22.64	22.00
Oil	1.20	1.05
Air pipe	4.60	4.80
Water pipe	5.40	6.00
Wire and lamps	1.30	1.45
Labor	479.25	593.75
Superintendence	150.00	150.00
Depreciation at 5%	100.00	100.00
Total	*$830.89	$1001.14
Per ton	1.374	*1.735

*Month of highest cost.

In contrast to many Australian drift mines, the gravel in the California drift mines rarely contains much clay, owing to the prevailing harder bedrock and the greater fall of the ancient rivers. Consequently the Australian methods of puddling, or comminuting the clay by revolving drags in pans are practically unknown in California. There are many localities in California where plenty of clay has been found in the later gravels, but the ancient channels of the Tertiary are remarkably free from this objectionable material. Clay may be all right in a 'pipe,' but troublesome in a sluice-box where it will gather up much small gold on the journey through, and hold it until disintegrated by the air, and lying on the waste dump, the gold is thus lost.

At present, weather conditions have curtailed activities in drift mining in Butte county, but during the year past, many old properties were opened up and the demand for this class of mine was very gratifying. The Mineral Slide, near Magalia, has been a steady producer, as has also the Nugget mine at Toadtown. The Old Indian Springs mine below De Sabla has been opened by some enterprising San Francisco mining men, who cleaned out and retimbered the old drift throughout its length, 5282 ft. They are now developing the gravel and hunting the 'pay,' with the chances in their favor for a good mine, considering the richness of the average gravel already taken out. They deserve success for their efforts. The Robbers Roost, Cole, Emma, and Kidd drift mines, near Nimshew, are all developing. The Emma is in 'pay.' Three plucky miners tackled the discouraging job of cleaning out the old drift, putting in air-pipe, and then driving for the channel, which they cut late in November. The first twelve pans of gravel, it is reported, yielded $32 in gold. The Royal Drift mine on the west side of Butte creek is developing steadily. This Company controls 1400 acres. The old Best drift, also on the west side of Butte creek, is being opened by the owners, who will prospect the mine thoroughly. Development has been done also on the Palace mine, just across the creek from the Best and the continuation of the same channel. Development is also being done at the Emancipation mine farther up on Butte creek. At the Kirby mine near De Sabla the shaft is being deepened preparatory to driving for the channel. The Pacific Gas & Electric Co. at De Sabla had an increase in business the past year due to the drift mines alone.

This locality has been a famous producer in the past, approximately $12,000,000 in gold having been taken from the Tertiary channels within a radius of three miles of De Sabla. The coming year will probably record a good gold production from this locality, and a further revival of interest in the exploitation and development of the ancient river channels of California which have been so productive in the past.

EXPORTATION of iron ore from the port of Lulea, Sweden, during the shipping season of 1914, namely from May until November, amounted to 1,034,350 tons. During the same period of 1913 it amounted to 1,471,450 tons.

GOLD OUTPUT of Victoria, Australia, was valued at £1,740,300 in 1914, compared with £1,840,700 in 1913.

Practical Rules for Cutting Mine Timber

By BERNARD CARR

*The following suggestions or rules are offered to the young miner or timberman to assist him in cutting and placing mine timber in flat seams with a maximum of economy, and at the same time make his work easier. The practical timbermen throughout our various collieries, who have their own good methods of cutting timber, may perhaps find nothing new in these rules, or they

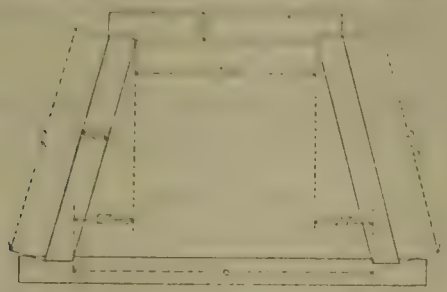


Fig. 1.

may even know of better ones than those suggested; but for the young timberman who is seeking to simplify his task and at the same time perform his work both efficiently and economically, the following instructions should prove of value.

To find the bevel on the heel of the leg on which the collar rests, divide the spread of the leg in inches by the length of the leg in feet. Cut the notches in the collar horizontal or level. This rule will be found ac-

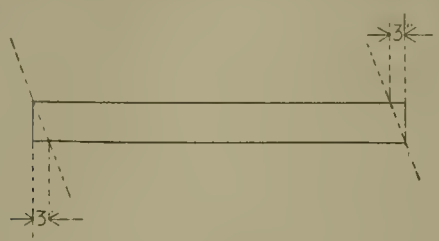


Fig. 2.

curate for timber 12 in. diameter, regardless of the length or spread of the leg.

Example: A gangway is timbered with a collar whose notches are 7 ft. apart, and two 9-ft. legs spread 11½ ft. apart, timber 12 in. diameter. What is the bevel on the heel of the legs? The spread of each leg (11½ — 7) ÷ 2 = 2¼ ft. or 27 in., 27 in. ÷ 9 (the length of the leg in feet) = 3-in. bevel of each leg.

Putting this in the shape of a formula, we have:

$$B = \frac{S}{L}$$

in which B is the bevel in inches, S the spread of the leg in inches, and L the length of the leg in feet. If stood on a mud sill as shown in Fig. 1, the timber will have the same bevel top and bottom.

In cutting the bevel in a crooked piece of timber, the miner's method for determining its equal sides should be used. This method, which requires but a knowledge of short division and the use of a tape-line and level, is as follows: Place a knife in the ring at the end of the tape and stick it in the centre of the end of the timber to be cut. Measure the front side of the leg to the

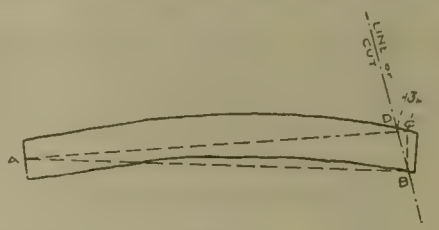


Fig. 3.

required length and mark it with a piece of chalk. Swing the tape to the back of the timber and make another mark. Then from this last mark in back of the timber measure down the bevel distance 2, 3, or 4

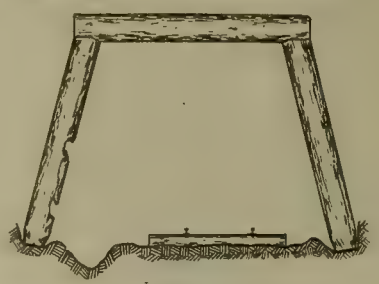


Fig. 4a.

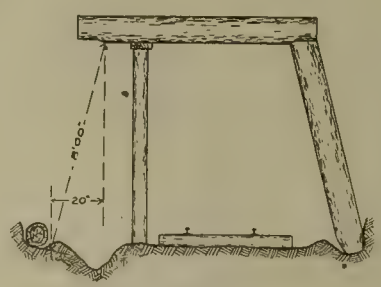


Fig. 4b.

in., whatever the required bevel may be as determined from foregoing rule. It will be found that this bevel will fit perfectly.

When one of the legs in a set of timber is broken and the leg and collar is good, the broken leg may be replaced as follows: After putting a brace under the

*Abstract from *Employes' Magazine* of the Lehigh Valley Coal Company.

collar as shown in Fig. 4a, chop the broken leg out. Hang the tape plumb from the notch in the collar and the floor of the gangway to obtain the vertical heights, and then measure in inches the distance from the tape over to the hole in which the leg stands. This will give the spread which, divided by the length of the leg (in feet) will give the bevel to be cut on the new leg. For instance, if the timber is 12 in. diameter, the length of the leg 9 ft., and the spread 20 in., the bevel will be

$$20 \div 8 = 2\frac{1}{2} \text{ in.}$$

The foregoing rules for obtaining the bevel to be cut on the heel of the leg was figured for timber 12 in. diameter. The bevel on the heel of any leg will vary as the length of the leg and also as its diameter. Given the length of the leg and its spread, the bevel can be found from the formula $B = \frac{S}{L}$. This bevel will be based on timber 12 in. diameter. Then by proportion and by comparing the diameter and bevels, the desired

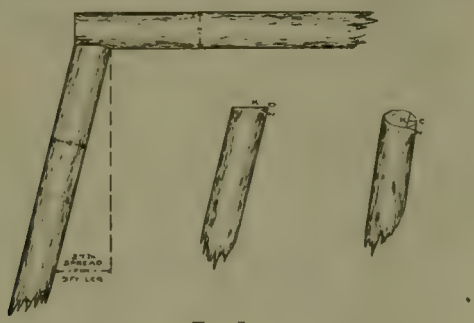


FIG. 5.

bevel may be found. For instance, suppose the diameter of the timber in the first example, whose legs were 9 ft. long and spread 27 in., was 18 in. instead of 12 in. First find the bevel for 12-in. timber from the formula $B = \frac{S}{L} = \frac{27}{9} = 3$ in. Then:

$$12 : 3 :: 18 : x. \qquad x = 4\frac{1}{2} \text{ in.}$$

For 8-in. timber the proportion would be the same:

$$12 : 3 :: 8 : x. \qquad x = 2 \text{ in.}$$

Thus it may be seen that regardless of the length or spread of the leg, the correct bevel for 12-in. timber is found from $\frac{S}{L}$, and by proportion the bevel for timber of any diameter is readily determined.

The depth of the notch in the collar, like the spread of the leg, varies with local conditions. As a general rule, however, the depth of the notch should be cut to about ¼ the diameter of the collar. That is, a collar 12 in. diameter will have its notch cut $12 \div 4 = 3$ in. deep.

All collars should be cut with a bevel to rest on the facing of the leg. This bevel in the collar should be ⅛ in. for each inch of diameter of the collar. Thus, for a 12-in. collar the bevel will be $\frac{12}{8} = 1\frac{1}{2}$ inches.

To find the facing on the front of the leg, add the bevel on the collar to the bevel on the heel of the leg. Thus, for 12-in. timber 3-in. + 1½ in. = 4½ in. facing. (See K O on Fig. 5.) Then cut K N intersecting N O, which is equal to the depth of the notch in the collar, that is, 3 inches.

The length of the collar is the distance between the notches plus twice the diameter of the timber.

Though the foregoing figures were based on timber 12 in. diameter and 9 ft. long with a spread of 27 in., the rules will be found to work through proportion for any size timber used.

Underground Haulage in the Bunker Hill & Sullivan Mine

By J. W. GWINN

*The underground haulage system in this lead-silver mine is the most extensive in the Coeur d'Alene district, comprising about 35,000 ft. of tunnels, drifts, and cross-cuts where locomotive haulage is in use. The main working adit, known as the Kellogg tunnel, or No. 9 level, is approximately 10,000 ft. in length from the portal to the main working shaft, and extends beyond that about 4500 ft. in each of two directions. On this level all the ore from the Bunker Hill & Sullivan, the Sierra Nevada Consolidated, and the Caledonia Mining Co., an average of 44,600 tons per month, is hauled to the mills, situated a short distance from the portal. Electric haulage by the trolley-type locomotive is used on this level throughout.

Below this level, at intervals of 200 ft. vertically, are five other working levels, No. 10, 11, 12, 13, and 14; and the total haulage distance on these, where electric locomotives are used, is approximately 16,000 ft. Of the four levels equipped with electric haulage, No. 11, 12, and 13 have storage-battery locomotives, and No. 10 still retains the trolley type by reason of the small and decreasing tonnage produced.

Electric power is supplied to the mine by two systems. The first, the 500-volt direct-current trolley, was installed in 1897 when the Kellogg tunnel was started, and was extended as the tunnel advanced. The second circuit, 2300 volts, alternating current, was installed in 1907, to furnish power for the pumps, as well as lights for the shaft and stations, and for preheating compressed air for the hoist.

The first storage-battery locomotive to be installed, replacing a 2½-ton Jeffrey trolley type, was a Jeffrey, weighing 5000 lb., on No. 11 level; the second installation, replacing a 4½-ton General Electric trolley type, was made on No. 12 level, a Westinghouse storage-battery type being installed weighing 7600 lb.; and the third installation was on No. 13 level, with a General Electric storage-battery locomotive weighing 8000 lb.

*Abstract from *Transactions* of the A. I. M. E., February.

Canadian Mining Institute Meeting

The seventeenth annual convention of the Canadian Mining Institute was held at the King Edward hotel, Toronto, March 3 to 5. Owing to the war and the financial depression the attendance was not so large as on previous occasions, but an excellent program was presented and the discussions were of an animated character. In the absence of the president, G. G. S. Lindsey, at present in England, the chair was occupied by the first vice-president, A. A. Cole, mining engineer of the Temiskaming & Northern Ontario railway, who in his opening address alluded to the mining districts of northern Ontario as the brightest spots in Canada, since there are no labor troubles and the companies are continuing to pay dividends.

Hon. G. Howard Ferguson, Provincial Minister of Mines, welcomed the convention to Toronto on behalf of the Ontario government in an address that created a favorable impression.

The first business taken up was the amendment of the by-laws respecting the election of councillors who, to the number of 20, have hitherto been elected by the members at large, with the result that the great majority have been residents of Ontario and Quebec, the other provinces having but few representatives. Amendments moved by Clifford E. Smith and seconded by A. G. Burrows provide for their election by provinces. British Columbia for this purpose including the Yukon, Alberta being grouped with Saskatchewan, and Manitoba and the Maritime provinces forming another group. Each province, or group, is to be represented by a number of councillors proportioned to the resident membership, who must reside in the provinces they represent.

A. A. Cole, representing the Cobalt branch, moved, seconded by Norman Fisher, that the consideration of the amendment be postponed until the next convention, as this was an abnormal year on account of the war. At a rough estimate 10% of the members had gone to the front. A. J. Young, Toronto, urged that the representation of the outlying provinces according to their membership was not a matter of favor, but a matter of right. J. A. Dresser, Sault Ste. Marie, thought that those in outlying districts, should, if they saw fit, have power to elect non-residents. Many of those at distant points could not attend the council meetings. H. E. T. Haultain, Toronto, strongly supported the amendments. For the past five years, out of 50 nominations to the council only 8 were resident outside of Ontario and Quebec. He objected to discussion being smothered by appeals to sentiment and thought that "Business as usual" should be the motto. F. D. Adams, Montreal, favored postponement. After a keen discussion the motion to postpone action was defeated and the amendments carried by a vote of 48 to 21.

John McLeish, Thomas W. Gibson, Theo. C. Denis, and D. B. Dowling presented preliminary statistics of mineral production which will be summarized next week.

M. Dowling presented a paper on 'Structural Geology of the Alberta Oilfields.' Six or seven companies were boring for oil on the Turner Valley anticline and in addition to the original discovery and the No. 2 well several of the wells had showings of oil. The wells in the broken country of the foothills, however, were not successful and he did not think that neighborhood offered much prospect. One of the wider anticlines to the northwest of the original discovery had yielded a little oil, and three or four wells on the Milk river show encouraging results.

A discussion on the stimulation of prospecting was led by H. E. T. Haultain, of Toronto, who urged that the decline in mineral production showed the need of encouraging prospecting in order to make new discoveries. The debate took a very wide range, many suggestions being made as to the best means of inducing more prospecting activity. G. R. Rogers, Gowganda, said that the government should subsidize prospectors as was done in Australia. T. W. Gibson said he had looked into the subject but was unable to ascertain that any new or important field had been brought to light by state-aided prospectors. George A. Guess, Toronto, thought that valuable suggestions on the subject could be obtained from the state of Colorado. Arthur B. Clabon, Vancouver, said business men should unite to stimulate an industry which was worth so much to commercial interests and co-operate with the prospector. Several speakers favored giving the prospector a percentage of the value of his discoveries. A communication received from R. W. Brock suggested that mining property should be held only as long as the owner worked it, and afterward should revert to the Crown and be open to prospectors. Mr. Haultain pointed out that invention had been organized instead of being left to individual initiative. The government and large corporations should in the same way organize prospecting and train young men for the work. He moved that the question be referred to a special committee to decide upon some definite measure. The resolution was carried.

At the evening session, E. T. Corkill, of Copper Cliff, described 'Safety Engineering at the Canadian Copper Co. Works and Mines at Copper Cliff,' illustrated by moving pictures showing safety work at the plant of the New Jersey Zinc Co. David H. Browne read a thoughtful and digestive paper on 'Things We Might Have Done,' showing the benefits often realized by experience gained from failures.

On the second day a resolution moved by Frank D. Adams and seconded by T. W. Gibson, expressing the thanks of the Institute to those members who have enlisted for active service, was passed with enthusiasm.

Mr. Adams read a paper on 'The Conservation of Our Mineral Resources,' in which he strongly combatted the prevalent impression that the natural wealth of Canada was inexhaustible, shared even by leading public men. As a matter of fact the resources have been seriously impaired by wasteful methods of production. In metallic mining there is but little avoidable waste, but there had

been much in connection with coal-mining. In Nova Scotia as much coal was formerly wasted as was taken out, but more economical methods have now been adopted and are enforced by strict government inspection. But there is still a good deal of preventable waste in the new coal areas of the West. In Alberta, which has 87% of the known coal reserves, the lessees of coal lands can adopt such methods of operation as they please and exploit a mine by taking the cream and leaving the remainder. Great saving could be effected by the use of gas producers in place of steam engines, and the substitution of by-product coke ovens for the beehive ovens, which has to some extent taken place in the East, would save much tar, sulphate of ammonia, and other valuable products which now go largely to waste.

Charles Fergie, of Nova Scotia, said that in that province as well as in British Columbia, the maximum amount of coal is now being taken out. The mines in those provinces are systematically laid out with a view to the prevention of waste. It should be borne in mind that the large total of the Canadian coal reserves includes deposits in inaccessible regions and seams so situated that they could not be economically worked. Small mines are often opened and worked for a temporary profit and then abandoned, leaving the remainder of the coal unworkable. The Dominion government should appoint an official to see that all mines are carefully laid out and systematically worked. James McEvoy, Toronto, contended that conservation should be judiciously applied, otherwise important industries might be injured, as the coal mining industry of Alaska had been by too stringent restrictions.

Walter A. Schmidt, of Los Angeles, gave a paper on the Cottrell process, tracing the development of the process for controlling fume and saving the metallic and chemical content. His paper, which excited great interest, was illustrated by lantern slides and moving pictures, showing the process in operation. It was followed by a demonstration with a model of the apparatus.

'The Smelting of Titaniferous Ores in the Blast-Furnace' was the subject of a paper by Bradley Stoughton, New York, who referred to the large deposits of titaniferous ore in Canada. A prejudice existed against this ore, which has lately been lessened, as actual practice had shown that ores containing 5 to 20% of titaniferous oxide can be smelted successfully. Ore containing as high as 36% of titaniferous oxide has been smelted in England. If titaniferous ore were used in as large proportion as could be done without interfering with the smelting process it would greatly increase the Canadian ore reserves. A discussion followed, some of the speakers expressing the view that it would be difficult to induce the blast-furnace men to use titaniferous ore.

E. B. Thornhill, Cobalt, read a paper on 'The Recovery of Mercury from Residues of Amalgamated Cobalt Ores,' describing the process pursued at the Buffalo mine, which yielded mercury remarkably pure and free from arsenic. The annual dinner was held in the evening.

Regulations Governing Placer Working in Western Canada

Under date of January 26, 1915, an Order in Council has been issued governing placer mining on bar diggings by hand methods. In view of the demand which exists in the Edmonton mining district for small areas of placer mining ground to be operated by rocker and grizzly hand methods, the Minister of Interior has granted permission to acquire such ground on the North

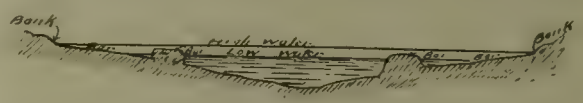


Fig. 1.

Saskatchewan river and elsewhere, in the provinces of Saskatchewan, Manitoba, Alberta, and the North West Territories under these conditions:

1. Bar diggings shall comprise lands in and along any river over which the water extends during the high water, but which are not covered at low water.

2. Bar diggings shall comprise a strip of land 100 ft. wide along the high water-mark of any river and thence extending into the river to its lowest water-level.

3. Any person desiring to work bar diggings, the property of the Crown, may, upon payment of a fee of

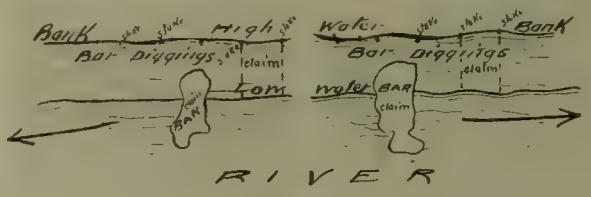


Fig. 2.

$1 to the mining recorder for the district in which the rights applied for lie, obtain a certificate upon the following form: "This is to certify that ——— of ——— has paid me, this day, the sum of $1, and is therefore entitled to all the rights and privileges prescribed by Order in Council governing the granting of bar diggings on the ——— river. (Signed) ———, Mining Recorder." This certificate will entitle the holder to stake out in accordance with the provisions of the regulations governing placer mining in Manitoba, Saskatchewan, Alberta, and the North West Territories, and work bar diggings of the dimensions above described.

The holder of the certificate who has staked out available ground in the manner above described, and illustrated, may continue to hold the same as long as he continues to operate it, but in case of a claim staked out under these regulations remaining unworked for three consecutive working days, the rights acquired under such staking shall absolutely lapse, unless a 'lay-over' has been granted by the mining recorder. There is much interest in the possibilities of the placer deposits of western Canada.

DISCUSSION

Readers of the MINING PRESS *are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.*

Who Will Engineer the Engineers?

The Editor:

Sir—The reopening of the discussion of "what is the matter with the mining profession?" is of timely interest to a large number of engineers. I recently received the record of 46 members of the 1911 graduating class of the College of Mining connected with a large Western university, bearing out in a striking manner some of the statements made by 'A. Engineer.' In the four years that have elapsed since graduation, nearly 50% have given up mining. That, in itself, would be of little importance, were it not for the fact that the list of those who have strayed from the fold includes many of the most competent men, who are now holding positions in other lines of work relatively higher than they could hope to have held had they remained with their profession. Another significant fact, emphasizing the statement of 'A. Engineer,' is that most of the ones who have deserted mining are those who have married. A statement by an applicant for a position that he is married and expects some sort of living accommodations where the mine is not situated near some town, usually reduces to a minimum his chance of obtaining the place. This statement may not apply to all branches of mining, but it certainly does to the majority of gold mines.

One cause of the low pay of managers and superintendents is, I believe, the increasing number of properties being purchased under bond and option, in which an attempt is made to meet payments from current earnings of the property. The result in many cases is lack of development work, use of antiquated machinery, and a tendency to gouge out the high-grade ore, regardless of the future. When the inevitable day of reckoning comes, payrolls suffer.

The foregoing was not written in a spirit of pessimistic fault-finding, but rather in the hope that a frank discussion of the case may lead to a palliative, if not a remedy, for the conditions generally admitted to exist. Personally, I admit having fallen a victim of the wave of optimism that has swept the country in the past few weeks, and believe that the mining industry is beginning to recover its lost "place in the sun."

Looking toward a remedy for the conditions, I would suggest the appointment of a committee of the A. I. M. E. having that end in view.

KCN ENGINEER.

Oakland, California, February 15.

[This is a problem of acute interest to many mining men, and one well worth discussion.—EDITOR.]

Rhythmic Precipitation of Colloidal Ores

The Editor:

Sir—Your editorial, 'Banding in Ore Deposits,' in the *Press* of January 9, 1915, brings up a subject of great interest and one that has occupied the earnest attention of the best minds in the profession.

I make no claims as a mineralogist nor as a geologist, although this last science has had a fair amount of my attention, both in the literature and the field, for the past 20 years, and I have always been deeply interested in the articles and discussions by the recognized lights in these sciences. So when such men as J. F. Kemp occupy themselves as he does in the discussion of 'Rhythmic Precipitation and Colloidal Ores,' in the same number of *Mining Press*, it is with the greatest trepidation that one of my limitations presumes to join in. However, I have had charge of and collaborated as engineer, foreman, and manager, in the development of mining properties both in the United States and Mexico, and being somewhat of an observer, as well as student, I have noted many curious things in relation to veins, ledges, and ore deposits; and for the past ten years have held some opinions in regard to their formation that I will now endeavor to elucidate, hoping that they will meet with a charitable reception, if not acceptance.

It is generally agreed that many ore deposits are the direct or indirect result of replacement; and I am led to believe that all ledges, with some rare exceptions of sedimentary origin, perhaps, are formed by replacement. Where one watches intimately the development of a mine, day by day, he notices many little changes and blendings that escape the notice of the untrained mind, and that, also, of the expert in the profession who may visit the property for special study, when dust and powder smoke have obliterated all traces of nature's hand-writing.

If we accept the premise that most ledges *are* the result of metasomatism, and take into consideration that replacements take place very gradually and at different periods, it will be easy to conceive of a solution for ledge formation, and even banding, and deposition of minerals and metals in the same, if we take into consideration the probable motive for the formation of the ledge and the well known necessary conditions.

From your editorial and Mr. Kemp's article, I judge you conceive the original 'mold' to be an open fissure, filled with solutions, depositing the gangue on each side

and gradually filling up the fissure toward the centre. This may be the case, sometimes, but let us conceive the original fissure as simply such, with no or but slight separation of the walls, a fault plane, if you please, with the side-walls shattered and cross-fissured for a greater or less distance each way. With this condition, and the necessary thermal conditions, all will concede, with the circulating waters supercharged with the minerals, and metals perhaps, seeping along the main fissure or rent, and penetrating, in all directions, into the country rock, each way, for a more or less limited distance, thoroughly saturating the shattered rock, and in time, geologically speaking, we have a replaced silicified body of irregular dimensions of greater or less width.

In these early geologic times internal cosmic movements were frequent and intense, if we may judge from the scars on the earth's face; and the first transformation hardly takes place before intense movements, horizontal and vertical, following the lines of least resistance, again shatter the ground along the original fissure. But as the narrow replaced zone is harder than the adjacent country rock, it, the replaced zone, may hold together, although often it too is shattered and fissured and even faulted, in which case, one or two new fissures, more or less parallel to the original, are formed, one on each side of the ledge matter, ore perhaps; and subsequent, if not contemporaneous, movements, each way, cause a grinding and shattering of the weaker, and perhaps decomposed, country rock, while, at the same time, they smooth or polish the sides of the replaced body, now taking the shape of a ledge, and we have the walls.

The first replacement may be but a few inches in thickness, and again it may be many feet, all depending on the amount of lateral shattering. The greater the extent of the shattering, the greater the replacement zone is liable to have been. In this last case there would be no banding. If the fissure be direct, with little stress, and the narrow zone, by contemporary movements, be ground fine and the naturally ragged walls smoothed somewhat, the circulating waters will replace the country rock, depositing silica, let us suppose, as this is the simplest and the most common medium, forming a compact vein.

Later or successive movements may form slickensides on one or both sides, and this, in turn, will be replaced, perhaps, by a solution of different composition from the first, and this new layer will be cemented or 'frozen' to the prior layer, and be, perhaps, of a different color and carry a different metal content. This process repeated during aeons will produce a ledge of banded structure.

As you say: "The transition from one crust (layer) to another is usually distinct and abrupt, but it is hard to imagine how similarly abrupt changes could take place in the composition of the solutions, * * *" you having in mind a solution coursing along an open fissure, depositing its mineral on the sides. To conceive of banding under such conditions is not only hard to imagine, but is almost absurd, may we not say? These changes, as a rule, are *not* made suddenly in Nature's workshop; but the transformation takes place slowly, very slowly; so slowly, perhaps, that it is hard for present-day mortals to conceive of it, any more than we can the infinite, except by faith. I am not taking issue; but hope by this to draw out on the subject such trained minds and keen observers as T. A. Rickard and others, from whom I have, in years gone by, learned much.

I have seen cases of one wall with very evident replacement extending one way, blending gradually and perceptibly from pure metal-bearing quartz out to pure country rock. Again, I have seen the fissure, both walls together (in igneous rock), worn smooth, and the gangue blending each way into pure country rock. And again I have seen the usual hanging and foot-walls with ground material (slickensides) between the walls and the ledge proper, and the ledge polished, in places, on the wall sides. Sometimes this happens only on one side, while the other side is 'frozen.' I have seen, as nearly every mining engineer has seen, the banded structure parallel to the walls; and I have seen, as they must have also, seams of ore or gangue adjacent to the main body, sometimes partly frozen to this, but at times with a distinct cleavage between, and at times with a minute seam of slickensides between. At other times I have noted slickensides composed mostly of crushed and pulped ore. I have seen a ledge composed of 4 ft. of silicious sulphide ore on the foot-wall, with about the same width, on the hanging wall, of secondary calcite, carrying a fair percentage of Fe_2O_3, adjacent and 'frozen.' There was a well defined line of separation, but no separation in fact of the two bodies. These annotated conditions, together with the well known metasomatic phenomena, have induced me to come to the conclusions above given.

Electricity probably played a greater part in the formation of orebodies, and especially in the precipitation or dissemination of the metals in them, than we have any conception; and it is easy to conceive the reason for the enrichment of the contents of one fissure intercepted by another carrying solutions of different composition. The contents of neither fissure, having a silica base, we will say, need have had that base in a colloidal form, if that were possible under the cosmic conditions existing at the time of ledge formations.

E. A. H. Tays.

San Blas, Sinaloa, Mexico, January 23.

Gold and silver yields from several New Zealand mines in 1914 are as follows:

Mine.	Tons.	Value.	To date.	Dividends.
Talisman	52,210	£263,516	£ 2,368,261	£ 965,534
Waihi	183,405	329,773	10,772,662	4,681,388
Waihi Grand Junct'n.	115,710	227,600	1,026,297	110,000

The Talisman made an increase of £47,874 over 1913, and the Grand Junction £47,481, while the Waihi had a decrease of £3899. On No. 11 level on the Waihi the Dreadnaught lode was driven east for 92 ft., showing 30 in. of $9.12 ore.

CONCENTRATES

Readers of the Mining Press *are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.*

Railroads of the United States earned $2,934,823,713, a decrease of $219,701,000 compared with the gross revenue in 1913.

Royalties paid by mines in Cobalt, Ontario, to the provincial government to the end of October 1914 amounted to $1,836,050.

Traffic through the Panama canal in January amounted to 454 vessels, with 2,192,856 tons of cargo. The working force in the Zone is now under 25,000 persons.

Lime consumption in treating an old dump of tailing at the Robinson mine, near Coolgardie, Western Australia, amounted to 120 lb. per ton. Preliminary water washes reduced this large expense.

Capacity of Pachuca vats may be found from the following formula:

$$\pi r^2 h + \pi r^2 \cdot \tfrac{1}{3} h_1$$

where π equals 3.1416, r equals the radius at the top of the vat, h the height of pulp in the cylindrical portion of the vat, and h_1 the height of the cone.

Electric blasting practice on the Rand had two extraordinary accidents, one in December and another in January, by which charged holes connected for firing were set off by lightning being conducted down the mine, in the latest instance by means of the wire ropes. Several white men and natives were killed by these premature explosions.

Aeration of pulp may be effected when the charge is being agitated with mechanical stirrers. If air is introduced into the bottom of an ordinary mechanical agitation vat it is retained in contact with the pulp for a very long time owing to the horizontal centrifugal action induced, and finally appears at the top of the vat in the form of imperceptibly minute bubbles.

Modern milling practice tends toward the rearrangement of well known machines rather than to any specific improvements in the design of pulverizers. Where fine grinding is practised, three or even four-stage crushing may be economically employed, each machine being chosen for successive reduction as being specially adapted for the grade of material it is called upon to handle.

Concentration tests with a table of the Wilfley type are best made by dividing the flowing edge into a number of equal sections, and by collecting the total quantity of ore overflowing from each of these for, say, 20 seconds; and also the concentrate produced during a similar period. The resulting samples should be dried, weighed, and assayed separately, and valuable indications of the distribution of metal in the ore may be obtained by this method. A screening analysis of the product from each section should accompany the tabulation of results.

Gold and silver of the Jewel-Denero mine, Boundary district, British Columbia, occur in the iron, copper, and lead sulphides in the ore, according to the report of Wm. Fleet Robertson, provincial mineralogist, for 1914. The 15-stamp mill crushed over 16,000 tons last year, cyanide solution being used in the mortar-boxes. A tube-mill grinds everything until 90% passes 200 mesh. The mineral is concentrated and returned to the tube-mill and ground in solution until very fine. The slime is settled, agitated, and filtered on a Moore machine.

Talc is one of the materials which is not very valuable in itself, but which is sold mainly on the basis of a business built up in prepared products. For example, talcum powder, under a well advertised brand, sells at a price which per ton is extremely high, but this is due, not only to the fine grinding and attractive package, but to the years of advertising back of the particular brand, and the expense put into building up the business. The United States imports something like 10,000 tons of talc per year, and the import price is about $11 per ton. We produce about 130,000 tons, worth, say, $1,430,000.

The principal market for barium sulphate on the Pacific Coast is among the paint manufacturers. For this purpose, it must be very light in color and ground extremely fine. Efforts to grind the material by dry processes have proved futile so far, at least in California. Continued treatment in a pebble-mill might accomplish this result, but the most satisfactory product is secured by flotation. The market for this product on the Pacific Coast has been variously estimated at from 1000 to 2000 tons per year, and the latter is probably nearly correct. The finished product sells at from $20 to $30 per ton under normal circumstances, and $25 would be likely to attract local purchasers. The preparation of the chloride and other compounds requires a large chemical equipment, and even the manufacturer of ground barite requires considerable investment. There is only one plant in this part of the country making any attempt in this direction, and that is the Barbour Chemical Co., at Melrose, California. This concern secures its ore at present from Mariposa county.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

JOPLIN, MISSOURI

PICHER LEAD CO.'S VALUABLE DEVELOPMENTS AND PLANS TO BUILD LARGE CONCENTRATING PLANTS AT NORTH MIAMI DISTRICT.—BRADLEY LEAD & ZINC CO.'S NEW MILL.—A W C MINING CO.'S NEW EQUIPMENT.

At the end of its first year of prospect drilling in the North Miami, Oklahoma, district, the Picher Lead Co., of Joplin, announces that it has sunk more than 40,000 ft. of holes, has blocked out a number of separate orebodies carrying both zinc and lead, and that eight 40-acre tracts out of a total of 3000 acres have been reserved by the Company, on which it will immediately begin active mining operations. Two shafts will be sunk on the most important ore discovery made on what is known as the Crawfish 'forty.' At one point on this tract, 29 drill-holes were sunk into a semi-sheet formation of ore, occurring at an average depth of 225 ft., and continuing down to as deep as 283 ft. in places, although the average thickness was nearer 20 ft. The drill clippings showed an average blende and galena content of 11%, the former predominating by the ratio of three to one. Prospect drilling will not be discontinued. On the other hand, the drill-rigs of the Company that have been working steadily in this district will continue, as it is the intention to carry on prospecting steadily for the ensuing two years. The prospecting campaign of the Picher company is the most extensive ever launched in the history of the Missouri-Oklahoma-Kansas zinc and lead district, and the announced intention of this Company to conduct mining activities, whereas it has confined itself solely to the lead-smelting industry in the past, is considered the most important mining news of recent years, if not the most important in the district's annals. The Company was spurred to launch its big prospecting and mining campaign through the fact that the production of the district, especially the production of lead ore, was not meeting the requirements of the smelters. The Company acquired 3000 acres of Indian lands under lease, and began drill prospecting at a point immediately north of the large developed area of the present North Miami mining district. The first few months netted no encouragement, and it was not until after the Company had spent $25,000 in prospecting alone that the first good deposit was encountered; this was in the extreme northeastern corner of the Company's holdings. Three distinct ore 'runs' were found, the first at 75 ft., the next at 130 ft., and the deepest at 200 ft. The tract of 40 acres on which this first ore was found has been leased to the W. M. Sheridan Co. (Inc.) of Chicago, and a shaft, 7 by 9 ft. in the clear, is being sunk to the deepest run of ore which was considered the most extensive. A large concentrating plant is to be erected on this lease. The Picher company, after sinking a number of holes into good ore on this lease, moved its rigs to a point near the Kansas line, and drilled a string of holes through 'hogchaw' ground without finding ore. The drills were then moved to a point east of a little stream known as Tar creek, which flows from north to south through the Miami district. No mining had yet been done east of this stream, all the big producers being situated from half to two miles to the west. Immediately east of the stream, however, the Company encountered rich shallow lead and zinc at a depth of 120 ft., and the 40 acres on which this find was made have been leased to the Ortt & Buchanan Mining Co. A shaft is now into ore and a concentrating plant is to be erected at once. The Company soon after making this find moved seven of its ten drills to the Crawfish and adjoining 40-acre tracts, some distance to the southeast, and the first hole revealed the orebody which has proved so extensive by subsequent drilling. The mineralized area has been blocked out as thoroughly as it is possible for drills to accomplish, for a distance of 600 ft. east and west, and 1200 ft. north and south. While the Picher company's first two shafts are under way, material will be moved to the ground to begin the construction of a 500-ton concentrating plant, and this will be only one of a number of similar large mills to be constructed in this field.

Operations have begun at the two properties of the Bradley Lead & Zinc Co. in the Chitwood district, northwest of Joplin. Mill No. 1 is situated on a lease of the St. Louis-Joplin Lead & Zinc Co.'s land, and embraces a portion of the old A B C Mining Co.'s lease, which was a heavy producer several years ago. The old A B C mill was burned. The Bradley company

AN ELECTRICALLY EQUIPPED ZINC MILL OF THE JOPLIN DISTRICT.

has constructed a new plant of 250-ton capacity, and has a new shaft into good ore south of the old workings. No. 2 mill is one-fourth mile to the southwest, and is situated on the old Martha Ball lease. The plant formerly used by the Martha Ball Mining Co. has been overhauled and improved, and now has a capacity of 250 tons. Mining at the A B C lease is in disseminated ore, occurring in faces 60 ft. high, while at the Martha Ball tract, a sheet-ore formation, 20 ft. thick, is encountered at a depth of 200 feet.

The A W C Mining Co., operating No. 1 and No. 2 mills, west of Joplin, has purchased the plant of the Grey Top Mining Co., in the North Miami, Oklahoma, district, and is moving it to a lease of the Luke & Ash land, immediately west of its present No. 2 mill. New shafts are being sunk, one at the site of the new mill, and another midway between the new mill, which will be known as No. 3, and No. 2 mill. At this midway shaft a large hopper is being erected and tramways built to connect with either plant. The feed from the hopper can be taken out at either the west or east side. This will be used as an emergency shaft to supply ore in case the production is cut off from either of the other shafts. The new mill will have a capacity of 250 tons. Operations in this district are conducted in sheet-ground at a depth of 190 ft. C. W. Edwards has leased to Longacre & Co. the Klondike mine at Klondike, four miles northwest of Joplin. The mill is being overhauled, and the ground has now been drained to a depth of 120 to 150 ft. The ore occurs in soft ground, necessitating timbering.

PLATTEVILLE, WISCONSIN

Result of High Prices of Spelter in the Wisconsin Fields. Market Conditions, Output, and Labor Shortage.

Never before in the history of zinc mining in the Wisconsin districts have such excited conditions been witnessed as prevailed all through the month of February. Spelter quotations broke all restraints in the closing days of the month, and some idea of the gains made can be best ascertained by making some near at hand comparisons. Spelter opened on St. Louis quotations, December 1, 1914, at $5.20 to $5.25 per cwt., closing on February 27 at $10 per cwt., thus recording in the short space of 60 days a doubling in value, as some of the spelter manufacturers were demanding $11 per cwt., St. Louis, on all deliveries for March and April. Spot metal had been entirely cleaned out of the markets, and grass mill special was being quoted in advance of $11, with users turning their attention to substitutes, presumably high-grade Prime Western metal. Foreign buying orders had been filled for 1914, aggregating 58,000 tons, against about 7500 tons for the preceding year, which in itself was the beginning of the incentive for higher prices, but this demand fell off considerably during January and February of this year. This in nowise influenced an extremely active domestic inquiry, coupled with shortage of stocks in smelter's hands, which constantly grew more acute. Press and trade journal quotations closed the month 50 points under actual trading conditions, and producers showed a determined reluctance to give out information or figures for the benefit of the press. Spot and future delivery quotations are separated by a narrow margin, and it would not be the least surprising to see this margin evened up and spot and future running on even terms at the close of the current month. The situation is so overbalanced that producers claim high prices will prevail for the entire year 1915, and possibly beyond.

Sheet zinc producers advanced their base to $12.75 f.o.b. in the closing days of the month, Illinois points, less 8% discount on car lots. Exports of spelter, all varieties of make, for the month of February exceeded 5000 tons.

Prices for sphalerite, or zinc ore, kept pace with the riotous condition in the metal market. There was a period when mine operators claimed it was imperative that zinc-blende should command not less than $40 per ton for 60% metal content, in order that zinc mining might be conducted profitably, but for the first time in the history of this industry the base had risen to $69 to $75 per ton, basis of 60% zinc content, and one or two of the separating plants in the field realized fancy prices, running well over $70 per ton. Producers of zinc ore have been handicapped for years by low prices on ore, skillfully controlled, they say, by the smelter interests, who, however, reaped fair profits on low ore and metal. A long period of depression in zinc mining extending from March 1913 until August 1914, had placed the industry at low ebb. The exploration and development of zinc mines had become nominal, and now that prices have soared, there is feverish activity in all of the zinc mining regions to get leases, to rehabilitate abandoned properties, and hasten mine development on such properties as have been under observation within the past year. It requires at least six months to one year to develop and equip a zinc producer, and it is reasonably certain no great gains will be shown in production of zinc ore for another six months, and perhaps longer. The anticipation of yield yet to come out of the ground is certain to stimulate prices to attempt even higher altitudes than that already acquired. The output under the spur of such unprecedented prices as were published during February shows unappreciable gains. Miners are delighted with the situation, and now look forward to larger returns on a conservative production spread out over a considerable period of time, than through a strenuous attempt to meet with present demands at prevailing quotations.

Large consumers of metal in the East charged manipulation and concealed stocks during the beginning of February and did not realize the true situation until it was too late. Buyers of metal have been trying to option consignments for future delivery on short term options, but in this they have only partly succeeded. The truth of the matter is found in restricted stocks in the hands of both metal producers and consumers. The history of the spelter branch of the industry shows that for a score of years production and consumption have been about equally divided, and the surplus carried over at the end of the year was small. The diversion of any considerable quantity of metal, therefore, into new channels could but act as a stimulating impulse toward higher prices. Foreign inquiries have been less insistent, and metal was quoted in London through February at lower levels than prevailed in local markets.

Lead ore was in better demand following improvement in the metal markets, but prices showed no marked advance, and much metal remained concealed in stock bins. Producers of iron pyrite found a market without feature, and production was maintained, although much ore was carried over. Producers of carbonate zinc ore (dry-bone) witnessed a sympathetic attitude in quotations with spelter, 40% qualities at one time during the month going over $40 per ton, but the interests controlling this class of ore offered no market, and demand was entirely absent. Scores of small operating concerns were diligently engaged in piling up mill feed for the open season cleaning, and a tonnage conservatively estimated at over 2000 tons was carried over at the end of the month.

Severe winter weather and heavy snows prevailed over the greater part of February, and outlying mines were completely isolated; in the northern half of the field traffic was blocked for a week. Shipments failed to keep pace with demand and a reserve of 4000 tons of concentrate was carried over at the close of the month. Shipments of ore out of the field, and to separating plants in the field, during the month, were as follows:

Districts.	Zinc, pounds.	Lead, pounds.	Pyrite, pounds.
Benton	8,608,000	.....	1,261,600
Galena	4,208,000	85,000	.....
Hazel Green	3,284,000	.....	.....
Livingston	2,918,000	.....	.....
Cuba	2,092,000	.....	.....
Platteville	1,324,000	80,000	.....
Linden	1,132,000	79,000	.....
Mifflin	1,020,000	.....	.....
Shullsburg	466,000	.....	.....
Highland	66,000	.....	.....
Mineral Point	60,000	.....	.....
Totals	25,178,000	244,000	1,261,600
Mineral Point Zinc Co.	4,454,100	.....	.....
	29,632,100	.....	.....

The Mineral Point Zinc Co. shipped 60 cars of calcined zinc ore to DePue, the best month's showing made in years. During the month it received 142 cars of local production, while a heavy tonnage was received from the far western states, and some ore from Mexico entered this port. The gross output of raw ores from mines for the month aggregated 22,152,480 lb., and net refined ores from separating plants to smelter and from mines to smelter, 15,491,790 pounds. Miners were in demand all over the field, shovelers receiving $3 to $5 per day, and enough men could not be obtained even at those wages.

The principal ore buyers were as follows: Mineral Point Zinc Co., 5788 tons; National Separating Works, Cuba, 2292 tons; Grasselli Chemical Co., 1103 tons; Empire Roasters, Platteville, 955 tons; Illinois Zinc Co., 788 tons; American Zinc Co., Hillsboro, 642 tons; M. & H. Zinc Co., LaSalle, 559 tons; American Metals Co., 290 tons; Campbell Separators, Cuba, 120 tons; and Linden Zinc Co., 43 tons.

NEW YORK

THE SPELTER SITUATION AND MINES.—ANACONDA FINANCES DISSECTED.—NEW CORNELIA MINE.—LAKE COPPER MINES.—SUNDRY NOTES.

The spelter situation continues to be the all-important feature in metals. Some of the producing concerns are enjoying a gala day, especially the Butte & Superior. The resumption of mining operations took place just about the time the market started to move up. The Butte & Superior ores go to Bartlesville, Oklahoma, from the concentrator, and settlements cannot be made until assays have been checked and agreed. This requires from four to six weeks, consequently the Butte & Superior got a large advantage in its first settlements after production was resumed. The market climbed nearly every day, to the substantial benefit of the Company, and it is making about $500,000 per month, and some 'extra' dividends may safely be anticipated. When the Butte & Superior resumed, its operations were larger than before. Notwithstanding February being a short month, there was mined 39,310 tons of ore, 2000 tons better than the best month in its history. The recovery of refined zinc is estimated at 13,000,000 lb. The famine in spelter grows worse; owners of spot metal can get their own price. Bids for May delivery in London are 9.50c. per lb., while the market on this side is anything from 9.25 to 10.50c., depending on delivery date, and 10.70 is said to have been paid for some spelter, Youngstown, Ohio, delivery. The zinc mines of this country are not, however, to have everything all their own way. The large Australian mines, no longer able to send their concentrates to Germany and Belgium, are seeking a market in the United States. It is stated that the American Metal Co. has purchased 40,000 tons of concentrates, and the New Jersey Zinc Co. a smaller consignment. The Butte-Duluth property, which is looked on as a possible zinc producer, its lands being almost surrounded by those of the Butte & Superior, and which has been under option to the Anaconda, is now under option to new interests. The Anaconda allowed its right to purchase to expire last week. It is stated that the new possible purchasers are connected with the Butte & Superior, though this is not wholly authoritative.

The sale of the United Metals Selling Co. by the Amalgamated Copper Co. to the Anaconda has resulted in a flood tide of figures working out the readjustment of the two companies. Amalgamated owns 3,070,784 shares of Anaconda, 150,000 shares of Inspiration, 30,800 shares of Greene Cananea, and $1,000,000 of bonds of the Butte, Anaconda & Pacific Railroad Co. The dividends received from Anaconda, and the interest received on the bonds of the railroad company comprise the entire present sources of revenue for Amalgamated. The capital liability of the Anaconda has been increased by about $27,500,000—$9,000,000 for the International Smelting & Refining Co., purchased early in 1914, at which time there was also provided $2,500,000 for new construction work for this refining company; now $12,500,000 for the United Metals Selling Co., and $3,500,000 for improvements. It becomes at once a question as to what the Anaconda received for this increase in liabilities. At the time the smelting company was acquired it was figured that in cash and quick assets it brought into the Anaconda treasury approximately $7,000,000, leaving the net liability incurred at about $4,000,000. The earnings of the International have always been large enough to justify the assumption of the liability which Anaconda took on at that time. The present purchase of the United Metals Selling Co. involved the issuance of notes to the amount of $16,000,000, which is largely offset, however, by the quick assets received in the deal. Anaconda gets 141,900 shares of its own stock, at the present market worth $3,500,000. Since 1910 the selling company's reports have been thrown in with those of the Amalgamated Copper Co., but at the close of that year the Selling Company had about $7,000,000 quick assets, without counting the stock of the International, which latter now comes back to Anaconda as its own stock, as just mentioned. It is fair to assume that the United Metals company is in better position now than in 1910, even if only a little improved it would bring to the Anaconda very nearly enough in quick assets to offset the note issue. The saving in commissions on copper, about $400,000, earnings on outside copper handled, say $150,000, plus the saving in dividends on the 141,900 shares of stock, which would be $141,900 at the present rate of distribution, may all be credited to offset the interest on the notes, $691,900, against an outlay of $800,000. Considering the outlook for large earnings for the Anaconda, apparently the moves which are being made are advantageous. The real question remaining is what is to happen to Amalgamated. It is now left without any multiplicity of interests; its speculative features can only be analyzed through a knowledge of what Anaconda may be doing. If it passes into history, its going will create a great opportunity for reminiscence. The February production of the Anaconda was 15,000,000 lb., about 65% of normal.

The problem of leaching oxidized ores is apparently coming in for a continually increasing amount of attention. The Cole-Ryan staff, headed by L. D. Ricketts, is making a serious attempt to devise a successful treatment for the overburden at the New Cornelia. The New Cornelia is to be a steam-shovel property. Drilling has proved 40,000,000 tons of 1.5% ore with a large percentage of drill-holes stopped in ore. There will be some financing required, but just how it is to be done has not yet been determined. In the matter of processes, there is some thorough work going forward in preparation for the next hearing of the Minerals Separation company against alleged infringers of its patents, and some important developments are said to be quite probable. These matters are quite apart from the problem being worked out in the Lake region for the treatment of old dumps. It may be expected that, with all the energy that is being expended, there will be devised a way for the profitable treatment of the various dumps in the copper country, the metal content of which is well known, and which are very largely in position where they can be rehandled cheaply. The Calumet & Hecla is selling all of its present production to domestic consumers. The Houghton refinery of the Calumet & Hecla installed this week one large dipper to do the work of eight smaller ones in pouring molten copper into the molds.

There is a good deal of activity among the Boston coppers. South Lake, one time the sensation of the list in Boston, is about to do some new financing; an offering of treasury shares to the stockholders is anticipated. Indiana, a neighbor of the South Lake, is doing some exploring underground in an attempt to find its famous No. 2 drill-hole. This drill-hole was one of the factors that helped South Lake sell above $90 per share when it 'sky-rocketed,' some years ago.——The Winona has been making money recently, although not operating. When the war broke out the Winona had some 600,000 lb. of refined copper on hand. It still has the metal, but it is worth 15c. today and shows a handsome profit over carrying charges as compared with the price for which it could have been sold when it went into storage.——The Baltic mine of the Copper Range Consolidated is producing the richest 'rock' ever mined by an amygdaloid mine in the Lake region, averaging for three months 30 lb. of copper per ton.

There was a time when Nevada-Utah was a name to conjure with in the New York mining markets; now the traders, save a few old-timers, would not recall it as a one-time big leader, handled by Lawson in his most spectacular manner. Even the old-timers would tell you it was dead; but dispatches state that the property is shipping 42% zinc ore to the Pueblo smelter. In the meantime the Lawson followers have been liquidated out very thoroughly.

There is being so much done in the way of readjustment that it is bewildering at times, and to some of the older

people some of the movements must seem to be born of outlawry. London is being assailed in many ways to take away various trade privileges long enjoyed, in the matter of metal quotations, London has always made quotations for the rest of the world. Now Berlin, through the 'elders of the merchants' is resolving to make independent quotations on zinc, lead, aluminum, and antimony. Heretofore, notwithstanding Germany's pre-eminence as a producer and a consumer of zinc, the price for the metal has been fixed in London.

BOSTON

Goldfield and Boston.—The Tirbircio Gold Mining Co., Calumet & Montana Consolidated Mining Co., and Fortuna Mines Corporation.—Anaconda and Butte-Duluth.—The Banker Mine.

There is a disposition on the Boston Curb at present to 'quarantine' Goldfield, as buying stocks there seems to be buying into litigation. It is thought here that a general apex fight is to start which bids fair to equal the long-drawn-out contentions which raged at Butte several years ago. This is unfortunate, because Boston had begun for the first time in its history to take some real interest in the Goldfield share market. Thereby hangs some history concerning Goldfield Consolidated. A few years ago, when that property was paying large dividends from high-grade ore, one of the leading Boston porphyry copper capitalists was a member of the board of directors, but became involved in an acrimonious war of words with the president of Goldfield Consolidated at a meeting in the Waldorf hotel in New York, so the story goes. As a result the Boston copper man withdrew from the board, and it appears that on account of his resignation a large amount of Boston activity and influence was thereafter alienated from Goldfield's premier mine. Since then the Boston man has been active in bringing out various low-grade copper and gold properties, but "never again" was he to be identified with a high-grade one. Little differences, like that between the actual and potential length of Cleopatra's nose, frequently change entirely the course of history. Boston still refuses to yield to treatment in Goldfield excitements, being still joined to the coppers, letting New York take the lead in making a market for the Goldfield, Tonopah, and Cobalt issues.

New England interests owning large blocks of shares in the Tirbircio Gold Mining Co. are making a strong effort to finance the installation of a cyanide plant and put the mine on a producing basis. The property is situated near La Plata, Colorado, 17 miles from Durango. There are about 400 acres of lode and placer claims, with about 1500 ft. of adits driven, exposing a mineral zone which the friends of the Company claim contains 5,000,000 tons of ore averaging about $6 per ton, which can be mined and treated at a profit of $2 per ton. Approximately $350,000 has been spent, it is stated, in the purchase of the property and its development and equipment. The latter includes a 1000-ton capacity rock-crusher, from which ore is delivered by gravity tramway to a 50 and 10-stamp mill, a distance of 4000 ft. Water rights on the La Plata river, owned by the Company, are said to have a value of $150,000. Henry C. Demming, geologist, Harrisburg, Pennsylvania, has made favorable reports on the property, and says it will take over 50 years to exhaust the mine. It is expected that Mr. Demming will become locally identified with the Company, which intends to operate as a mining and custom mill concern.

Shares of the Calumet & Montana Consolidated Mining Co., formerly known as the Dark Horse, in the Bitter Root mountains on the divide between Montana and Idaho, have been listed on the Boston Curb for trading. The Company is a reorganization of the Calumet & Montana Mining Co., which went into bankruptcy a few years ago. The revival of the property is influenced principally by the certainty of the building of the Boston & Montana Development Co.'s railroad, the Southern Montana, from Divide, Montana, on the Oregon Short Line, to Jackson, Beaverhead county, Montana, which will place these mines within shipping distance of a railroad. It is expected that the Southern Montana, when completed to Jackson, will be extended across the Bitter Root range on its way to the Pacific Coast, crossing at or near the Dark Horse property. This consists of 228 acres. Ernest Le Duc, a Duluth mining engineer, has examined it, and recommends that it be put on a producing basis. I. Grettum, of Duluth, is president of the reorganized Company.

Active trading in the shares of the Fortuna Mines Corporation has taken place since listing on the Boston Curb here recently. The Company owns the old Fortuna mine, in the Fortuna district, Yuma county, 22 miles southeast of Yuma, Arizona, at the foot of the eastern slope of the Gila range. The general manager is Frank B. Keever, and consulting engineer, T. C. Woodworth, both of San Francisco, who are now in Boston in the interest of the Company. The president and treasurer, F. E. Boland and Frank B. Hobbs, are both San Francisco men. The eastern office is 31 State street, Boston, and the western office is in the Sharon building, San Francisco. Associated with the management will be Fred J. Martin, superintendent of the Utica mine, Angels Camp, California, who operated the Fortuna 20 years ago for the late Charles D. Lane, during a period of eight years, in which the mine produced $3,000,000 in gold and paid dividends of $1,180,000. This profitable career was interrupted 10 years ago by a cross fault, and after spending $500,000 trying to locate a continuation of the vein, the old owners decided to part with the mine, and the present Company acquired it. The story now is that, after spending $100,000, the present management has recovered the vein on the opposite, or south, side of the fault, the only place where the former management had not looked for it. The Company has a capitalization of 500,000 shares, par $1, and began trading here at $1.25, afterward advancing to over $2. Ex-governor Foss is a large stockholder.

Surprise is expressed here at the Anaconda company failing to take up its option on the Butte-Duluth properties of A. B. Wolvin, but the failure is said to be a matter of a difference in price only, Anaconda bidding $1,000,000, and Wolvin holding out for $1,500,000.

Ray J. Barber, a mining engineer from Boston, is now in Leadville, Colorado, with associates for the purpose of resuming operations at the Banker mine, situated on the western slope of Breece hill, about three miles east of the business centre of Leadville. It is understood that the mine is to be unwatered to the 350-ft. level, on the theory that the former management uncovered a rich body of ore in driving from that level, and kept the discovery secret. This mine was active until the death, 12 years ago, of John Duth, of Leadville, who had entire control of the property. It is said that over $200,000 has been spent in developing and equipping it, sinking a shaft down over 1000 ft. When the Yak drainage tunnel was being driven, it would have passed directly through the Banker property, but Mr. Duth would never consent to this being done, although it would have resulted in cheap drainage, power, and transportation to the mines, without any additional cost. On account of his attitude the tunnel course was deflected, and now runs about 90 ft. south of the end-line of the Banker property. Some of the old stockholders claim that Duth's opposition to the tunnel passing through the property was based on his fear that in this way underground conditions would become a matter of outside knowledge. The property was sold for taxes a few years ago, and was bid in by G. Johnson Rittenhouse, of Los Angeles, who became sole owner. It is stated that there will be at least $200,000 spent on reopening the mine by Boston capitalists.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press.

ALASKA

Juneau

January returns from the mines on Douglas island were as follows:

Details of operation.	Alaska Mexican.	Alaska Treadwell.	Alaska Ready Bullion.	United. 700-Ft. Claim.
Development, feet	185	912	890	349
Stock of broken ore, tons.	12,422	47,128	+ 4,348	- 14,639
Stamps working	120	540	120	120-150
Ore crushed, tons	18,865	75,488	19,684	23,940
Gold by amalgamation	$20,015	$75,971	$24,965	$30,021
Concentrate cyanided, tons	402	1,613	433	534
Gold from concentrate	$21,806	$70,355	$19,360	$28,149
Total realizable value	41,402	144,863	43,882	57,589
Operating expenses	23,193	83,221	27,309	24,274
Construction	3,955	12,488	4,903	2,905
Net profit	$14,255	$49,154	$11,669	$30,409

At the 700-Ft. Claim, 30 stamps worked from January 10 to 31, inclusive, making 150 in all. On February 26, steam power at the Ready Bullion mill was changed to electric motors, although the former plant is still supplying steam for the hoist and compressor, which will be electrified this year.

ARIZONA

Cochise County

A drill-hole from 1800 ft. in the Junction mine of the Calumet & Arizona, at Bisbee, passed through 35 ft. of good sulphide ore some time ago. The hole was in the direction of the American-Saginaw claims, purchased over a year ago. The upper levels, above 1000 ft., of the Irish Mag claim have been leased to miners.

Maricopa County

The annual meeting of the Monarch Mining & Smelting Co. was held at Wickenburg on January 27, when directors and officers were elected. The president, J. H. Mulholland, stated that in March 1914, the Company was heavily in debt and the mine shut down. Of the $50,000 paid by him and associates for 750,000 shares, less than $225,000 was available for mine development. A 100-hp. Fairbanks-Morse gas engine for general power purposes, a 12-hp. engine of the same make for the concentrating floor drive, electric lighting plant, another set of rolls, and a table were purchased. These installations took four months. The property had a good surface showing of copper ores, but development proved them to be irregular in formation. Any profit in this ore was doubtful. In June 1914 it was decided to raise the capital of the Company from $1,500,000 to $3,000,000; but the war started, affecting the copper and money markets. Eventually $20,000 was secured to proceed with development until next October or November. At December 31, 1914, the real assets showed a balance of $62,523 over liabilities, other than capital stock.

Mohave County

The Golconda mine is being opened at 800 ft., and the shaft is to be sunk to 1000 ft. as soon as possible. Rich zinc ore is showing in the new level.——Six feet of zinc ore was cut recently in the Columbus mine at Cerbat. At present it is being piled on a dump.——It is reported that the Arizona Western Mines Co. is to sink to 500 ft. and open the gold-silver-lead and zinc-lead deposits on its ground in the Chloride district.

CALIFORNIA

Calaveras County

Twenty stamps are to be added to the existing 100 head at the Melones mine at Angels, while four miles of fluming is to be repaired this summer.

Eldorado County

Some rich ore has been found again in a pocket of the Jones mine at Ringgold, which is bonded to N. Judson. Several similar bonanzas have been opened during the past few months.——A valuable deposit of molybdenite is reported to have been opened by Y. A. Murray on the road to Grizzly Flat.

Kern County

At Johannesburg, the Phoenix Mining Co. has a shaft down 300 ft. on the incline, and total development amounts to 2500 ft. A wide vein is being opened. Lessees have 15 men em-

JOHANNESBURG, KERN COUNTY, CALIFORNIA.

ployed. Equipment consists of a 10-stamp mill and a 25-ton cyanide plant. A dump of 38,000 tons of tailing is to be treated.——The Atolia Mining Co., five miles south of Randsburg, a producer of tungsten ore, has decided to grant new leases, subject to 60 days' notice.

Nevada County

On March 7 the incline rise from 2490 ft. in the Champion mine was connected with the 1000-ft. level, constituting one of the best underground feats of the district. The rise makes good ventilation throughout the Champion mine, and will aid development greatly. A winze was started from 1000-ft. to meet the rise, and connection was excellent. Time taken was over a year.

The North Star company, which owns the Champion and Providence properties, is to enlarge the Providence shaft down to 1800 ft., and install a large electric hoist and erect a head-frame. After this is done, the shaft will be sunk deeper. At present the Champion shaft is mostly used for hoisting ore and supplies, and this new arrangement will relieve the pressure at that point.——Fifty cars of gravel awaiting washing at the Goodwin mine at You Bet was washed by thieves, who also cleaned up at the sluice-boxes. It is estimated that $2000 was stolen.

Placer County

The Rough and Ready gravel mine at Dutch Flat has been acquired by the newly formed Federal Drift Mining Co. of San Francisco. A plant of 250-ton daily capacity is to be installed.

PLUMAS COUNTY

A caterpillar tractor of 40-ton capacity is to be used by the Engels Copper Mining Co. to haul supplies to the mine and concentrate to the Western Pacific line at Keddie, a distance of nearly 40 miles. It is estimated that freight will be reduced from $11.50 to $2 per ton by this means.

SHASTA COUNTY

The Noble Electric Steel Co. will probably resume production of pig iron and ferromanganese in April. ——At the Bright Star, near Stella, the shaft is being sunk to 170 ft. A 5-stamp mill is to be erected at once.

Thirty-five tons of flint pebble from Europe is being sent from Redding to the Globe mill at Dedrick, Trinity county, in 50-lb. sacks, by parcel post. The reason of this means of transport is on account of the bad roads.

SIERRA COUNTY

The rich shoot cut in the Kate Hardy mine continues to open satisfactorily.——The Tightner company at Alleghany has started sinking a large shaft. Rich ore is still being extracted, and the 20-stamp mill kept busy.

SISKIYOU COUNTY

At Happy Camp the Reeves-Davis placer claims have two giants at work. Recent storms damaged the ditches to some extent.——The Siskiyou Mines Co. has three giants sluicing. ——The district is generally busy.

SONOMA COUNTY

Directors of the Sonoma Magnesite Co. have discussed preliminary plans for the erection of a plant to manufacture by-products, such as precipitated magnesia for firebrick, magnesite stucco for imitation marble, ornaments, and calcined magnesite materials. The 13-mile narrow-gage line from the mines to the Northwestern Pacific, north of Guerneville, will be in operation in a few days. Chicago capital is interested in this concern.

TRINITY COUNTY

On Rush creek, near Weaverville, the Rush Creek Gold Mining Co. is planning more extensive work on its 22 gravel claims, and is enlarging its ditches and flumes. M. E. Eastman is general manager.

TUOLUMNE COUNTY

The White Lead gravel claims near Columbia have been acquired by C. M. Belshaw, C. C. Gross, and J. M. Jackson, and extensive work is planned.

COLORADO

LAKE COUNTY (LEADVILLE)

All is in readiness at the Penrose pumping shaft for the new pumps. A large tonnage of zinc carbonate and sulphide ore is being mined from Yankee hill.——A large body of carbonate has been opened in the upper levels of the Wolftone. ——The Banker mine on Breece hill is to be reopened this spring. One method of drainage would be a connection with the Yak tunnel.——Denver people have leased the Jennie June claims in the East Tennessee district, and four feet of gold ore has been cut.

OURAY COUNTY

The Camp Bird company reports as follows for the last quarter of 1914: development, 688 ft.; stoping, 93,920 cu. ft.; ore broken in stopes, 20,345 tons; ore treated, 8882 tons; revenue from bullion and concentrate, $246,916; net profits above all expenses in Colorado and London, $120,000; and profit from Santa Gertrudis company of Mexico, $115,000. It is not considered that during the period ore developments added to profit reserve of consequence.

TELLER COUNTY (CRIPPLE CREEK)

The gold output of this district in February is estimated as $1,355,661 from 72,100 tons of ore.——At the Midget mine the shaft is 900 ft. deep and it is proposed to sink 100 ft. further when the Corundum vein should be cut. The February output was 2+ cars of ore. The Company is to spend $15,000 on development and plant. J. F. W. Doepke is manager. ——Three feet of $60 ore has been opened in the Wreck Lode claim on Bull hill.

The Golden Cycle Mining Co.'s properties have been acquired by the Vindicator Consolidated company for $4,500,000 cash, the principals in the transaction being John T. Milliken, A. E. Carlton, E. P. Shove, and others. This will settle the litigation between the two companies, involving $1,000,000.

About 200 tons of ore worth $500,000 was sent from the Cresson mine to the Globe smelter at Denver, but as there was a large difference between the assays, the lot is to be treated in a special run at the Golden Cycle mill at Colorado City.

IDAHO

SHOSHONE COUNTY (COEUR D'ALENE)

On April 1 the Interstate-Callahan Mining Co. will pay a dividend of 25c. per share, amounting to $115,000. The directors have decided to distribute this each quarter. The gross earnings from the shipment of 150 tons of crude ore and concentrate daily to the smelter are about $500,000 per month. There are 155 men employed at present. J. H. Robbers is general manager. In the Idaho mineral display at the Exposition at San Francisco is a piece of Interstate ore weighing about 3800 pounds.

Renewed interest is being taken in the Big Creek lead-silver district, especially since milling ore was opened in the Magnee claim. Transportation facilities have held back development of the area. Over $50,000 has been extracted from the Yankee Boy mine in the past three years. One of the largest properties is that of the Liston Mining Co., in charge of Matt Baumgartner. An adit has been driven 2600 ft., of which 600 ft. has been on a wide vein. Other work has been done on the Big Creek, Western Star, Blue Bell, Bunker Hill Extension, Rockford, Coeur d'Alene Central, and Bismarck claims. Road construction has occupied miners on the west fork of the creek.

Nine feet of lead-zinc ore has been opened in a rise from 2200 ft. in the Frisco mine at Gem. All work had been concentrated on this rise, but the whole mine will be reopened about April 15. The mill, with a flotation process recently installed, will be ready by that time.

In the suit of the Ontario Mining Co. *v.* the Stewart Mining Co., Judge Flynn on March 2 decided in favor of the former for $48,245, holding that the trespass existed from January 20, 1914, to September 2, 1914, and estimates the amount of ore taken out as about 70,000 cu. ft., 10 cu. ft. to equal one ton. He decided that the trespass was partly innocent and partly wilful, and divided the ore removed into two groups. The wilful trespass was set at 46,662.75 cu. ft., while 24,030 cu. ft. was taken innocently.

MISSOURI

JASPER COUNTY

The output of the Missouri-Kansas-Oklahoma district during the last week of February was as follows: blende, 7,015,260 lb.; calamine, 1,743,700 lb.; and lead, 1,301,970 lb., making the nine weeks' total of 85,591,490 lb., 7,226,580 lb., and 12,979,620 lb., respectively, worth $2,948,181. Principal district outputs were:

District.	Blende.	Calamine.	Lead.
Joplin	1,221,230	76,160	235,430
Webb City-Carterville	2,241,390	.....	606,410
Alba-Neck City-Purcell	.....	665,880	.....
Oronogo	574,230	.....	79,050
Duenweg	468,270	.....	21,320
Galena	662,110	.....	57,070
Miami	378,510	.....	.....
Granby	90,640	1,422,860	48,270

ST. FRANCOIS COUNTY

The annual meeting of the St. Joseph Lead Co. of Flat River was held on February 15, and Robert Holmes has issued a 22-page circular on the Company's affairs. The vote for directors resulted in the election of the administration ticket, which received 1,031,640 shares, and 229,282 shares for the opposition

MAP OF THE FLAT RIVER LEAD DISTRICT, MISSOURI.

ticket. The former vote was a decrease of 187,851, and the latter a gain of 16,370 shares over last year. The discussion of the Company's connection with the Doe Run Lead Co., Farmers & Miners Trust Co., and others, is so mixed that a full study of the pamphlet is necessary to grasp it.

MONTANA

It is proposed to organize a Montana branch of the American Mining Congress, and H. S. Taylor has started canvassing in Granite county.——The Montana Power Co. sells current for light and power to 28,500 consumers in this state for domestic, industrial, mining, and railroad purposes. Net earnings in 1914 amounted to $2,639,239.

JEFFERSON COUNTY

The old Clancy district contains many lodes carrying zinc, and there is a revival of interest in the properties, including the Hope, Joe Garneau, and Clancy.

POWELL COUNTY

The Nigger Hill silver-lead district, eight miles south of Elliston, is shipping ore from the Black Jack, Democrat, Nystrom & Co.'s lease, Carbonate King, and Big Dick, in which considerable work has been done.

SILVERBOW COUNTY

It is reported that the American Zinc Co. has leased the old Emma mine in Butte county from the owners, the Butte Copper & Zinc Co. Good zinc ore had been developed at 800 ft., with about 2% copper.

NEVADA

ESMERALDA COUNTY

The estimated production of the Goldfield Consolidated company for February is as follows: Ore mined, tons, 29,864; gross extraction, $340,000; operating expenses, $168,000; and net realization, $172,000. According to the secretary, A. H. Howe, rumors that the Company is likely to be mixed up in litigation with the Reorganized Booth company over apex rights are not true, an agreement having been made last December whereby the Consolidated was given a release from liability for past ore extraction and the right to continue to mine within its vertical boundaries. The Consolidated has leased part of its Grizzly Bear mine, from 1400 ft. down, to the Atlanta company. In the Booth-Jumbo Extension suit, it has been arranged that the latter Company can resume work in a few days. According to the report of the Extension for the last quarter of 1914, the production was 5658 tons of ore valued at $74.37 per ton. Extraction cost $3.01 per ton, totaling $16,513. Development amounted to 1406 ft., at $9.03 per foot, or $12,702. Net profits were $255,020. Dividends totaled $100,396. In January there was 1572 tons of ore shipped worth $67,873, of which $41,328 was profit.

The Florence Goldfield Mining Co. held its annual meeting last week. The output was 8029 tons of ore worth $211,859. Operations cost $140,428. On December 31, 1914, the cash balance was $124,793. The manager, Harry B. Clapp, stated that development totaled 2601 ft. at $4.35 per foot. The cost of stoping and delivering ore in railroad cars was $1.29 per ton. It was previously decided to sink the main shaft from 1270 to 2000 ft. to cut the latite-shale contact, but this is to be postponed. To try to prove its apex rights in the Jumbo Extension suit, the Booth company has started sinking an incline shaft on the vein, 400 ft. south of its present shaft.

LINCOLN COUNTY

Control of the Prince Consolidated at Pioche was recently obtained by Godbe Bros. of Salt Lake City, and M. C. Godbe has been examining the property. The mine never looked so promising as at present, and the daily production is 475 tons of ore.

NYE COUNTY

Seven mines at Tonopah produced 10,408 tons of ore, worth $213,304, during the first week of March.——Renewed interest is being taken in the western area of the district since the important development in the Monarch-Pittsburg mine, and it is reported that the Tonopah Mining Co. is taking over 16 or 18 claims nearby. In the Monarch-Pittsburg the crosscut is out over 80 ft. in the formations cut, with no foot-wall in sight. Assays have shown irregular values.——Arguments by counsel in the Jim Butler-West End suit started March 8.

UTAH

BEAVER COUNTY

Thirty per cent zinc ore is being shipped from the Cedar-Talisman in the Star district. S. S. Pond is in charge.

Twenty-three iron-ore claims near Newhouse have been relocated by L. P. Palmer, T. Marioneaux, S. H. Taylor, and L. Hall of Salt Lake City. A large vein of smelting flux, containing 50% iron and $3 to $5 gold per ton is included. It is low in silica. At present the ground is covered with snow, but work will commence in the spring.

In the Leonora mine, in the Star district, high-grade zinc ore is to be shipped in a few days. The silver-lead shoot has been opened for 195 ft. A. C. Nebeker is superintendent.

JUAB COUNTY

Ore shipments from Tintic in February only totaled 297 cars, compared with 430 in January, although the latter month included five weeks. Storms, shortage of power and water, and low silver contributed to the decrease in February.——Lessees in the Yankee Consolidated are shipping high-grade zinc ore, seven of the nine sets working in this ore. On account of bad roads the zinc ore from the May Day is held up.

SALT LAKE COUNTY

Since 1910 the Cardiff mine has yielded $100,550 net from 3340 tons of ore. The property has been opened to 300 ft., and there has been 5085 ft. of development accomplished. The Cardiff Mining & Milling Co. has been listed on the Salt Lake

Stock Exchange.——The Montana Bingham company's tunnel is in over 3600 ft., two machines advancing about 5 ft. per day. The flow of water is 200,000 gal. per day. Some important developments are expected shortly. The following properties expect to use the tunnel for mining purposes and cheaper transport of ores to the railroad: Montana Bingham, Bingham Amalgamated, Bingham-Consol, Keystone, Extension, and Fortuna. By driving to the south, the tunnel will also cut the orebodies in the Starless mine, where it is said that about 1,000,000 tons has been blocked out.

SUMMIT COUNTY

The annual meeting of the Silver King Consolidated Mining Co. was held in Salt Lake City on February 27. Solon Spiro was reelected president and general manager. Ore sales totaled $346,990, and total revenue in 1914 was $797,884. Cash on hand and cash loans on January 31, 1915, were $61,266 and $141,131, respectively. The Spiro transactions were discussed. Development in the mine totaled 10,127 ft. Owing to the metal market, production was stopped after the war started. Prospects at 1700 and 1800 ft. are good.

The ore production of Park City in February totaled 8517 tons, the heaviest in over a year. The mines contributing were as follows: Silver-King Coalition, 4034; Daly-Judge, 1855; Daly West, 1778; and Silver King Consolidated, 850; a total of 8517 tons.

WASHINGTON

FERRY COUNTY

(Special Correspondence.)—During the past week meetings were held in Republic by the miners and business men of the district, discountenancing irresponsible mine operators, and urging prompt pay-days. The outcome was the appointment of committees, to act jointly as an investigating and advisory board, whose principal duties will be to ascertain and report as to the responsibility of operating companies. On adjournment of the last joint meeting of the miners and merchants (not the committees), the business men remained and took steps to organize a business men's club. Behind all is the moral support of the community.

The Ben Hur mine is now producing good ore from the stope north of the shaft above the 200-ft. level.——G. C. Taylor, assayer at Republic, has received a letter from the Consolidated Mining & Smelting Co., Trail, British Columbia, stating that the Canadian tariff does not apply to any kind of ore.

Republic, February 26.

OKANOGAN COUNTY

(Special Correspondence.)—Inquires are being made about a story said to have been published in *The Chicago Examiner* relative to a mine in the Adirondack lode for which one F. A. Mabee and his wife are reported to have refused $10,000,000. The property referred to, from a story printed in *The Okanogan Independent*, is in Sheridan district, just over the Ferry County line, in Okanogan county. One W. R. Foley, alleged to have been connected with the deal, is said to have skipped out, a defaulter to the amount of several thousand dollars.

Republic, February 26.

The Golden King Mining Co. has announced that construction of a mill will be started next month on its property, which is near Oroville. Work has commenced on a 4 to 10-ft. vein which assays from $6 to $8 per ton.——The Golden Zone company, in the same district, is driving a 1400-ft. adit. The management is planning to enlarge the present mill, which has not large enough capacity.——The Ivanhoe people are driving a 4000-ft. adit and some ore has been cut, but there is about 1600 ft. yet to go before cutting the main orebody.

The mining department of the state college has agreed to investigate and make a public report on the proper metallurgical treatment for the low-grade silicious silver ores of the Okanogan country.

STEVENS COUNTY

Spokane people, including J. L. Harper of Republic, are negotiating to acquire the Copper King mine, at Chewelah, for $300,000.——A flotation plant has been ordered for the United Copper company's 150-ton mill. Conrad Wolfe, of Spokane, is president of the Company.

CANADA

BRITISH COLUMBIA

Ore is soon to be shipped from the Rocher de Boule mine near Hazelton, and an output of 100 tons of 12% copper ore is expected to be maintained. A 3½-mile aerial tramway connects the mine ore-bins with the Grand Trunk railroad to Prince Rupert. Adits have opened four extensive shoots. J. E. Oppenheimer, of Butte, B. Binnard and John F. Cowan, of Salt Lake City, control the Company.

ONTARIO

Ore shipments from Cobalt in February amounted to only 996 tons, the lowest in seven years. The power shortage was mainly responsible for this low tonnage. Bullion shipments during 1914 totaled 9,624,629 oz., according to A. A. Cole, mining engineer for the Temiskaming and Northern Ontario Railroad Commission.——On April 3 the McKinley-Darragh company will pay 3%, equal to $67,431, making 199% and $4,722,140 to date.——A Cobalt mine's surface magazine, containing about 5000 lb. of powder, narrowly escaped being blown up last week, a fuse having been laid by some miscreant, but went out near the cap.——The Nipissing Mines Co. has temporarily ceased work on the Teck-Hughes property. The Company has an option on the property, which is controlled by the Great Northern Silver Mines Co.——On account of the power and silver situation, the Trethewey mine and mill have been closed indefinitely, putting 100 men out of work.

The Dome mine in January produced 23,220 tons of ore averaging $3.56 per ton.

YUKON

The Yukon Gold Co.'s output in 1914 was valued at $4,307,000, of which $3,143,000 was from the Dawson district, against $3,600,068 in 1913. The net profit was approximately $1,500,000.

MEXICO

BAJA CALIFORNIA

(Special Correspondence.)—Everything is quiet in this part of Mexico, but at times the people suffer inconvenience from scarcity of supplies and news, due to the irregularity of the steamers. The new governor, General Ortega, recently issued a decree for all people here, including foreigners, to deliver any and all firearms they may have to the government. Export duties have been materially increased. The export duty on gold bullion, including other attendant fees now comes to about 10 per cent.

La Paz, February 28.

HIDALGO

The Santa Gertrudis company reports as follows for the last quarter of 1914: ore treated, 64,429 tons; bullion produced, $370,000 (U. S. gold); and profit at the mine, $160,000. On account of the scarcity of supplies the treatment capacity was reduced from 85% in November to 40% in December. Work was not hampered by political occurrences. In the upper part of the mine, development totaled 1663 ft., of which 1146 ft. was in average low-grade 'pay' ore. Generally the work was very satisfactory. It was again necessary to repair the timbering of San Guillermo shaft where it passes through the vein. In connection with vein No. 8, a hanging-wall orebody was developed on No. 9, 11, 13, and 14 levels, where it was from 60 to 80 ft. long, and averaging 30 ft. in width. Further work on No. 9 level shows it is worth $13.20 per ton; No. 11, 31 ft. wide and $35.88; No. 14, 13 to 47 ft. and $22.54 to $26.76 per ton.

PERSONAL

Francis Drake has left Buluwayo for Capetown.

Oscar Hershey was in San Francisco during the week.

C. H. Benedict is spending a holiday in San Francisco.

Clifford Dennis was in San Francisco early in the week.

W. J. Loring has gone to visit mining properties in California.

O. E. Kirkpatrick, of Leesburg, Idaho, is in San Francisco this week.

J. H. Bigger has returned to Tampa from an extended trip through Honduras.

H. V. Winchell and J. R. Finlay will act as experts for the Jumbo Extension Mining Co. in litigation at Goldfield.

W. D. Blackburn, who has recently been assisting George H. Garbly on work in the Tonopah district, is now in Texas.

Thomas M. Skinner, Jr., has moved from Red Cliff, Colorado, to Keeler, California, care of the Inyo Development Company.

L. Ferdinand Johnson has returned to San Francisco from Sierra county and will be at 953 Monadnock building until May 1.

A. M. Yonge is spending a holiday in the United States and expects to pass through San Francisco early in April, returning to Costa Rica.

Leo Von Rosenberg has left the Ray district of Arizona for the Cripple Creek district, Colorado. He will be in New York by the end of March.

L. O. Kellogg, formerly on the editorial staff of *The Engineering and Mining Journal*, is now associate editor of *The Engineering Magazine*.

C. R. Olson, recently of Aurora and Tonopah, Nevada, has been appointed mill superintendent for the Pittsburg-Dolores Mining Co., Rockland *via* Yerington, Nevada.

Frank M. Leland, general manager for the Balaklala Consolidated Copper Co., at Kennett, California, has been appointed general manager for the Trinity Copper Co. also, the claims of which are adjoining.

F. McN. Hamilton was recently in the Nevada City and the Grass Valley districts, California, visiting the mines. Errol McBoyle, also representing the state mineralogist's office, spent several months in Nevada and Sierra counties during the past year.

At the Canadian Mining Institute meeting at Toronto the following officers for 1915 were elected on the third day: President, G. G. S. Lindsey, Toronto. Vice-presidents, Thomas Cantley, Sydney, Nova Scotia; A. A. Cole, Cobalt, Ontario. Councillors, M. B. Baker, Kingston, Ontario; J. W. Bell, Montreal; R. W. Brock, Vancouver, British Columbia; Theo. C. Denis, Quebec; D. A. Dunlop, Toronto; M. B. R. Gordon, Cobalt; G. C. Mackenzie, Ottawa; D. H. McDougall, Sydney, Nova Scotia; J. T. Stirling, Edmonton, Alberta; and A. J. Young, Toronto.

W. H. Johnston, of Ishpeming, has resigned as general superintendent of the properties of the Oliver Mining Co. on the Marquette range. Mr. Johnston has been actively associated with the Lake Superior Iron Co. and the Oliver Iron Mining Co. for the past 39 years. He became general superintendent several years ago, when the Steel Corporation subsidiary took possession of the Lake Superior Iron Co. Frank E. Keese will succeed Mr. Johnston. Mr. Keese has had wide experience in mining, having worked in all branches of the industry from his youth. He has been closely associated with Mr. Johnston since 1905, when he went to Ishpeming to take charge of the mining operations of the Oliver company's mines under Mr. Johnston.

SCHOOLS AND SOCIETIES

A school of mines is to be started at Tonopah, as the Nevada legislature passed a bill on February 25 to establish the institution.

The Northwest Mining Convention, which was held at Spokane during the last week of February, was pronounced to be "the best ever."

The Sydney (New South Wales) University Engineering Society's *Journal* shows that the total membership is over 320. Papers on surveying, hydraulics, assay plans, and flotation are published.

The University of Wisconsin is to hold an exposition at Madison on March 25, 26, and 27. Exhibits will include a mine model, shaft, drills, concentrating tables, magnetic separator, and assay laboratory.

The Colorado School of Mines, at Golden, will give a course in coal mining, from April 5 to May 28, for which no fees are to be charged. It will consist of mathematics, drawing, chemistry, geology, and mining.

The Scientific Society of the Colorado School of Mines met on February 26, and the following officers were elected: V. D. Howbert, president; C. E. Carstens, vice-president; and F. E. Briber, corresponding secretary.

Alumni and former students of the Michigan College of Mines held a luncheon at the Engineers' Club, New York, during the February meeting of the A. I. M. E. Several interesting talks were made, one by Scott Turner being on mining in Spitzbergen, where he is in charge of the Arctic Coal Co.; and W. L. Cumings on South America, mainly Chile, as a mining country. It is proposed to form a permanent eastern M. C. M. club for those living near New York and those passing through. James Dunstan, of 42 Broadway, is secretary.

The Australasian Institute of Mining Engineers held its annual meeting at Melbourne on January 29. H. H. Schlapp was chairman, and referred to the proposed meeting at Mt. Lyell. Incorporation of the Institute was under consideration. The election of officers to fill the annual vacancies resulted as follows: president, Robt. C. Sticht, Tasmania; vice-president, James Horsburgh, Queensland; council, E. G. Banks, New Zealand; W. H. Corbould, Queensland; C. F. Courtney, New South Wales; H. Lipson Hancock, South Australia; H. Herman, Victoria; Ernest W. Skeats, Victoria; and John W. Moule, Queensland.

Volume I of the *Transactions* of the International Engineering Congress, to be held at San Francisco on September 20 to 25, will comprise a unique series of papers on the engineering of the Panama canal. The various topics and subdivisions of the work have been arranged by Col. G. W. Goethals, chief engineer, and now governor of the Canal Zone. He has also selected the author for the treatment of each paper, and he will himself contribute the introductory chapter. The various authors are in general the officers who were in direct charge of the actual work of construction, and the collection of papers thus becomes a first-hand account of the engineering of the canal. There will be 24 papers in all, profusely illustrated, 22 of which deal with actual constructive and engineering problems connected with the work, one with the preliminary work in municipal engineering in the Canal Zone, and one with the commercial and trade aspects of the canal. This volume would in itself be a valuable acquisition for any person interested in the progress of the world's work, whether or not an engineer, and for any library, whether technical or not. It can be obtained only through enrollment in the Congress. The transactions of the Congress as a whole will include from seven to nine other volumes, covering all important phases of engineering work.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, March 11

Antimony	.20 —20¾
Electrolytic copper	15½ 15¾
Pig lead	4.20 5.15
Quicksilver (flask)	$80.00
Spelter	10¾ -11
Tin	38 39½
Zinc dust, 100-kg zinc-lined cases	12

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK March 11. Copper and lead are firm, but the spelter market is demoralized, buyers holding back and sellers pressing sales, prices ranging from 7.50 to 8.50c. per pound.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Mch.	4 ..... 14.37	Jan. 27	14.00
"	5 ..... 14.37	Feb. 3	14.50
"	6 ..... 14.50	" 10	14.29
"	7 Sunday	" 17	14.30
"	8 ..... 14.50	" 24	14.42
"	9 ..... 14.63	Mch. 3	14.38
"	10 ..... 14.63	" 10	14.50

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	....
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	....	Sept.	12.02	....
Apr.	14.19	....	Oct.	11.10	....
May	13.97	....	Nov.	11.75	....
June	13.60	....	Dec.	12.75	....

Exports during the last week of February amounted to 10,171,816 lb., France taking 5,100,874 lb.; Italy, 2,961,038 lb.; and England 1,622,255 lb. Imports totaled 840,002 lb. According to a consular report of February 9, there is a shortage of metal in Sweden. The monthly consumption in that country is 800 tons, and only 762 tons entered in November and December, 1775 tons being held in England. There is about two months' supply for consumers. In February the Anaconda output was 15,100,000 lb., compared with 13,700,000 lb. in January.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date		Average week ending	
Mch.	4 ..... 3.95	Jan. 27	3.70
"	5 ..... 3.95	Feb. 3	3.80
"	6 ..... 3.95	" 10	3.80
"	7 Sunday	" 17	3.85
"	8 ..... 3.95	" 24	3.85
"	9 ..... 3.95	Mch. 3	3.87
"	10 ..... 3.95	" 10	3.95

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	....
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	....	Sept.	3.82	....
Apr.	3.86	....	Oct.	3.60	....
May	3.90	....	Nov.	3.68	....
June	3.90	....	Dec.	3.80	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date		Average week ending	
Mch.	4 ..... 7.50	Jan. 27	6.88
"	5 ..... 7.75	Feb. 3	7.58
"	6 ..... 8.00	" 10	7.75
"	7 Sunday	" 17	8.24
"	8 ..... 8.00	" 24	8.25
"	9 ..... 8.25	Mch. 3	9.05
"	10 ..... 8.50	" 10	8.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb. 25	9.05		Aug.	4.45	....
Mch.	5.12	....	Sept.	5.16	....
Apr.	4.98	....	Oct.	4.75	....
May	4.91	....	Nov.	5.01	....
June	4.84	....	Dec.	5.40	....

Letters from the Missouri and Wisconsin zinc fields appear on pages 416 and 417 of this issue. The Missouri Kansas-Oklahoma people are greatly perturbed on account of the increase in price of spelter, and decreased prices offered for ore. Instead of $75 two weeks ago, last week's sales were only $66 to $73 per ton.

It is very interesting to learn that the Reed Zinc Co. of San Francisco, with an electrolytic plant about 30 miles south, sold 10,184 lb. of zinc to the Selby Smelting Co. last week. This is probably the largest sale of electrolytic zinc ever made in the United States and perhaps in the world. The plant was described in the 'Press' of January 2, 1915.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.		Average week ending	
Mch.	4 ..... 49.12	Jan. 27	48.77
"	5 ..... 49.25	Feb. 3	48.52
"	6 ..... 49.37	" 10	48.25
"	7 Sunday	" 17	48.12
"	8 ..... 50.12	" 24	48.70
"	9 ..... 50.00	Mch. 3	49.02
"	10 ..... 51.00	" 10	49.81

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	....
Feb.	57.53	48.45	Aug.	54.35	....
Mch.	58.01	....	Sept.	53.75	....
Apr.	58.52	....	Oct.	51.12	....
May	58.21	....	Nov.	49.12	....
June	56.43	....	Dec.	49.27	....

The silver market has shown decided strength during the week. On March 6 about 300,000 oz. left San Francisco for the Orient. During the first week in the current month the Nipissing shipped 276,709 oz. to London, but the bullion insurance rate to England has been raised from $1.80 to $10 per $1000 of metal, so shipments from Cobalt will be curtailed, and probably diverted to New York, as happened during 1914. Samuel Montagu & Co., of London, writing on February 18, state that the tone of the market continues good, coinage orders for abroad are considerable (Dutch Mint bought 1,280,000 oz.), and the demand for India remains fairly constant.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Feb. 11 ..... 60.00		Feb. 24	62 50
" 18 ..... 62.50		Mch. 3	70.00
		" 10	80.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60.00	Aug.	80.00	....
Mar.	39.00	....	Sept.	76.25	....
Apr.	38.90	....	Oct.	53.00	....
May	39.00	....	Nov.	55.00	....
June	38.60	....	Dec.	53.10	....

The quicksilver market is bare of supplies, resulting in the above advance during the week.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	....
Feb.	39.76	37 23	Aug.	50.20	....
Mch.	38.10	....	Sept.	33.10	....
Apr.	36.10	....	Oct.	30.40	....
May	33.29	....	Nov.	33.51	....
June	30.72	....	Dec.	33.60	....

Owing to the shipping trouble in England, tin has advanced to as high as 52c., but on March 10 New York prices were 44 to 48c. Large consumers are said to be fairly well supplied for the current month. In their review of tin, dated March 5, L. Vogelstein & Co. of New York, discuss supplies and prices. Several factors will result in higher or lower prices, but there promises to be a period of acute scarcity with high prices for spot metal. The Vulcan Detinning Co. in 1914 had an income of $781,688, about the same as in 1913. Operations resulted in a loss of $74,853, against $214,280. The surplus is $333,912.

COMPANY REPORTS

TOUGH-OAKES GOLD MINES, LTD.

This property is in the Kirkland Lake district, Ontario, and the report is for the calendar year 1914. The small mill treated 3493 tons of ore worth $22.33 per ton, and 213 tons smelted averaged $351 per ton. The total production was $117,644, but a loss of $59,807 was made. A new 100-ton mill is nearly ready for work, and it is complete with all modern processes. According to the manager, C. A. O'Connell, development totaled 1477 ft., and ore reserves above 300 ft. are valued at $1,500,000. In addition, dumps and tailing are worth $160,000. Considerable surface improvements were finished.

PREMIER (TRANSVAAL) DIAMOND MINING CO., LTD.

All diamond-mining companies suspended operations in August 1914, so the report of this Company, whose year ends on October 31, covers work for about nine months. During this time 7,683,943 loads (1600 lb. each) was washed, yielding 1,417,755 carats. Compared with the whole of the previous year, this shows a decrease of 690,228 carats. The stones averaged $4.26 per carat, and the value per load was 78c. Costs totaled 60c. per load. Sales realized £1,259,643, against £2,336,828, and working profit £302,516 compared with £1,003,098 in 1912-13. Unsold diamonds amount to £593,074. Dividends amounted to £190,000.

PORTLAND GOLD MINING COMPANY

The report of the manager, Frank L. Small, of this well known Cripple Creek property, covers the year 1914. Development totaled 15,592 ft., of which 2843 ft. was done by lessees on the 200-ft. level. Drifts cost $6.617, cross-cuts $6.99, rises and winzes $7.77, No. 1 shaft $62.83, and No. 2 shaft $50.78 per foot. Shaft-sinking includes timbering, pipes, guides, wiring, and everything ready for use. On the 1700-ft. level, No. 1 vein has been exposed for 1350 ft., of which 1050 ft. is shipping ore, the remainder suitable for the Victor or local mill. A large amount of prospecting is under way on this level, but a year is required to finish it. Mechanical haulage was started here in October, a 3½-ton storage-battery locomotive being used. Tramming costs have been reduced. A 515-man capacity change-house was completed in December for all employees. It is thoroughly modern.

There was 62,997 tons of ore sent to the Colorado Springs mill, which yielded $1,467,005, including 9955 tons worth $224,952 from lessees. The Victor mill treated 210,132 tons, 18,934 tons coming direct from the mine and 191,198 tons the reject of shipping ore, and from the dumps. This yielded $419,962. The total revenue was therefore $1,886,966, and the profit $577,087. Dividends amounted to $360,000, and the balance on January 1, 1915, was $507,260, including that from the previous year.

Operations to date have resulted in the following: development, 272,779 ft.; ore treated, 2,040,722 tons; gross value, $38,274,933; and dividends, $9,817,080.

NEVADA HILLS MINING COMPANY

This Company's property is in Churchill county, Nevada, 40 miles from the railroad, and with only fair labor conditions, yet operating costs totaled only $5.66 per ton. The net profit for 1914 was $67,036, but the president, George Wingfield, does not consider that a dividend should be paid at present.

The general manager, E. A. Julian, makes the following remarks: Operation during the year was continuous. Mine development amounted to 5697 ft., at a cost of $8.15 per foot for driving and cross-cutting, $6.30 for rising, $15.27 for winzing, and $62.48 for shaft-sinking, the total expenditure on this account being $46,782. The Weber shaft is down 935 ft., and the 900-ft. level opened. West of the 'Big' fault the Nevada Hills vein system between the surface and 200 ft. yielded a fair tonnage; and the east side, at 500 ft., produced a considerable amount of low-grade ore. Nothing of value was found at 800 ft. Regarding the Wingfield vein, it seems that it has 'bottomed' on the hanging wall of the 'blout' vein at 770 ft. Little hope is held that it will be found at depth. No commercial ore occurs in the Eagle vein below 50 ft. The 503 vein is erratic in width and value, in places being low grade, and others 12 in. wide worth $100 per ton, at 900 ft., which is encouraging. Ore reserves are about 40,000 tons, equal to a mill supply for seven months. The cost of mining was $2.69 per ton of ore produced, or $1.94 per ton of ore and waste.

The mill worked 97% of the possible time, and treated 64,348 tons, equal to 176 tons per day, with 88.8% recovery. This ore was worth $505,799, or $7.86 per ton. Silver extracted was approximately 600,000 oz. Treatment cost $2.242, marketing concentrate and bullion 43.6c., and general charges 47c. per ton. Operating costs totaled $2.18 per ton below those of 1913. Quick assets are valued at $256,546, with no liabilities.

THE EXPLORATION COMPANY, LTD.

The directors of this holding Company state that for the year ended December 31, 1914, there was a net realized profit of £28,586, to which must be added £27,826, being the credit balance brought forward from the preceding year, making a total of £56,412 to the credit of profit and loss account. Sundry investments stand in the balance sheet at book cost. Owing to the restricted markets at the present time, and to the conditions existing in Mexico, the directors are unable to place, as usual, a reliable valuation on these investments; but recognizing that a serious depreciation exists, they cannot recommend the distribution of a dividend for the past year.

The Exploration Company of England and Mexico, Ltd., has not been able to resume business since January 1913. The El Oro Mining and Railway Co., Ltd., was compelled to suspend operations on April 26, owing to the disorganization of railway transportation which followed the occupation of Vera Cruz by the military and naval forces of the United States. On October 1, the El Oro company, under pressure from the then government of Mexico, was compelled to resume operations, and since that date has been operating to the best advantage that the disturbed conditions of the country permit. The Suchi Timber Co., Ltd., was compelled to cease production in August last, but resumed work on a modified scale in November. The Buena Tierra Mining Co., Ltd., was obliged to cease operations on April 23, but resumed again in July, and has since been working intermittently. The Santa Rosa Mining Co., Ltd., property has been shut down since April 1913, owing to the unsettled condition of the surrounding country. Two dividends of $1 each were paid by the Greene-Cananea Copper Co. in March and June last, but it was forced to suspend operations in August. Conditions in Mexico during the year 1914 did not improve. The operations of the above-mentioned Companies in that republic during the past year have in consequence been hindered and disturbed. The economic as well as the political outlook is still troubled and obscure. The Tomboy Gold Mines Co.'s Colorado property has been continuously and successfully operated throughout the year. A cyanide plant for the treatment of the residue from the gold mill has recently been installed, and the profits expected from this source should add considerably to the revenue of the Company. A plan for the reorganization of the Natomas Consolidated of California has been carried through during the past year. The new capital secured under this scheme will materially assist in the completion of the works which are necessary for the ultimate prosperity of the undertaking. The latest reports from the Chile Copper Co. are satisfactory.

New Machines and Devices

Miners' Electric Lamp

A new miners' electric lamp that is entirely safe to use, of strong construction yet light in weight, simple in design, fool-proof, efficient in operation and of ample guaranteed capacity, is being offered by the General Electric Co. The outfit consists essentially of a lead plate battery, carried on the belt; a ¾-cp. Mazda lamp with a suitable reflector held in a steel shell, carried on the cap; and a strong, serviceable cable connecting the battery and the lamp.

Owing to the hazardous nature of work in gaseous mines, a demand has been growing for some time for a practical, portable electric lamp. That an electric lamp would be safe to use has been well recognized, because it could be made so that it would not ignite inflammable gases, and would produce a uniform light regardless of atmospheric conditions. While the carbon filament lamp represented the best available electric illuminant, such a miners' lamp was not possible, because of its relative inefficiency; as storage batteries of the required capacity could not be designed within permissible weight and dimension limits. The perfection of the efficient Mazda lamp in miniature sizes by this Company, and the development of small, efficient, light-weight storage batteries has resulted in the design of the long-desired type BL form B miners' electric lamp.

GENERAL ELECTRIC CO.'S NEW MINERS' ELECTRIC LAMP.

The prime feature of this lamp is that it has been made thoroughly safe to use, by adequate insulation of the entire circuit. The outfit complete weighs only 3¾ lb., of which 3½ lb. is carried on the belt and 4 oz. on the cap. The battery is rated at 7.2 amp-hr. Normally it will light the lamp 12 hr. per charge, and can be relied on to furnish light at least 10¾ hr. per charge at the end of one year's service. The ¾-cp. Mazda lamp operates at 1.9 volts, and the reflector distributes the light evenly through a solid angle of about 130 degrees.

The battery is non-spilling, and the terminals are not subject to acid corrosion. Direct current only should be used for charging. In some instances mercury arc rectifier or motor-generator sets may be required to change alternating current into suitable direct current. Small sets adapted for this purpose can be supplied readily. Charging racks arranged for charging batteries conveniently in quantities are also offered. The battery case is of medium hard rubber. The battery box is of drawn sheet steel, electrically welded.

A Compact First-Aid Kit

In all first-aid work it is necessary to have materials handy for effective treatment of patients and in a compact container. Many of such outfits are in general use in individual establishments, mines, mills, and other places. Wood and tin boxes have been provided, but have several disadvantages. Glass jars are now being used for this purpose, and that sold by the National Affiliated Safety Organizations, of West Lynn, Massachusetts, was developed to meet all requirements of a compact, convenient, sanitary first-aid outfit. The jar itself is structurally strong, and is made yet stronger by a special annealing treatment. It was designed with smooth surfaces and particularly with straight walls on the inside to promote cleanliness and facilitate the removal of first-aid materials. In the glass cover of the jar is molded a convenient carrying handle and the cover is securely held on the jar by suitable spring clips which are a part of a metal cage in which the whole jar sets; this metal cage affords added protection against breakage of the jar. A rubber gasket between the jar and the cover makes the outfit dustproof and equalizes strains in the cover. The jar is made only high enough to accommodate the bottles of medicaments stored in it so that the stoppers cannot come out of the bottles when the cover rests on the jar. Medicine bottles, bandages, absorbent cotton, burn ointment in collapsible tubes, and a wire gauze splint are set along the wall of the jar so that they are plainly visible from the outside and can be quickly found. A metal dish of special construction placed in the inside of the jar keeps the materials just mentioned in their proper place. The metal dish itself is used as a receptacle for other parts of the contents, such as tourniquet, medicine glass, gauze bandages, medicine droppers, spoon, scissors, and other necessaries. Complete with contents it weighs about 12 lb., yet it includes all that is required for first aid. The jars are put up at West Lynn, under the supervision of the secretary of the associations, Magnus W. Alexander.

THE N. A. S. O. STANDARD FIRST-AID JAR.

Use of Electric Furnaces

The fact that the electric furnace offers a compact, reliable, and economical method of manufacturing crucible quality steel has now become more generally recognized among iron and steel founders, and, in consequence, there has been an appreciable increase in the number and size of the equipment recently installed or in process of construction, and a concomitant improvement in details tending toward improved efficiency, according to the General Electric Co. Perhaps the most striking advance has been in the induction type of furnace; for, prior to 1914, the largest unit of this type in the

RESISTANCE TYPE ANNEALING FURNACE WITH CONTROL PANEL. LATER FORMS OF THIS FURNACE ARE SHEATHED WITH CAST IRON PLATES.

United States had a capacity of only 2 tons, whereas during 1914 this was carried to 20 tons, two units of this rating having been completed. This is the largest of any type in the United States used for refining steel, the core and coils of each furnace weighing approximately 60 tons. The resistance type of furnace, which utilizes heat generated by passing the electric current through a resistor composed of foundry coke, with auxiliary heating from a carborundum arch radiating heat downward on the charge, has also been provided with a simple current relay control that insures the maintenance of a constant temperature over a range of approximately 600 to 1300° C. For the arc type of electric furnace, special forms of transformers and auxiliary equipment have been designed, together with a reliable system of automatic control, which is particularly interesting to the practical operator in that, except for a short period after starting the furnace, a constant power input is maintained at such a value as may be predetermined by the operator.

Commercial Paragraphs

The CHALMERS & WILLIAMS company, of Chicago Heights, Illinois, announce that the El Arco Mines of Mexico has purchased one of its adjustable quick-discharge tube-mills, also Nissen stamps and other mill equipment.

The TROPENAS CONVERTER CO., of New York, *Steel Castings* for February contains a discussion by G. Muntz and E. Roubieu on 'The Greatest Asset of the Steel Foundryman—Common Sense.' This deals with liquid steel, solidifying steel, semi-finished steel, and other points in the foundry.

The YUBA CONSTRUCTION CO. of Marysville, California, has installed a model dredge in the Yuba County exhibit at the Panama-Pacific Exposition. The boat is one-twentieth of the size of No. 14, now working on the Yuba river, and is complete in every respect. P. R. Parker, superintendent of the shops, was in charge of the installation.

The AMERICAN VANADIUM CO., of Pittsburgh, monthly *American Vanadium Facts*, contains notes on the use of vanadium steel in passenger and freight automobiles, couplers, and frames for the 'Mikado' class of locomotives for the Southern Pacific System. The tensile strength of the latter's cast steel frames is 83,570 lb. per square inch.

The JUSTRITE MANUFACTURING CO., of Chicago, manufacturer of acetylene lamps, lanterns, and fire-prevention appliances, has issued a complete catalogue of its specialties and the latest jobbers' and wholesale price-lists. The Company states that it had a substantial increase in business in 1914. It also calls attention to the necessity of carrying a stock of Justrite repair parts.

In the February issue of *Mine and Quarry* are the following articles: 'Rescuing an Iowa mine,' 'Low Drill Repair Cost on the Gogebic Range,' 'Air-Lift Pumping with Elevated Discharge,' 'A New Connecticut River Hydro-Electric Station,' 'Top Cutting in Coal Mines,' 'Two New Sullivan Drills,' 'A Utah Granite Enterprise,' 'Road Building in the Rockies,' and other interesting data for the miner.

The BLAISDELL MACHINERY CO., of Bradford, Pennsylvania, has issued an illustrated general catalogue of 120 pages, covering the smaller machines made. These include air-compressors of all types for use in sand-blasting, use in textile manufacturing, air-lift pumping, steam hammers, extraction of gasoline from natural gas, and other purposes. Vacuum pumps for many uses are described. A great deal of useful data are given on compressors and compressed air.

The W. S. ROCKWELL CO., furnace engineers, of 50 Church street, New York, has published on cardboard, ready to be hung on a wall of a melting room, a comparative scale of Fahrenheit and centigrade temperatures. Around a 4¼-in. circle are given the corresponding degrees of each scale; below it are the temperature conversion factors, and below these are details of hardening and tempering heats. A useful chart for assayers, smelters, and steel workers.

The BUSCH-SULZER BROS.-DIESEL ENGINE CO., of St. Louis, has issued a bulletin describing the type B, vertical, 4-cylinder, single-acting, 4-stroke cycle, enclosed crank-case, medium speed Diesel engine, with 3-stage air-compressor integral, manufactured by that firm. The publication covers in a few words the efficiency and economy of the engine, materials, workmanship, interchangeability, details of construction, fuel control, principal dimensions, life, and guarantees against defects. A number of illustrations serve to show the general characteristics of this excellent means of generating power.

In *Bulletin W*, 1915, the GENERAL FILTRATION CO., of Rochester, New York, describes the Robacher Filtros Wheel, a continuous rotary vacuum-filter. This filter is virtually a wheel, made of cast iron, with an over-all diameter of 10 ft. 6 in. Wood or other material may be used in construction. The wheel is divided into 16 separate compartments, with two compartments to a segment, each compartment being isolated from the others. Built up on this frame is the filtering medium 'Filtros,' which has been previously described in the *Press*. The plates of this material are two inches thick, and 160 are required for a 10-ft. wheel, the complete wheel weighing 9027 lb. 'Filtros' of several grades of porosity is supplied when ordered, to suit the finer or coarser pulps. Full directions are given in the bulletin for construction and operation of the wheel. The apparatus is less than half submerged in a tank containing pulp or wash water, and is connected with a vacuum-pump. With one revolution in four minutes a one-inch cake is formed, and the capacity is 3.84 tons of dry ore per hour; with one revolution in a half minute with a ⅛-in. cake, the capacity is 6.30 tons per hour. The treated cake is scraped off. The wheel consumes about one horse-power, excluding pumps and other plant. This machine may be used in filtering any material.

MINING PRESS

Volume 110 SAN FRANCISCO, MARCH 20, 1915 Number 12

LEADVILLE first attracted the attention of the miner by its gold placers. Later its silver-lead ores made it one of the best known districts of the world. Now its zinc and manganese ores have become of importance and new industries have sprung up in the mining town which spreads over the slopes of Carbonate and Fryer hills. In this issue is printed the first description of one of the most important—the making of zinc oxide pigments direct from the ore. The illustration in the upper corner is the Wetherill furnace in course of construction, and the illustration below shows the completed plant.

Zinc Pigments and the Leadville Works—page 443

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Buyers Directory—Page 26
Advertisers Index—Last Page

TABLE OF CONTENTS

EDITORIAL Page.

Notes 429
Barite 430
Economic Geology and Its Needs 430
Precision of Thought 431

ARTICLES

LOOKING FORWARD 432

Unrest in industry has come to occupy a large place in the thought of those who realize that their duty as citizens is to bear their part in adjusting circumstances to environment in the life of society. The first prerequisite to relieving unrest is to find the causes of it, and the Federal Commission on Industrial Relations has summarized all the causes which have been brought to its attention by employees and employers.

ZINC PIGMENTS AND THE LEADVILLE WORKS.

By E. H. Leslie 433

Zinc forms the basis of four white pigments, and these are produced in amounts valued at several million dollars yearly. Some zinc ores are suited to the direct production of pigment from ore. The Western Zinc Mining & Reducing Co. has recently built a 50-ton plant at Leadville to produce zinc pigment, and the first detailed description of the plant is given here.

A SIMPLE SIEVE SHAKER.

By W. S. Black 439

Much labor can often be saved by taking advantage of appliances which are conveniently at hand. How labor can be saved in screening and better results obtained is described by an engineer.

COSTS AT THE HOLLINGER MINE AND MILL 439

Mining costs at the Hollinger have been reduced to less than $2 per ton and milling costs to less than $1.25. The items which go to make up the totals are here analyzed.

VISUALIZING WORKING CONDITIONS IN A MINE.

By H. N. Stronck and J. R. Billyard 440

Systematic control of mining operations is as feasible as similar organization in a workshop. Two young engineers have devised a method by which officers can see at a glance in what part of a mine work is being performed, the scope of the work, the number of men and machines engaged, and the extent of the work planned ahead for them.

THE OMINECA MINING DIVISION, BRITISH COLUMBIA.

By Wm. M. Brewer 443

Copper ores and placer gold are important in this district, which is tributary to Prince Rupert. The vein mines are rather difficult of access, and the deposits, though large, are many of them low grade.

MINING METHODS AT PARK CITY, UTAH.

By James Humes 444

Irregularity of the deposits in the Park City mines makes it difficult to determine beforehand the best method of removing the ore when found. By the use of small hoists, development work is reduced to a minimum, and as much ore is removed by overhand as by underhand stoping.

COSTS AT THE SONS OF GWALIA MINE 445

Details of the costs of the various operations in mining in a Western Australia mine are given, as well as the cost of milling by stamping, grinding, leaching, and filtering.

ECONOMICAL USE OF EXPLOSIVES.

By R. Noblett 446

Much of the dynamite used in charging holes is wasted, and by careful thought a smaller amount can often be made to do as much work. A working miner here tells how he found this out for himself, and offers useful suggestions to his fellows.

MINERAL PRODUCTION OF CANADA, 1914 447

Mineral products of Canada show a decrease of nearly 12% in 1914, according to preliminary estimates. Details as to products and provinces are given.

COSTS AT THE LAKE VIEW & STAR MINES 447

Mining costs at this Australian mine are $1.64 per ton; milling costs are $2.23. These are analyzed in detail.

THE HOLLINGER MILL'S RECORD IN 1914 447

The Hollinger mill recovered $2,719,354 from ore containing $13.67 per ton, making a tailing containing 56c. per ton, with a stamp-duty of 13.3 tons per day.

GOLD PRODUCTION OF THE PHILIPPINES 451

During 1914 an increase in gold production of nearly 40% was made, about equal amounts having been produced by dredging and lode mining.

DEPARTMENTS

DISCUSSION:

Precision of Thought.

By W. H. Shockley 448

A scholarly engineer takes us to task for our use of verbs, and the editor defends his position.

Amalgamation in Hardinge Mills.

By Francis O'Boyle 450

A millman contributes his personal experience to the discussion evoked by Gelasio Caetani's description of the Plymouth mill.

CONCENTRATES 452

REVIEW OF MINING: Special correspondence from Houghton, Michigan; New York; Washington, D. C.; Leadville, Colorado; Rochester, Nevada 453

THE MINING SUMMARY 457

PERSONAL 461

THE MARKET PLACE:

Metal Prices 462

COMPANY REPORTS 463

Tongkah Harbour Tin Co.; Associated Northern Blocks (W. A.), Ltd.; Wasp No. 2 Mining Co.; Hollinger Gold Mines, Ltd.; Standard Oil Co. (California); Rico-Wellington Consolidated Mining Co.; Buckeye Belmont Mines Co.; Osceola Consolidated Mining Co.; Mass Consolidated Mining Company.

MINING DECISIONS 465

RECENT PUBLICATIONS 465

NEW MACHINES AND DEVICES:

Diesel Engine Operating at the Exposition 466
Small Mazda Lamps With Concentrated Filaments ... 466
Commercial Paragraphs 466

EDITORIAL

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PIG IRON production during 1914 decreased 7,633,908 tons, or 24.65 per cent, being the smallest output since 1908, according to the figures given out by the Iron and Steel Institute.

SMOKE investigation at Salt Lake City is to be directed at the coal-burning industries, according to advice from Mr. D. A. Lyon, instead of the smelters, as indicated in our editorial columns last week. It is pleasant to record that it is being recognized that smelters are not the only plants that make smoke.

RECORDS in converter practice have lately been made at the Hayden smelter, of which Mr. J. J. Ormsbee is manager. With a standard size Pierce-Smith converter an average of over 81 tons of copper per day was produced from a 42 per cent matte throughout the month of November. During the first half of February a daily average of 85 tons was maintained, and when the figures for the whole month are available it is probable that a new record will have been set.

ACCIDENTS cannot be altogether prevented by even the best of care, as the cave-in at the Gagnon shaft at Butte last month goes to show. The crew which was caught was made up of experienced men who had already repaired the timbering for 600 feet of the same shaft and were working in a part which did not appear to be in a dangerous condition when it suddenly caved for a distance of fifty feet. Four men died before they could be removed. The safety department of the Anaconda has done notable work, the fatal accidents in 1914 showing a decrease of 35.3 per cent as compared with 1913, and total a decrease of 7.8 per cent.

PRESENTATION of the annual gold medal of the Mining and Metallurgical Society of America to Mr. Robert H. Richards on March 18 was a happy recognition of the services to the mining profession of one who is not only a distinguished teacher but also an investigator of problems in ore dressing who has done more than any other American for the advancement of the art. His inventions are everywhere known, and in mining schools especially it is so rare that the college laboratory is able to contribute much toward the solution of problems in the mine and mill that his achievements are all the more notable. The Society does honor to itself in thus recognizing Mr. Richards' achievements.

FINAL figures for copper exports during the six months ended December 31 last are now available. Exports for the half year totaled 313,336,364 pounds, valued at $39,765,111, as compared with 469,492,649 pounds, valued at $71,964,054 in the same period of 1913; all of which scarcely supports the contention of the Foreign Office of Great Britain that our copper trade is in a prosperous state and that exports to European countries have shown a suspicious increase.

ACTION on copper shipments has at last been begun by the prize courts, and the first decision holds that no belligerent has a right to requisition a cargo belonging to a neutral government. The case at issue was a consignment of 1000 tons of copper to Götenborg for the use of contractors to the Swedish government. This was seized by a British warship. The registrar of the prize court proposed to turn the copper over to the British government for use at the Woolwich arsenal, but the Swedish owners successfully opposed such a high-handed course of action. The final disposition of the shipment is still to be passed on by the prize court. Now that action has finally been initiated, it is to be hoped that the many shipments still detained will be passed upon.

LEADVILLE, the site of the zinc oxide plant described in this issue by Mr. E. H. Leslie, is the long lived district of Colorado which always manages to bring out a new ore or industry at that time when needed most. The oxide plant, which was completed last year by the Western Zinc Mining & Reducing Company, is about to begin operations under the auspices of a new company which was organized by James B. McDonald, Howard E. Burton, and A. B. Augustine, all well known mining men of the district. In that the oxide works will make possible the treatment of the low-grade carbonate ores of the district, it is believed that the new industry will give a decided impetus to carbonate mining which has long been a problem with the Leadville miners. The zinc carbonate deposits of the district are quite extensive and capable of supplying ore to the new plant for many years to come. It would seem that the story of Leadville will never be complete. At the 'Pick and Hammer' dinners at Washington the young men of the Geological Survey sing:

"I is for Irving, who's wrestling still
With the endless report on the ores of Leadville."

BARITE

One of our subscribers has written to ask us whether it would be profitable to develop a barite deposit, the situation of which he does not state. As others may be interested in barite and equally unaware of the conditions governing it, a brief summary of them will be of interest. Barite is used for a great variety of purposes, such as the making of lithopone (a mixture of barite and zinc oxide) and other white pigments, in the paper industry to give weight and quality to the product, the manufacture of barium peroxide and of white rubber goods, glazing of pottery and the enameling of ironware, in the beet sugar industry, the manufacture of oilcloth and linoleum, filling the cloth of sacks, the making of certain cements, and of a long list of other articles, such as the artificial ivory from which poker chips are made. For most of these purposes the carbonate of barium, witherite, would be more satisfactory, but barite is so much more common that the desired salts are made from it by chemical processes. Even where it is used as sulphate it must undergo fine grinding and other preparatory processes which greatly increase its cost. Thus prepared, it ordinarily commands $15 to $25 per ton in the large city, while the average price realized at the mine by the domestic producers during 1913 was $3.45, according to the United States Geological Survey. New York and St. Louis are the markets in which the price of crude is fixed, and the usual sale basis there is $4 to $6 per ton for material containing 96 per cent $BaSO_4$, with a penalty of 20 cents per ton for each per cent less; material containing less than 92 per cent $BaSO_4$, or more than $1\frac{1}{2}$ per cent SiO_2, is ordinarily not salable. To the average millman the difference in price between the crude and prepared material seems a disproportionate one, and a company has recently been formed in New York that expects to be able to cheapen and improve the work of preparation.

Under these conditions it is obvious that freight rates will generally be the deciding factor as to whether any otherwise suitable barite deposit can be worked. As ocean freights are generally cheaper than railroad transportation, and as the largest consumption is along the Atlantic seaboard, a good deal is imported. Domestic production in 1913 was valued at $156,000, more than two-thirds of this being from Missouri, where large deposits of good quality exist and where freight rates to consumers in the Middle states are favorable to the domestic producer. Imports of crude barite in 1913 were valued at $61,500 and prepared products at about $430,000; of this, more than half was barium peroxide, which has come into general use for the making of hydrogen peroxide. The increase in trans-Atlantic freight rates because of the war and the interference with German production has given some advantage to the domestic producers, but the same general conditions still hold, and a large increase in domestic production can hardly be expected. Speaking generally, barite deposits in the Rocky Mountain region are beyond the possibility of being worked at a profit, as practically all the consumers in the West require prepared products and a market for crude barite is practically non-existent.

ECONOMIC GEOLOGY AND ITS NEEDS

Ten years ago a group of the younger men interested in applied geology undertook the publication of a journal devoted to that branch of science. The majority of them were workers upon the United States Geological Survey or some one of the various state organizations. By the same token they were men who had but moderate salaries, and few of the original group had any considerable other income. To found and undertake to maintain a scientific journal was, under the circumstances, a bold project. The support, to a modest degree, of a few of the men whose service outside official life had permitted accumulation of more capital was enlisted, and the sum of $2000 was subscribed. The shares were placed at $25. As we remember, the largest individual subscription was for four shares, except that the present director of the Geological Survey, then one of the younger assistants, subscribed for those remaining unsold so as to comply with the laws of the District of Columbia under which the publishing company was organized. These 'remaining' shares were subsequently distributed in small lots, and the total sum of $2000 has now gone into the enterprise. Into it also has gone an amount of hard work not altogether appreciated, we believe, by those who use and enjoy the ably conducted periodical that has resulted.

Economic Geology is just beginning its tenth year. From the first it enlisted the interest and support of an able corps of contributors, and in its pages have been printed many of the significant contributions to economic geology of the last decade. It has stuck close to its original plan and has trespassed neither on the field of pure geology or of that of the technology of mining. As a result its subscription list has been small though select. As a business venture, such a journal could not be hoped to be a success: that is, no revenues could be anticipated that would more than pay manufacturing cost, since as an advertising medium its field is limited. This was realized at the first, and the projectors and supporters of the journal have given their time, money, and energy purely for the good of the profession at large. From the first the managing editor has been Mr. John D. Irving, and with him have been associated such men as Messrs. Waldemar Lindgren, F. L. Ransome, J. F. Kemp, H. V. Winchell, M. R. Campbell, C. K. Leith, W. G. Miller, W. H. Emmons, and others who for longer or shorter periods have assumed responsibility for some part of the work. For several years Mr. W. S. Bayley has handled the business of the venture despite many demands on his time. Gradually the sum originally subscribed has been absorbed in the enterprise, though all have served without pay. The balance-sheet for 1914 showed expenses for the year amounting to $1200 in excess of receipts and only a

small amount in bank. Evidently more funds must be made available, publication stopped, or a considerable change made in the character of the publication. Under these conditions the board of directors has proposed to issue $20,000 worth of preferred non-voting stock, the proceeds to be invested in securities and only the income to be used to meet any deficit incurred by the journal. The amount asked for is small in proportion to the excellent work already done by *Economic Geology* and the good work of which it is capable. Part of the money has been subscribed, but more is necessary in order to complete the arrangement. We bespeak favorable consideration on the part of our many readers who, directly or indirectly, have received stimulus from the work already done. Mr. Lindgren, at the Massachusetts Institute of Technology, will gladly correspond with any who may be interested. It would certainly seem that the importance of the work and the spirit in which it has been conducted would insure a prompt and generous response from mining men.

PRECISION OF THOUGHT

Some time ago we printed an editorial on this subject explaining the reason why it is our practice to use the singular verb in such expressions as "626,000 tons was crushed." This statement of our position has attracted a gratifying amount of attention and a surprising intensity of opinion as to whether our views are or are not justified. Elsewhere in this issue we print a long letter from Mr. W. H. Shockley, discussing the matter. At the time of sending the letter, Mr. Shockley suggested that it was too long, and that most of it might profitably be excised, but at our solicitation he has consented to its publication in full. We are glad to accord it so much space, not only because, like all of Mr. Shockley's writings, it is interesting, but also because it represents the thoughtful effort of a studious and scholarly engineer to ascertain the truth, an attitude of mind which cannot be too highly commended. Above all, it serves excellently as a text upon which to elaborate our original thesis that a careful use of words is essential in the exact expression of precise thought, of which engineers should be the chief exemplars.

The point which we have made is, in the terminology of the chemist, a reversible reaction. Stating it in this way, the best use of words is contingent on precise thought, and this on a clear understanding of the subject under discussion. On this we base our premise that a studious and scholarly engineer is a better authority as to the best use of words in the literature of mining than a professor of the English of general literature. But before going further along this line of discussion it is necessary to settle a question of fact raised in Mr. Shockley's letter. Two of the professors of English to whom he submitted our editorial make the statement that, in the expression quoted above, 'tons' is not a collective noun and therefore the general rule does not apply. To show that the professors, and not ourselves, are in error here it will be sufficient to quote briefly from J. C. Fernald's recent 'A Working Grammar of the English Language,' page 294, where, following his discussion of collective nouns, he says: "Certain nouns plural in form are singular in construction, and take verbs in the singular number. See page 38." And on page 38: "A noun plural in form, when it denotes a collection, group, or amount, is treated as a singular taking a singular verb or being referred to by a singular pronoun; as, 'That hundred dollars is here.'" While it is possible to raise the point that a collective noun is ordinarily singular in form and that some other name should be applied to a noun plural in form which is treated as a singular, no grammarian seems to have devised such a term, and in referring to 'tons' as a collective noun we were in agreement with so good an authority as Fernald.

The really vital question is that raised in the concluding paragraphs of Mr. Shockley's letter: the mental concept which the writer was endeavoring to evoke in his readers. We submit that this concept is one of unity rather than multiplicity. What the writer had in mind was that an amount of ore, which he specified as 626,000 tons, was crushed. We have already made the point, which a physicist would be quick to grasp, that a ton cannot be crushed; it would be as difficult as to black the eye of a kilowatt. There is more unity here than in the expression 'football team,' because the individual members of the football team could easily be distinguished, but no one could possibly distinguish one ton from another of the quantity of ore crushed. Mr. Shockley gets an idea of multiplicity by thinking of cages rising and falling, and this is quite correct if he wishes to say that 626,000 skip-loads were hoisted. If, however, he is referring to the total quantity hoisted, a transfer of ideas is involved that serves to befog the concept. A mathematical relation can doubtless be deduced between the number of skip-loads hoisted and the total quantity in tons, but we find ourselves unable to perceive in what subtle way the multiplicity of the former injects itself into the unity of the latter.

With the *laissez faire* philosophy of style enunciated by Herbert Spencer and quoted with approval by Mr. T. R. Lounsbury, it is almost needless to say, we are not in accord. If a mechanical engineer designed his machinery with an eye single to avoiding friction, or if a business man organized his office force with the same object, without regard to the net total of results desired, it is evident that the outcome would be unsatisfactory. Skillful writers often insert in their paragraphs words or phrases which catch and detain the reader's attention, just as an architect relieves the monotony of a smooth surface by projections or decorations. Mush is an unsatisfactory diet; the average man likes something he can get his teeth upon. The average reader is none the worse for meeting a word or phrase which focuses his attention, and if it causes him to think carefully, as our use of the singular verb seems to have done, the result is a useful one.

LOOKING FORWARD

The primary duty imposed upon the Commission on Industrial Relations by Congress is to ascertain "the underlying causes of dissatisfaction in the industrial situation." While it is recognized that this subject is practically inexhaustible, it is believed nevertheless that the testimony furnishes an outline of the fundamental causes. Analysis of this testimony shows that the following causes have been most frequently advanced by the witnesses who have been questioned on this subject:

1. Largely a world-wide movement arising from a laudable desire for better living conditions. Advanced by representatives of labor, sociologists, and employers, and generally endorsed.

2. A protest against low wages, long hours, and improper working conditions in many industries. Advanced by practically all labor representatives and assented to by many employers.

3. A desire on the part of the workers for a voice in the determination of the conditions under which they labor, and a revolt against arbitrary treatment of individual workers and against the suppression of organization. Almost uniformly approved by labor witnesses.

4. Unemployment and the insecurity of employment. Generally advanced by witnesses from every standpoint.

5. Unjust distribution of the product of industry. Advanced by most labor representatives and agreed to by some employers.

6. Misunderstanding and prejudice. Agreed to by employers and employees.

7. Agitation and agitators. Generally advanced by employers, but defended by labor representatives and others as a necessary means of education.

8. The rapid rise of prices as compared with wages. This was given by a very large number of employers, labor witnesses, and students of industrial conditions.

9. A rapidly growing feeling that redress for injustice and oppression cannot be secured through existing governmental institutions. The statement came from a large number of labor witnesses.

In addition, it has been stated by many witnesses that the tremendous immigration of the last quarter century, while not itself a direct cause of unrest, has served to accentuate the conditions arising from other causes by creating an oversupply of labor, unfamiliar with American customs, language, and conditions. A number of causes must be considered in relation to the partisan bias of the various witnesses who urged them.

Causes of Unrest Advanced by Employers

1. Normal desire for better living conditions.
2. Misunderstanding and prejudice. Lack of conception that interests of labor and capital are identical.
3. Agitation by politicians and agitators.
4. Unemployment.
5. Unreasonable demands arising from strength of organization.
6. Labor leaders who stir up trouble to keep themselves in office and to graft on employers.
7. Inefficiency of workers.
8. Rapidly increasing complexity of industry.
9. Sudden transition of large numbers of foreigners from repression to freedom, which makes them an easy prey to labor agitators.
10. Universal craze to get rich quick.
11. Decay of old ideas of honesty and thrift.
12. Misinformation in newspapers.
13. Too many organizations for combative purposes.
14. Violence in labor troubles.
15. Sympathetic strikes and jurisdictional disputes.
16. Boycotting and picketing.
17. Meddlesome and burdensome legislation.
18. The 'closed shop,' making for labor monopoly.
19. Financial irresponsibility of labor unions.

Causes of Unrest Advanced by Employees

1. Normal desire for better living conditions.
2. Protest against low wages, long hours, insanitary and dangerous conditions existing in many industries.
3. Demand for industrial democracy, and revolt against the suppression of organization.
4. Unemployment, and the insecurity which the wage-earner feels at all times.
5. Unjust distribution of the product of industry. "Demand for full share of production."
6. Unjust attitude of police and courts.
7. There is one law for the rich, another for the poor.
8. Immigration, causing oversupply of labor.
9. Existence of a 'double standard,' which sanctions only a poor living in return for the hardest manual labor, and luxury for persons who perform no useful service.
10. Disregard of grievances of individual employees and lack of machinery for redressing the same.
11. Control by 'Big Business' over industry and state.
12. Fear on the part of those in comfortable positions of being driven to poverty by sickness, accident, or involuntary loss of employment.
13. Inefficiency of workers through lack of training.
14. Unfair competition from prison labor.
15. The rapid pace of modern industry, which results in accidents and premature old age.
16. Lack of attention to sickness and accidents.
17. Arbitrary discharge of employees.
18. Blacklisting of individual employees.
19. Exploitation and cruel treatment of women and children in industry.
20. Promotion of violence by the use of gunmen, spies, and provokers hired by employers.
21. Attempt to destroy unionism by the pretense of the 'open shop.'
22. Ignorance of social economics on the part of employers and indifference to well-being of employees.
23. Monopolization of land and natural resources.
24. Suppression of free speech and right of assembly.

Zinc Pigments and the Leadville Works

By E. H. LESLIE

Mineral paints are usually divided into three groups natural mineral pigments, pigments made directly from ores, and chemically manufactured pigments. The first group includes ochre, umber, sienna, hematite, siderite, and limonite. The last three, which are ores of iron, are the principal basis of metallic paints and mortar colors. Many other minerals or mineral products are used in the paint trade, such as asbestos, aluminum, asphalt, barytes, clay, graphite, gypsum, magnesite, mica, pyrite, and tripoli. Zinc oxide, with which this article is concerned, belongs to that group of pigments which are made directly from ores, including zinc oxide, leaded zinc oxide, sublimed white lead, and sublimed blue lead; the last two are commercially known as the basic sulphates of lead. The third group, the chemically manufactured pigments, comprises the chemical products—basic carbonates, white lead, litharge, red lead, orange mineral, lithopone, and others. While the production of natural pigments has increased somewhat of recent years, there has been a decrease in the production of those made directly from ores and chemically manufactured. The total marketed production of the United States of the three groups, according to the United States Geological Survey figures, was as follows:

	1912.		1913.	
	Quantity.	Value.	Quantity.	Value.
Natural mineral pigments	74,657	$ 561,693	75,595	$ 522,410
Pigments made directly from ores	106,497	9,507,895	97,573	9,020,896
Chemically manufactured pigments	228,135	26,356,232	219,644	25,123,167
Total	409,289	$36,425,820	392,812	$34,666,473

There are four white pigments which have zinc for a base, either in whole or in part, namely, zinc oxide, leaded zinc oxide, zinc-lead oxide, and lithopone. All of these pigments may be made direct from ore, and in American practice the first three pigments mentioned usually are made in this manner. Zinc oxide is the most important of these pigments. In European practice the oxide is made from spelter, although in France zinc oxide is made from ore in an electrothermic furnace invented by Côte and Pierron. In the United States the oxide is largely made from ore, although spelter is accountable for a good percentage of the output.

Zinc oxide, which is the most important of the zinc pigments, is a white powder consisting, when chemically pure, of 80.34% zinc and 19.66% oxygen. On account of its stability, whiteness, opaque nature, and slight tendency to chalk, it is invaluable as a pigment. Its extreme hardness makes it less resistant to temperature changes, when used alone, than the more stable complex formulas. The two methods of manufacture are known as the American and French processes.

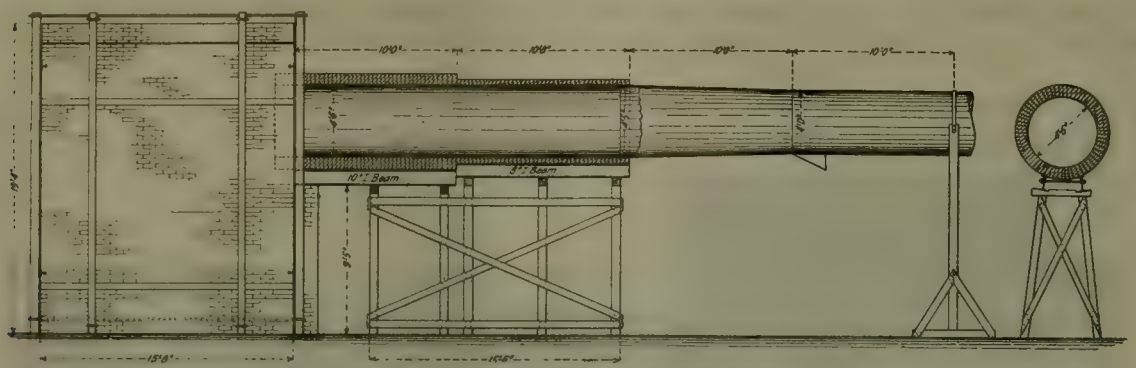
BAG-HOUSE AND ROASTER PLANT, LEADVILLE WORKS.

The ores from which zinc oxide is made are the franklinite ore of New Jersey, the sulphide ores of the Mississippi valley, and the sulphide, carbonate, and silicate ores of Colorado, New Mexico, and Nevada. The companies which produced zinc oxide in 1913 were the New Jersey Zinc Co. of Pennsylvania, with plants situated at Palmerton and Freemansburg, Pennsylvania, the Mineral Point Zinc Co., at Mineral Point, Wisconsin, and the Bertha Mineral Co., at Austinville, Virginia. The Western Zinc Mining & Reducing Co.'s Leadville plant is the latest of the American plants, and while its installation was fraught with difficulties, the practice is

most modern and the plant, while of only 50 tons capacity at present, gives promise, when the present difficulties have been eradicated, of becoming an important factor in the industry.

Zinc oxide manufacture on a commercial scale was commenced in the United States about the year 1855, the oxide being manufactured under patents issued to Samuel Wetherill and Samuel T. Jones. The Wetherill patents covered the furnace and the preparation of the material, while the Jones patent covered the manner of collecting the fume. The Wetherill furnace, a modification of which is used at the Leadville plant, consists of an arched chamber of rectangular horizontal section. The hearth is supplied with perforated cast iron grate through which air is admitted under pressure. The charge rests upon the grate. The forced draft oxidizes

The construction of a zinc oxide plant at Leadville, it would seem, was the logical move for the industry, as the district abounds in carbonate zinc ores which have been the source of no little trouble to market profitably. The new plant is in a position to handle 14% zinc carbonate ore, where the zinc smelters will not consider ore containing less than 20%. As the Leadville ore has not proved amenable to the established concentration methods, the new oxide plant offers a solution for the zinc carbonate problem of the Leadville district, and when fully established the new plant will undoubtedly make some of the old carbonate deposits profitable. The plant is situated about two miles west of the city of Leadville, Colorado, on a spur of the Denver & Rio Grande railway, and is, therefore, but a short distance from the mines of the district and the freight rates on the ore are very



FURNACE CONNECTION WITH THE FUME CONDUIT.

the lowest layer of coal forming carbonic acid (carbon dioxide), which passes through the bed of coal and is reduced to carbon monoxide. The monoxide reduces the zinc oxide of the ore to metallic zinc, which is reoxidized in the presence of carbonic acid. The zinc at the highest temperature of the furnace, volatilizes and its heated vapors, uniting with the oxygen of the carbonic acid, are again oxidized. Thus reduction and oxidation of the zinc takes place in the same furnace chamber. The oxidation must take place from the carbonic acid, as the nature of the process prohibits sufficient atmospheric oxygen. The residue or slag is removed from the furnace after the charge is treated, and consists of ash and the non-volatile contents of the ore. This is scoriaceous in character. If the ore contains gold, silver, or copper, these metals are retained in the residue and may be subsequently recovered by ordinary methods. The oxide formed is carried off by exhaust fans through the clarifying and cooling systems and is finally collected in large muslin bags. A great number of these bags are connected to the sheet iron hoppers, which in turn are connected to the conveying pipes, permitting the entry of gases in which is suspended the amorphous zinc oxide. The gases escape through the porous cloth and the zinc oxide is separated. The bags are shaken at intervals, the oxide falling from the bags in which it has been collected, and discharging into the hoppers from which it is drawn at stated intervals through openings in the bottom.

low. The plant is housed in frame buildings, an idea as to the size and construction of which may be obtained from the accompanying halftones. The total investment is exceedingly modest as compared with the cost of a modern 50-ton zinc smelter for spelter production. The plant was designed and erected under the direction of E. J. Jones, whose name has been prominently connected with the zinc smelting industry for a number of years.

The situation of the Leadville plant, due to its extreme altitude of over 10,000 ft. presented special problems in the smelter construction, which could only be solved by experience, and several improvements are still to be made before the plant will attain its greatest efficiency as an oxide producer. One of the principal difficulties with the present plant is the lack of bag capacity. At a lower altitude this difficulty would not have been experienced, but at an altitude of 10,000 ft. it is necessary to use so much greater volume of air in the furnace that the bag-house for such a plant must necessarily be greatly increased over a similar plant at sea-level. This shortage in bag-house capacity increased the ordinary losses and consequently decreased the extraction. The labor problem is also one of the difficulties to be contended with in the operation of an oxide plant in a new locality. Furnace work is very hard manual labor and requires experienced men for the best results. None of the obstacles encountered, however, are of a serious

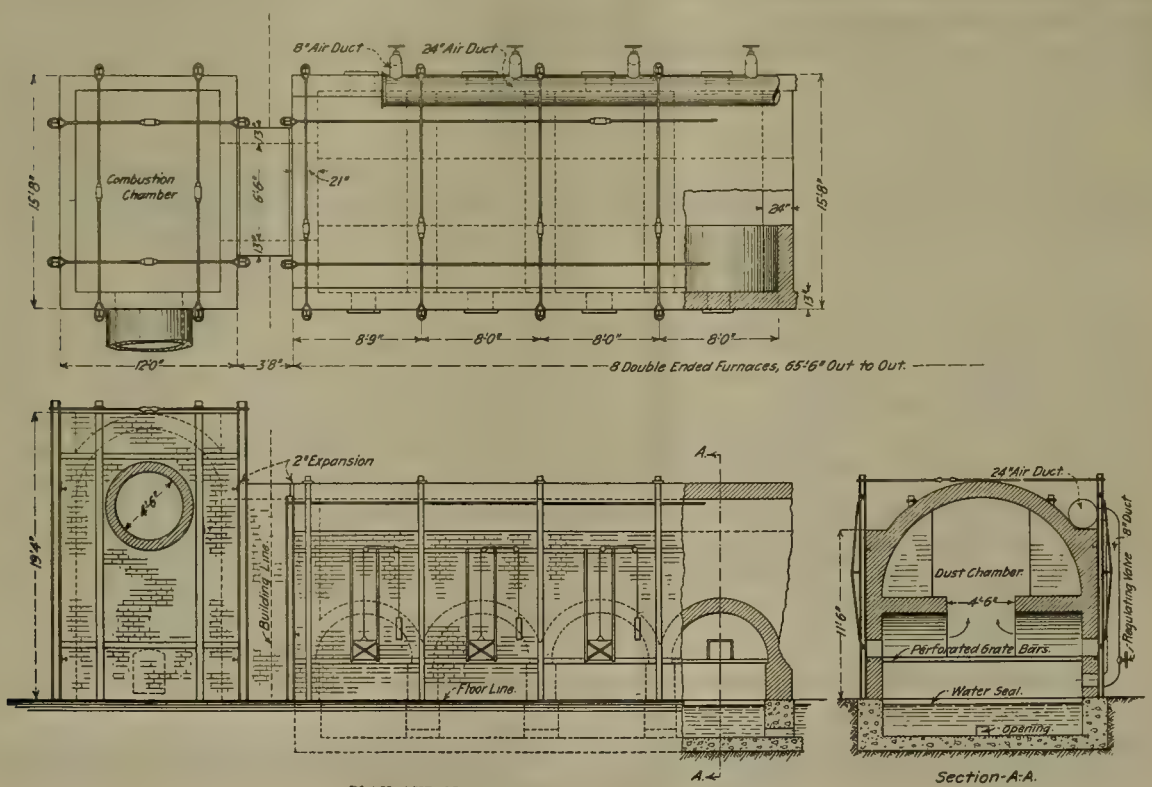
nature, and with a reorganization and rehabilitation, the plant will undoubtedly be an important factor in the activities of the district.

WETHERILL FURNACE, SHOWING METHOD OF REINFORCEMENT.

The carbonate ore, which is a smithsonite mined in the district, is delivered at the plant in standard freight cars and unloaded by hand into the storage bins or stored in piles for future use. The ore is fed through a hopper over a $^3/_8$-in. screen and the oversize from the screen is discharged into a 9 by 15-in. Blake crusher and is here reduced to about $^1/_4$-in. The discharge from the crusher, together with the undersize from the screen, is elevated by a bucket elevator to a $^1/_4$-in. revolving trommel screen. The undersize from the screen, which is through $^1/_4$-in., is then elevated to a wooden storage bin of 200 tons capacity. The oversize from the trommel is returned to a set of 12 by 20-in. Denver Engineering Works rigid rolls and is here given a regrind and returned by elevator to the trommel. The entire crushing plant is driven by one 50-hp. General Electric Co. motor operating on a 440-volt circuit. Power is supplied by the Colorado Power Co., being generated at Shoshone.

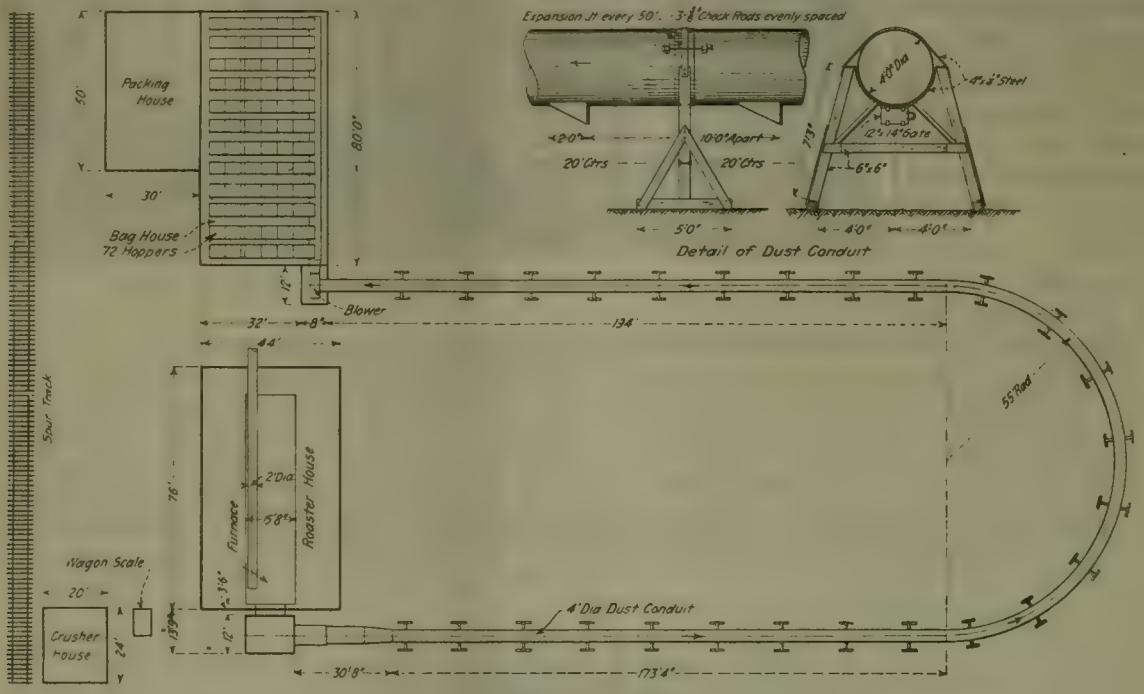
The coal used for mixing with the ore for the furnace charge is mined at the Floriston mine of the Colorado Fuel & Iron Co., and is an anthracite screening. This fuel as delivered at the property is through $^1/_4$-in., and as such requires no further crushing before being mixed in the furnace charge.

As the plant stands, no mechanical mixer has been



PLAN AND SIDE ELEVATION OF WETHERILL FURNACE.

provided and the ore and fuel as drawn from the bins are weighed and mixed by hand on the floor of the furnace room. This method of mixing is not as satisfactory as the mechanical method, and the concrete mixer which is generally employed for this purpose will eventually be substituted for the present hand method. The charge consists of two parts by weight of ore to one of coal; each single charge as mixed for one fire-box of the furnace consists of 1000 lb. ore, 500 lb. of soft coal, and 300 lb. hard coal which is first thrown on the grate and allowed to ignite from the heat from the arch before the charge is thrown in.



PLAN OF LEADVILLE WORKS.

Modified Wetherill Furnace

The Wetherill type of furnace is of special design, the construction of which is shown in the accompanying drawings and halftones. The over-all dimensions of the furnace are as follows: length, 65 ft. 6 in.; width, 15 ft. 8 in.; and height, 11 ft. 6 in. The foundation of the furnace is of concrete, as shown in the drawing and is so constructed as to be made up of eight water-tight compartments which are connected with one another by openings through the dividing walls. In the operation of the furnace these foundation compartments below the grates are kept partly filled with water, the small amount of steam thus formed and mixed with the air which is forced through the grates aids in the operation of the furnace by augmenting the oxidation process. When it becomes necessary to clean out the water-sealed compartments, in which material gradually accumulates by falling through the grate, workmen enter the compartments below the grates through an opening in front of the furnace below the fire doors. This opening is closed with brick when not in use.

The furnace proper is built of Cañon City fire brick and is of a double arch construction and made up of eight individual fire-boxes on each side of the furnace. These fire-boxes are 7 ft. 6 in. by 6 ft. 9 in. and are arranged on opposite sides of the furnace, as shown in the accompanying drawing. The fire-boxes have perforated grates made of cast iron in which are cast openings which are in the form of truncated cones with their base toward the foundation. These apertures are ⅛ in. diameter at the top and ¾ in. at the bottom. The plates used for the grates are made to extend completely across the furnace under the fire-boxes on opposite sides of the furnace. They are cast 11 in. wide, 6 ft. 9 in. long, 1¼ in. thick, and are laid adjacent to each other and supported by the walls of the furnace and rails crosswise of the furnace, their ends laid in the walls. The arches over the fire-boxes are semicircular in form springing from the grate level. The gases from the fire-boxes discharge into the centre of the furnace, where they ascend to the main arch of the combustion chamber. This arch is semicircular and at right angles to the arches of the fire-boxes, the construction of which is shown in the drawing. The furnace is reinforced with trussed railroad iron buck stays. The ends of the furnace are braced with 90-lb. buck stays, and the intermediate stays are of 52-lb. rail and reinforced by trusses. The buck stays are set in concrete foundations and tied at the top with ¾-in. tie rods.

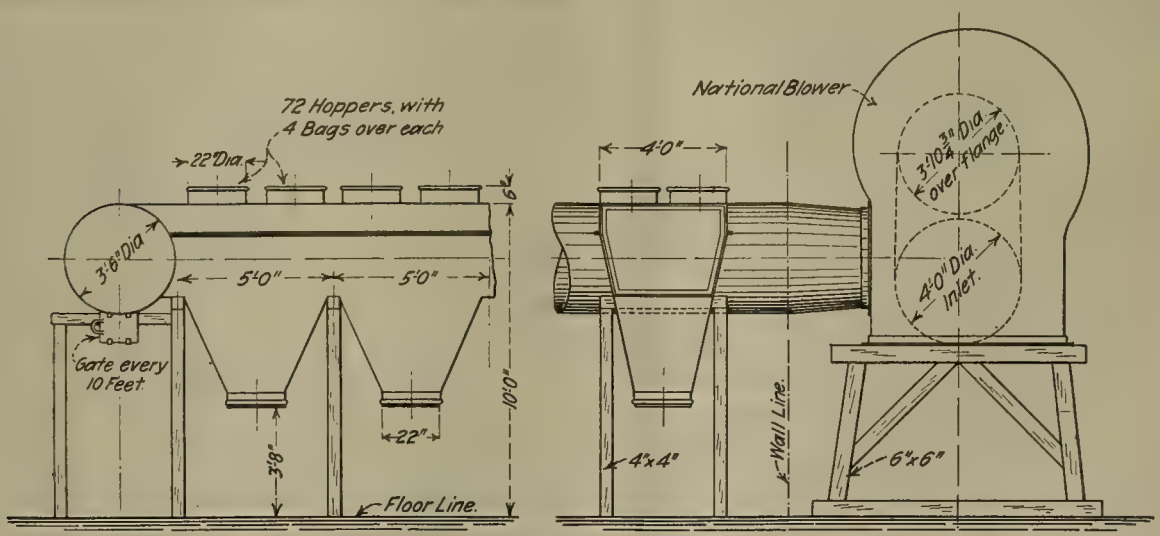
At the end and outside of the furnace building is a chamber built of fire brick which is 15 ft. 8 in. by 10 ft.

FOUNDATION FOR WETHERILL FURNACE, SHOWING WATER-SEALED COMPARTMENTS.

and 19 ft. high. A brick tower is commonly used, but at this plant the chamber causes the most of the ash to settle which is carried from the furnace by the blast. This is subsequently removed through a door in the bottom of the chamber. Upon the top of the furnace rests a 24-in. air main to which 8-in. pipes are connected that conduct the air to the pit under the grate, one of such blast pipes being supplied for each of the compartments of the furnace.

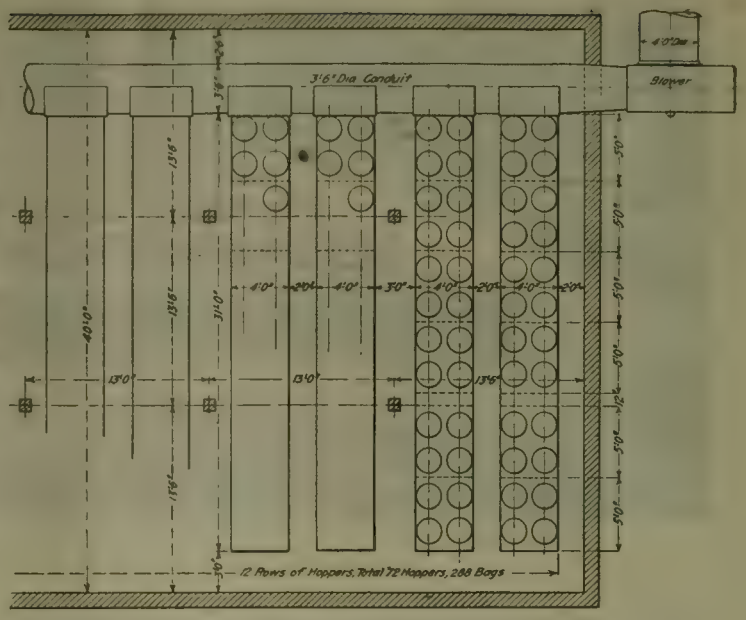
In the operation of the furnace after the grate has been cleaned a thin layer of anthracite screenings is thrown into the fire-boxes, which ignites almost immediately from the heat of the furnace, a low blast pressure being used at this stage of the operation. The charge, which is a mixture of 1000 lb. ore and 500 lb. anthracite screenings, is then shoveled in, it being evenly distributed over the thin bed of coal. The charge is slightly moistened before being charged, and after being shoveled into the furnace the blast pressure is gradually raised to about 5 oz. In operating the furnace, care must be exercised to keep the combustion uniform throughout the fire-box by avoiding blow holes in the charge which cause an uneven combustion. About four hours is required to exhaust a charge. In operating the furnace the fire-boxes are charged one after another, keeping the flue temperature as nearly uniform as possible. In this manner about 50 tons of ore is treated per day. When the charge is exhausted in one of the fire-boxes the ashes are drawn and the clinker or 'slag' is pried from the grate and removed. The clinker carries from 3.8 to 4.2% zinc.

The zinc oxide fumes as discharged from the furnace require purification and are conducted from the chamber at the ends of the furnace through a dust train 600 ft. long to the bag-house. The train is 'U' shape with a radius of 55 ft. and is supported on wooden trusses. The



DETAILS OF HOPPERS, FAN, AND BAG-HOUSE CONNECTION.

construction and plan of this train are as shown in the accompanying sketches. A No. 10 Sturtevant blower, operating at 1020 r.p.m., supplies the blast for the furnace, and a National exhaust fan, operating at 250 r.p.m., draws the fume and gases through the dust train and forces them through the bag-house. A 75-hp. General Electric motor supplies the power for both the blower and fan. The dust train is fitted with hoppers every 10 ft., and discharge gates as shown in the sketch, and here the impure oxide is collected as deposited from the fume and is periodically removed and shipped to the smelters for converting into spelter. The gates may also be opened to cool the train if it becomes over-heated.



PLAN OF BAG-HOUSE.

Bag-House

In the bag-house there are 12 lateral branches from the main train; the plan and construction of which are as shown in the accompanying drawings. It will be noted that the laterals are supplied with a hopper for every four bags. There are thus 6 hoppers or 24 bags on each lateral, giving the present bag-house a complement of 288 bags. The bags are of muslin, of 22 in. diameter, and about 24 ft. high, being suspended over the hoppers and laterals to which they are attached from supports at the top. The capacity of the plant is from 8 to 10 tons of zinc oxide per day. The oxide is of good quality, an analysis of which is as follows:

	Per cent.		Per cent.
ZnO	98.0	PbO	none
$ZnSO_4$	0.5	$PbSO_4$	1.5

The plant is operated in three 8-hour shifts. Two men are employed on each side of the furnace during each shift, making a total of 12 men for handling the furnace. A day foreman and a night foreman, together with a man in the bag-house, one in the packing house, and two men in the cooperage comprise the operating force, with four men for unloading and crushing.

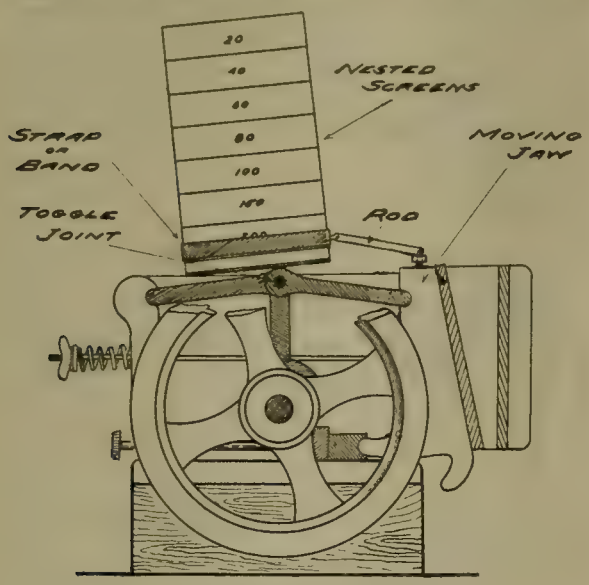
While at the present time the plant is not in operation for reasons not pertinent to this discussion, the ten days' trial run demonstrated that the plant is well adapted to the purpose of its designers. However, several minor changes must be made for its most efficient operation before it is put into commission permanently, as more or less trouble was experienced in the preliminary run. The principal difficulty is the lack of bag-house capacity. At a lower altitude the present equipment would undoubtedly be adequate, but at an altitude of 10,000 ft. it is necessary to use so much more air in the furnace that more bags are necessary. With the present equipment and great volume of air and reduced pressure on the outside of the bags, they are kept tight, resulting in a loss of oxide from the doors of the furnace. Unfortunately the greatest amount of air is used when the furnace is making the most and heaviest oxide, and it was at this time that the losses by blowing out of the furnace doors was greatest. It was estimated on assays of the clinker and oxide output that the loss due to this source was almost 30%. This difficulty could be overcome by either enlarging the bag-house, which would be much the cheaper and simpler way, or by enlarging the pipe-line. The latter would be more expensive, but much more efficient, as it would allow the fumes to stay longer in the pipe and give them a better opportunity to cool. By this means the suction fan could be slowed down, using less power and reducing the pressure on the bags. It was found in the operation of the plant that the bags became quite hot at times and it became necessary to admit large quantities of cold air into the line. This trouble would not be overcome by enlarging the bag-house. The lack of a mechanical device for mixing the charge also added difficulties, in that with imperfect mixing of the charge, the best extraction was not possible, as considerable of the ore was not burned, due to the hand mixing employed. Inexperienced labor was also a source of trouble. Furnace work is hard labor and it was difficult to keep men not accustomed to it at work. This necessitated the continual training of new men, which was not conducive to the best results. As a result of these difficulties, most of which can be corrected, the trial run showed a loss of about 40%. The zinc oxide produced in this run was not up to standard in color, due to the unskilled labor in not keeping the furnace in condition to make a pure white pigment. However, the oxide is but slightly deficient in this respect and can be brought up to standard by heating for five minutes in a stove or furnace. The cost of producing zinc oxide in Leadville should not exceed $40 per ton, although the trial run was hardly long enough to determine exact costs.

A Simple Sieve Shaker

By W. S. BLACK

The usual assay office is rarely equipped with a mechanical sieve shaker. In some plants such a piece of apparatus is by no means necessary, as very few screening tests have to be made, but in other plants screening tests must be made regularly; this is especially true of plants which are obliged to resort to fine grinding to obtain good extraction, and in such cases the hand screening of the different products becomes exceptionally tedious and trying. If a number of tests have to be made and a mechanical sieve shaker is not available, a simple and efficient substitute may be easily set up on a common laboratory sample crusher.

The general arrangement is shown in the accompanying cut. The nest of sieves is placed directly over the toggle mechanism of the crusher. A strap or a metal



A CONVENIENT SIEVE SHAKER.

band is fastened snugly about the bottom screen, and to this a short stiff rod is connected, which is in turn connected to the top of the moving crusher jaw. Now when the crusher is started the hinge of the toggle rises and strikes a sharp upward blow against the sieves and then drops them again on the frame of the crusher, which causes another sharp shock. At the same time that this is happening the crusher jaw is moving backward and then forward, which causes two sharp accelerated jerks to be imparted to the sieves through the connecting rod. The result of this series of oscillations is a good screening action. There are a few points, however, which must not be overlooked if good results are to be obtained. There must be no play or looseness in the connecting rod; for if equal thrusts in both directions are not given to the sieves the material will accumulate at one side of the screen, and the full screening area will not be utilized. For the same reason the position of the sieves with respect to the toggle joint must not be overlooked. The correct position can be best determined through actual trial, changing the length of the connecting rod until the best results are obtained. Another point is the protection of the bottom pan of the nested screens; for if it is not protected it will wear rapidly from its contact with the toggle. This may be accomplished by using a shallow pan made from sheet tin to fit over the sieve pan. While this method affords good protection, it has the objection of being rather noisy. A better method is to have a piece of stiff belting riveted to the sieve pan.

The use of this device not only has the advantage of being a labor saver, but it may also be used to secure accurate comparative results, such as are often desired on classifier and tube-mill products. By screening equal samples for equal lengths of time, the results will be found to be much more valuable for comparative work than any which can be obtained by hand screening.

Costs at the Hollinger Mine and Mill

In 1914 this property, at Porcupine, Ontario, produced 208,936 tons of ore averaging $13.676 per ton, with the following costs:

COST PER TON MATERIAL BROKEN

Mining:		Track laying	$0.023
General charges	$0.022	Tramming	0.300
Superintendence	0.050	Pipe-fitting below	0.025
Diamond-drilling	0.038	Mine drainage	0.024
Cross-cutting	0.074	Hoisting	0.141
Shafts	0.036	Landing	0.029
Driving	0.254	Drill repairs	0.049
Rising	0.019	Sharpening steel	0.071
Winzing	0.022	Collecting steel	0.028
Tramways	0.006	Mine sampling	0.019
Timbering shafts, winzes, and rises	0.032	Assaying	0.005
Stoping	0.534	Change-house	0.007
Scaling	0.011	Surveying	0.009
Timbering drifts and stopes	0.101	Mine lighting	0.017
		Total mining	$1.946

The mill treated 211,846 tons of ore, of which 2910 tons was from the Acme mine, controlled by the Hollinger company. The distribution of costs was as follows:

COST PER TON OF ORE MILLED

Milling:		Handling pulp	$0.040
General charges	$0.054	Thickening	0.014
Superintendence	0.047	Continuous decantat'n	0.031
Disposal of residue	0.018	Filtration	0.103
Lighting	0.011	Neutralizing	0.012
Heating	0.039	Clarifying and precipitation	0.063
Shoveling in bins	0.012	Refining	0.059
Crushing	0.079	Pumping solution	0.021
Conveying	0.034	Cyanide	0.083
Stamping	0.160	Cleaning mill	0.019
Classification and tube-mills	0.188	Alterations	0.034
Concentration	0.062	Assaying	0.015
Handling concentrate	0.007		
Treating concentrate	0.032	Total milling	$1.237

When alterations and additions to the mill are completed, the daily capacity will be 1600 tons.

Visualizing Working Conditions in a Mine

By H. N. STRONCK and J. R. BILLYARD

The bulletin-board method of visualizing and dispatching, as used in shop management, can be modified and made applicable to mines, and we will here endeavor to shew how this can be done. The method is flexible and can be changed for different conditions. As explained here, it is based on assumed conditions such as are found in general mining practice in a mine which employs about 200 men.

The general duties of a shift boss in a mine are very numerous, therefore he must be an all-around man to perform them capably. He must see that the men are supplied with work at all times, see that they are supplied with materials and tools, direct and show them where, when, and how work should be done. The method introduces a new functionary, a master shifter (who may be the foreman or superintendent), who answers the questions, *what* work should be done and *where, when* it should be done and by *whom*. This relieves the bosses of these functions and gives them more time to actually direct operations. By grouping these functions, better co-ordination of work is assured, which results in a saving of time.

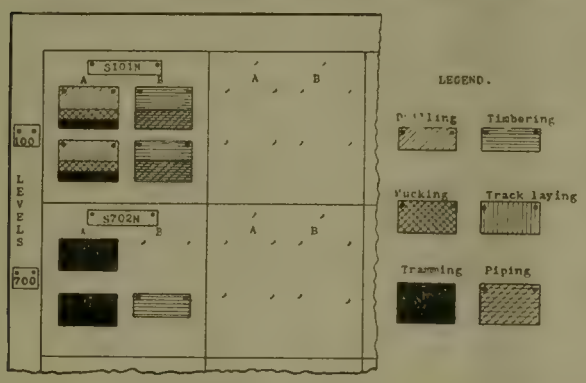


FIG. 1. STOPE BOARD.

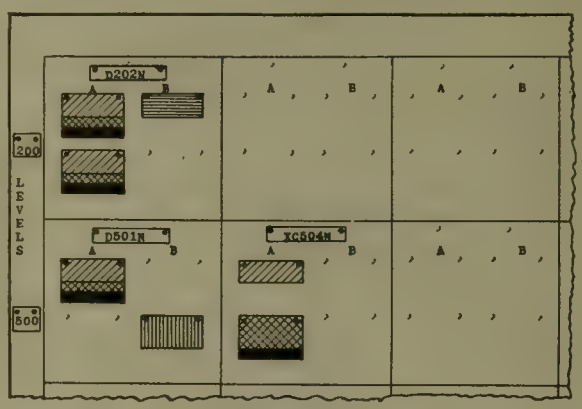


FIG. 2. DRIFT AND CROSS-CUT BOARD.

A brief description of the method successfully worked out and practised in connection with the Taylor system of scientific management in shops is given, to show our aim. Each machine and workplace is given a symbol or number, and is represented on the bulletin board by three sets of hooks. A card, or operation order, as it is called, on the first set of hooks, shows that work is being performed on that machine or at that workplace, at the present time. Cards on the second set of hooks show work ready at the machine or workplace and to be performed next in regular sequence. Cards on the third set of hooks show work which will be done in the future, but which is not yet ready. These boards show at a glance the exact conditions in the shop, and are of great aid in planning and co-ordinating work.

It will be noted that in a shop the machines and workplaces are fixed, which fixes the position of the men that do the work, and the work is routed and moved to these fixed places. In a mine the work is, to a certain extent, fixed, and the men and machines must be routed and moved to the work, so that almost reverse conditions prevail. In an ideal shop, work is always in progress at each machine and workplace, while in a mine, work may be temporarily or entirely abandoned in whole areas of the mine. This also calls for a change. In order to save space and to simplify the method, mine work is here classified under two headings, A and B. A represents the direct mining operations of drilling, shoveling, and tramming. B represents the necessary auxiliaries of timbering, track laying, piping, and others.

A complete survey, which shows the position of all workings of the mine, must be made. A glass model will be of aid. All drifts, stopes, cross-cuts, and other openings must be numbered or named in a manner which definitely indicates their position; these numbers are placed on the map and workings underground, so that the *where* can be designated and easily found. Also a record must be made of the different kinds of work that each man can do and that for which he is best qualified. This information must be indexed and filed so as to be quickly available.

Any number of bulletin boards may be made. In the present case, three are considered; one for stoping, one for drifts and cross-cuts, and one for rises, winzes, and shafts. These boards are made large enough to show present places where work is carried on, and anticipated future places as well. For example, the stoping board (Fig. 1) is laid out for four stopes. Each stope is indicated by a card above with a number in the corresponding level. All stopes on one level run in a horizontal line. Each stope has four sets of hooks from

TIMBERING
(green)

Date 1/4/15
Location 5702 N
Time 2 shifts
Material Standard square set
Men's Nos. 75 — 27
Remarks Report condition of roof

DRILLING
(blue)

Date Jan. 2 15
Location 5101 N
Time 3 shifts

Machine Nos.	58	W10	W11
Men's Nos.	15	26	58
Helper's Nos.	....	....	....

Remarks .....

TRACKLAYING
(brown)

Date 1/4/15
Location D501 N
Time 1/2 shift
Material Use old track from D403 N
Men's Nos. 102 — 103
Remarks .....

MUCKING
(yellow)

Date 1/4/15
Location D202 N
Time 1 shift
Men's Nos. 71 — 89

Remarks .....

PIPING
(pink)

Date 1/4/15
Location X-C 504 N
Time 2 hours
Material Reg. 1041
Men's Nos. 91 — 92
Remarks when finished report to McSorley.

TRAMMING
(red)

Date 1/4/15
Location D202 N
Time 1 shift
Chute No. .....
No. of Cars .....
Men's No. 71 — 89

Remarks .....

FIG. 3. OPERATION CARDS.

which the operation cards are suspended. The two sets of hooks in the vertical column under A represent the operations of drilling, shoveling, and tramming; those under B of timbering, track laying, piping, and miscellaneous. Each operation under A is designated by a card of different color and length. Similarly for operations under B. Cards suspended from the first horizontal row of hooks show work actually being performed in that stope. Cards on the second horizontal row show work planned ahead and which will follow in sequence. Thus, for example, Fig. 1 shows that in stope S101N on the 100-ft. level, the following work is in progress: drilling, shoveling, and tramming, also timbering and piping; while the following work is planned ahead:

drilling, shoveling and tramming, and timbering and piping. In stope S702N on the 700-ft. level, tramming or drawing ore from the stope is the only operation taking place, and planned ahead there is more tramming and some timbering. Fig. 2 shows the drift and crosscut board, similarly laid out and interpreted. The third board is made in the same manner.

The operation cards used are illustrated in Fig. 3. On each card can be written the *what, when, where,* and *who* of the operations. For example, the drilling card shows the date on which the work is to begin, at what part of the mine it is to take place, about how long it is to be continued, the number of the machine to be used, the number of the men who are to do the work, and any remarks necessary. The cards are filled out in duplicate. The original is used on the boards, and the carbon copy given to the shift boss under whom the designated men are working. Information as to the progress of the work is furnished by the shift bosses to the master shifter, who rearranges the cards accordingly.

The bulletin boards, arranged in this manner, show at a glance at what part of the mine work is being performed, the scope of the work, the number of men and machines doing the work, and the work planned ahead for them. From this can also be seen where and when materials and supplies are needed, so that they can be placed there ahead of time, thus eliminating many avoidable delays. The time required for arranging the cards on these boards need not necessarily be long, and it certainly will be time well spent.

Another method which arranges and shows the progress of the work is the pin-chart method used in efficiency work applied to construction. For this method a chart is made which shows the completed job, and the progress of the work is indicated by the position of the different colored heads of the pins. A color is given to each class of work, and the number of the man is attached on a small piece of paper. For example: a longitudinal section of the mine is drawn which shows all stopes, drifts, rises, and other workings in which actual work is now being performed and in which work will be done in the near future. The outlines of the workings are drawn as they will appear after all of the ore is extracted. The tacks or pins which represent the different classes of operations have the number of the worker that the tack represents stamped on the head, or the number of the worker is written on a small tag and suspended from the tack. Each class of work has a different colored tack, thus:

Machine men—yellow.
Shovelers—red.
Trammers—blue.
Timbermen—brown.
Lessees—black and white.

The machine number is written on a larger tag and suspended from the tack of the machine man who is operating that machine. These tacks are placed at the actual position on the drawing that represents the place where the men work. The most advanced position of the working face is indicated by a white tack with a tag suspended from it on which is written the date the work reached this point. Future, or planned ahead, positions of the different men are indicated by an entirely different type of tack. This type of tack is one on which small cards can be attached to the head. These cards are of the same color as the kind of work which they represent, and the worker's number and date is written on these cards.

This method is also applicable to coal mines, where it is generally advantageous to use a plan drawing of the mine instead of a longitudinal section. In case of an explosion in a coal mine, this method would indicate at a glance to outside rescue parties the exact position and number of men that were in the mine before the explosion took place. This definite knowledge would undoubtedly be of great aid in directing the rescue work.

The progress chart is used to show at a glance whether or not work is on time, ahead of time, or behind time. For example, in driving a drift, a drawing is made to scale which shows the completed work. Suppose this drift is to be 80 ft. long and it should be completed in 20 days. This would mean that an average of 4 ft. per day of progress must be maintained to complete the work on schedule time. Four-foot sections are, therefore, drawn along this drift and the date on which each position should be reached is indicated. The actual position which the working face reached each day is indicated by different colored tacks from which are suspended the date tags. A white tack indicates that the work is on schedule time; a blue tack, ahead of time; and a red tack, behind time. As can be seen, this method is of great use for contract work, as it gives both to the management and to the contractor a definite idea as to the status of the work. It is also a good incentive for increasing the output of the worker. Such charts are programs of work. When the work is completed, the tacks can be replaced by colored circles and filed, thus they remain as records.

The best planner is he who—other things being equal—is the most ingenious, the most experienced, and the best observer. It is not every man who is fitted by nature to observe closely, and hence plan. Practice in visualizing makes for increasing the faculty of constructive imagination. The man with the best constructive imagination is the best planner. These methods of visualizing are of great aid in fostering constructive imagination and the resulting work of planning. We believe this to be the first study of the possible application of this method to mining operations. Any suggestions for improving the method will be welcomed.

COAL EXPORTS from Newcastle, New South Wales, in 1914 amounted to 4,753,505 tons, a decrease of 483,116 tons. Owing to the nitrate crisis in Chile, exports of coal to that republic were 356,000 tons less. Shipping of the port totaled 1757 vessels entering, with a tonnage of 3,484,608.

The Omineca Mining Division, British Columbia

By WM. M. BREWER

The mineral resources of that portion of British Columbia which is adjacent to the recently opened Grand Trunk Pacific railroad are to a great extent unknown to the outside world, although placer gold was discovered about 50 years ago on Lorne creek, a tributary of the Skeena river, situated 130 miles from Prince Rupert, the ocean terminus of the railroad, and even

MAP OF THE OMINECA MINING DIVISION, BRITISH COLUMBIA.

today hydraulic mining operations are being carried on with satisfactory results.

Lack of transportation facilities has been a serious handicap in the past, especially with regard to mining ores that require to be smelted; therefore the pioneer prospectors confined their operations to placer mining, and although several lode mineral claims were staked as early as 1894, operation on these was confined to the assessment work necessary to hold the title and obtain crown grants.

Starting from Prince Rupert, the railroad enters the Skeena valley proper on the opposite side of the river from Port Essington, the head of navigation for deep-draft vessels, and follows along the west bank of the Skeena to a few miles from Hazelton, the head of navigation for stern-wheel steamers, about 190 miles northeast from the terminus. At that point the railroad crosses the river, and follows up the Bulkley valley toward the east.

Hazelton is the seat of government for the Omineca mining division, headquarters for the mining recorder, and general distributing centre for the neighboring mines. The most important among these are the Silver Standard, Canadian King, American Boy, Silver Cup, and Rocher Déboulé groups of mineral claims, all of which have been developed to that stage which warrants their being ranked as mines rather than prospects.

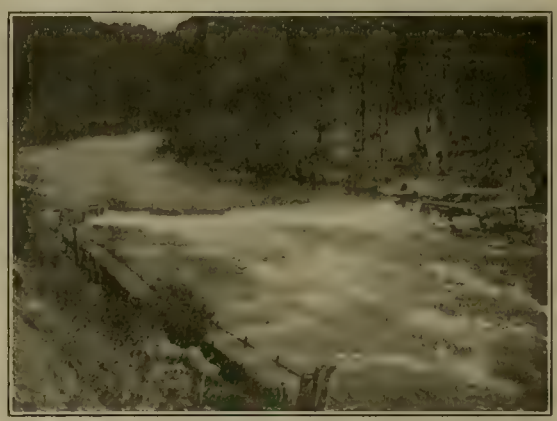
The southern portion of the division is situated in the vicinity of Kitsalas canon, one of the earliest settled places in this part of the province, as well as showing some of the finest scenery in the north.

The distributing centre for this part of the division is Prince Rupert, but for the convenience of the locality, which is situated nearly 100 miles from Hazelton, there is a deputy mining recorder's office at Pacific Station, about 20 miles northeast, and another at Terrace, about 14 miles southwest from the canon.

This southern section of the division includes the Copper river, Kleanza creek, Chimdemash creek, St. Croix creek, and Legate creek, tributaries of the Skeena river which flow in from the east, as well as Phillips creek, also a tributary of the same river, but which flows in from the west. The surrounding country is quite mountainous, some peaks having an elevation of nearly 8000 ft., but the average altitude where mineral has been discovered is from 2000 to 5000 ft. above sea-level, and from 500 to 4500 ft. above the level of the Skeena valley.

The rock formations of this area are made up of a wide belt of volcanics associated with some sedimentary rocks, the series being grouped by the Canadian Geological Survey as the Kitsalas formation. They are repeatedly intruded by granitic dikes and stocks, and in places are somewhat schistose; ordinarily they are greenish to purple massive rocks, spotted with large and irregular areas of epidote, and lined along the fracture planes with the same mineral.

The predominating ore-bearing minerals are bornite,



KLEANZA CREEK HYDRAULIC GROUND, OMINECA MINING DIVISION, BRITISH COLUMBIA.

chalcocite, chalcopyrite, iron pyrite, and gold, the latter usually being found in its free state, and can be saved by amalgamation. In Kleanza creek, placer gold has been mined for several years past; some parts of the creek have yielded satisfactory 'pay' and are still being mined by hydraulicking.

The commercial values contained in the ores referred to vary from low gold and copper to $16 gold per ton, with from 3 to 21% copper and 11 oz. silver. Usually these ores carry such low silver content as to form almost a negligible quantity, and there appears to be a

relationship between the gold and copper; or, in other words, when the gold is high, the copper is comparatively low, and *vice versa*.

The gangue material in this class of mineral claims is almost invariably quartz where the mineral occurs as vein filling, but in many instances the mineralization occurs as replacement in igneous dikes, and then the gangue is brecciated dike rock occupying a zone or zones in the dike itself. These mineralized zones are often of very considerable width; some sampled by myself last summer showed appreciable value for from 20 to 45 ft. across the dikes, and while the minerals across the entire width were not high enough to ship the ore without careful sorting—or better still, treatment by concentration—the properties certainly possess many attractive features, and apparently could be developed into producers of large tonnage.

There is one very noticeable feature associated with the occurrence of the two classes of orebodies referred to, which is, that while the veins almost invariably are situated in the mountains near the Skeena river, the mineralized dike formation is found at the high altitudes some miles back from the river, and consequently not as easy of access to transportation.

As an illustration that the country has been but little prospected, only last summer the outcroppings of a vein were found at an elevation of only 500 ft. above the valley on the eastern slope of Kitsalas mountain, within 2000 ft. of the railroad track. The quartz outcrop carried particles of free gold visible to the naked eye, and was easily traceable for about 200 ft. along the strike. The predominating mineral exposed in opencuts was bornite in the quartz gangue, and an average sample across three feet assayed: gold, $8; silver, 3.8 oz.; and copper, 7.1%. The width of this vein varied from one to eight feet. It was a clean-cut fissure in a schistose volcanic rock, with well defined walls, and a few inches of talcose gouge separating the vein matter from the wall-rock. This instance is given to show the attractiveness of the Skeena River country for prospecting, and the opportunity offered to the experienced prospector since the completion of the Grand Trunk line.

The mineralized zones traversed by the Skeena valley between Prince Rupert and Hazelton are, so far as at present known, two in number, the southerly one occupying an area from the northwest boundary of the batholith of coast granite, at about milepost 94 on the railroad, to about mile 130; while the northerly zone, known to be mineral bearing, has its southern boundary near Skeena Crossing, about 12 miles southwest from Hazelton, and extends in an easterly direction toward the Telkwa river, but its northern boundary is not yet well defined.

The southern mineralized zone extends in a southeast direction toward the coast for several miles along the mountain range which separates the Zymoetz or Copper river from the Lakelse valley, and in a northwest direction to the divide between the Skeena and Nass rivers, a distance of about 50 miles.

Mining Methods at Park City, Utah

By JAMES HUMES

*The active mines in the Park City district at the present time are the Silver King Coalition, Daly-Judge, Daly West, and Silver King Consolidated. Several other companies, such as the Daly, American Flag, and Ontario, are doing considerable development work.

In the Silver King Coalition mines the ore is a replacement of a dark silicious limestone bed, varying in thickness from 18 in. to several feet. In places the ore is 25 ft. thick. This limestone bed lies within 100 ft. of the underlying Weber quartzite. There are other lime beds, similar in appearance to this one, in Park City formation, which is approximately 700 ft. thick; but not one of them has been found to contain any traces of ore. Directly under and in contact with the ore-bearing bed is another, composed of gray lime well studded with dark concretionary nodules; and this one is an unfailing indication of the proximity of the ore-bearing bed.

These ore deposits make out from or have connection with some one of the ore-bearing fissures, which were undoubtedly the channels for the circulation of mineral-bearing solutions. It is therefore proper to run prospecting drifts in the fissures, although they seldom contain much ore.

As a general rule, driving in the fissures is not costly. Mining and 'mucking' cost from $2.50 to $4 per foot, and little timber is required. There are instances, as in the Daly fissure in the Daly-Judge mine, where the expense of keeping drifts open in the fissure is so great that it has proved economical to make the drifts in the footwall rock and run cross-cuts into the fissure at short intervals.

In the Park City mines it is not easy to determine beforehand the best method for extracting the ore from a newly discovered ore-shoot in the bedded deposits. While we may get one dimension from the drift driven in the fissure, that will not give us a correct idea as to the other dimensions of the orebody. The fissures here referred to have a north 35° east strike, and the beds dip from 10 to 30° northwest. The accompanying sketch map shows part of a worked-out orebody that has a connection with an ore-bearing fissure at the southeast end and 200 ft. higher up on the dip of the beds. It will be noticed that the 900-ft. drift was advanced a long way in barren rock, yet it was all the time in the replacement bed, and where the ore is shown at the top of the incline it was very thin and discouraging, but persistent exploration developed a fine body of ore.

The orebodies are somewhat lenticular in form, with their greatest length along the strike of the lime beds. The perimeter, except on the fissure side, is very irregular in outline. There are numerous branches, extending sometimes as much as 100 ft., and averaging from 5 to 25

*Abstract from *Transactions* of the A. I. M. E., New York meeting, February 1915.

ft. in width. Ore also occurs up and down in small fissures for a few feet, and there are 'rolls' in the foot-wall that make the beds almost vertical for from 5 to 25 feet.

Most frequently the ore dips down from the fissures (that is, the north-dipping fissures); and if a drift in the fissure has cut the ore it is worked down as far as possible by shoveling out the rock. If it persists in going down, a small hoist is rigged, of which there are a dozen in the Coalition mine, ranging in size from a Holman stretcher-bar hoist to a double-cylinder 35 hp. These little hoists enable us to raise the regular mine cars. If the angle is too steep for a direct pull, simply fasten the end of the hoisting rope to a post at the top of the inclined winze, and pass it through a 7-in pulley which is hooked into the car. This method gives the engine a double purchase; and even with the little double-cylinder

SKETCH MAP OF WORKED-OUT OREBODY.

5 by 6-in. engines we are seldom unable to manage the 18-cu. ft. cars. If the deposit is too thin, enough of the bottom is taken up to admit the car. Often the temporary inclines will meet with a face of barren rock. In such cases we do not cut through the waste, but turn the rails to the right or left, as the case may be, and follow the ore. (See sketch.) Should the ore continue down on the dip for a considerable distance, small drifts are run right and left from the main incline, in which is used a small special car, dumping its contents into a hopper that connects with the car on the main incline. Should there be a sufficient thickness of ore at the point where we wish to run one of these sub-levels, we simply put down a track switch on the main incline, the points of which are thrown with a lever on the level that is connected with the points by means of a long rod, crank, and short rod, and in this way we are able to load the mine cars that are hauled to the ore-bins on the surface.

An experienced miner, reading these lines, will probably ask himself the question, 'Why don't they do their development work from the lower edge of their orebodies?' As I said before, it is impossible to predetermine the outlines of such orebodies. At the time this property was taken charge of, there were many schemes for moving the ore from the faces to the levels. The best and easiest of application was the shaking chute, but as time went on, the thought of trying any of them was abandoned. At the present time, as much underhand as overhead stoping is done, and in doing so a great deal of development work is avoided. Most of the time the deposit is so flat and thin that it is impossible to use a stoping machine to advantage, so that most of the mining is done by the 'single jack' method. Sometimes the ore is only a few inches thick, but it is not abandoned until there is no sign of ore, as many times a small stringer has led to a large deposit. The cost of mining ore here ranges from $1 to $4 per ton.

I understand that the above methods prevail in all the mines here where they are mining the replacement deposits. Following is a scale adopted by the Daly-Judge Mining Co. for driving drifts and cross-cuts with Leyner machines, the Company furnishing all supplies:

Average footage per shift.	Machine men.	Machine helpers.	Muckers.
Less than 3.5	$3.25	$3.25	$3.00
3.5 to 4.0	3.50	3.25	3.00
4.0 to 4.5	3.75	3.50	3.00
4.5 to 5.0	4.00	3.50	3.00
5.0 to 6.0	4.25	3.75	3.25
6.0 to 7.0	4.50	4.00	3.25

Costs at the Sons of Gwalia Mine

This property is at Leonora, Western Australia, about 140 miles northeast of Kalgoorlie. The main incline shaft is down about 3000 ft., and the mill contains stamps, grinding-pans, leaching tanks, filter-presses, and vacuum filters. Costs during 1913 were as follows:

Operations.	Per foot.
Shaft-sinking	$96.18
Station-cutting and shaft bins	0.39
Driving	18.56
Cross-cutting	17.84
Rising	16.50
Winzing	22.30
Diamond-drilling	5.30

Total development was 7640 ft., with 2433 ft. of drilling and 11,244 cu. ft. of cutting, the whole costing $1.07 per ton of ore milled.

COST PER TON MILLED

Development	$1.07	Disposal of residue	$0.07
Ore extraction:		Clean-up	0.12
Breaking ore	$1.66		
Filling stopes	0.05	Total milling	$1.67
Tramming and hoisting	0.52	General expenses:	
		Salaries and wages	$0.20
Total mining	$2.23	Sundry	0.08
Treatment:		Maintenance and supplies	0.01
Rock-crushing	$0.12	Rent and insurance	0.10
Ore transport	0.05		
Stamping	0.31	Total general	$0.39
Filter-pressing	0.54	Bullion realization	0.06
Leaching sand	0.14		
Fine grinding	0.32	Grand total	$5.42

The plant treated 162,101 tons of ore yielding $7.50 per ton. Dividends totaled $312,000.

COAL MINE ACCIDENTS in England in 1914 totaled 1210, compared with 1753 in 1913 and 1276 in 1912.

Economical Use of Explosives

By R. NOBLETT

It seems worth while to set forth to mining men, and especially to the miner, some of my experiments, their results, and conclusions reached in the economical use of explosives in mining. Most of these experiments were made with the explosives most generally used, 40% dynamite and 40% gelatin. My first experiment was made when driving a drift which required seven holes to each round. This drift was driven about 200 ft. before I went into it. The rock was soft and easily broken with powder. As it was a prospect drift, the manager wished to drive it without timber if it could be safely done. The round was composed of one back-hole, two breast-holes, two cut-holes, and two lifters. This round of holes was in general use at the mine when driving in country rock, and thousands of feet of driving was done each month.

The charge of powder in general use for each round was 36 sticks of 40% gelatin. I began my work in the drift with 32 sticks to the round. Three sticks was the charge given the back-hole, and it was found to be too much. I reduced it to two sticks and used two sticks of tamping on top of the charge. I made the sticks of tamping by wrapping paper around the loading-stick, closing the paper over the end of the stick, withdrawing the stick and filling the paper tube with dry drillings. To my intense surprise, this charge was worse than the former one of three sticks. I reduced it to 1½ sticks, and found that too much, and finally reduced it to one stick. I ran that drift more than 300 ft. using one stick, and found it to be ample.

Having succeeded so well in this experiment, I turned my attention to the two breast-holes; I had been using 4 sticks to each of these holes (most of the miners were using 5). I reduced from the 4 to 3, using 1 stick of tamping to each hole. I could see no difference in the breaking, so I reduced the charge to 2½ sticks, with 2 sticks of tamping to each hole. I found by that trial that it was not safe to make any further reduction. I then turned my attention to the cut-holes. I was using 5 sticks to each of these holes; I reduced this to 3½ sticks with 2 sticks of tamping. This charge I used for about two months and it never failed; in fact I got better results with 23 sticks to the round than I had when using 32. I found also that this reduction in powder was making enemies for me, and made no attempt to reduce the charge in the lifters. In fact I was compelled to report more powder than I used each shift.

In regard to the tamping, I have used this same form in rises and stopes as well as drifts, and prefer it to any other kind or form. It most certainly pays for the time and paper required to make it. It is easily and quickly prepared especially in stopes or rises where drillings are plentiful. It is not good practice to ram the tamping when working in soft or medium rock. Press it in the hole in much the same manner as the powder is pressed. The expanding gases will do the ramming for you. In very hard rock the tamping must be well rammed to get good results, and care is needed in its preparation. It must contain no small pebbles which could injure the fuse. Even in hard rock I have found the loading-stick to be all that is required in doing the tamping.

I shall give here no further details of experiments made in hard rock, but will state one conclusion that was forced upon me after many tests. These tests were made in the 'black sulphide' rock commonly occurring in copper mines. This rock generally has a distinct cleavage, sometimes slaty but more often angular. When the cleavage is marked, a strong explosive will give better results. That is, a 60% dynamite will do more work for the same cost than 40% will. It will also be found to be safer when properly used; one reason why it gives better results is that it is quicker; another is that the charge can be placed nearer the bottom of the hole, *where it should be*. There is more danger in using explosives in this kind of rock than in any other that I know of. Not only is the rock black, giving poor reflection from the miners' light, but everything in sight is black. If there should be a stick of dynamite in the broken rock it is not likely to be seen by the men at work. The rock is very heavy and hard to shovel, requiring frequent use of the pick. It is almost certain that the pick will find the lost powder first. The use of a stronger explosive places the charge farther from the collar of the hole, making it safer for that reason. In massive rock, that is, rock having no pronounced cleavage, the stronger explosive does not give results such as to justify its use in general mining work. I have taken more space than I intended in beginning, but with the Editor's kind permission I would like to say a few words to the miners who may read this. In the first place, no man can from a distance tell a miner how much powder he needs to use in his holes. He can only suggest investigations to see whether the same work cannot be done with less, always keeping in mind the fact that the less powder used, the less is the danger from it. If you used none at all there could be no danger at all. My advice to the miner is to be careful with what you use, and cut your fuses with a sharp knife, one that will not mash the end so that it cannot spit fire into the cap. This is the cause of many missed holes, and if you have no missed holes you will lessen the danger for everyone about you. Do not accept old customs altogether, but do a little experimenting for yourself.

BULLION TRANSACTIONS at the San Francisco Mint in February were as follows: gold received, 248,191.6 fine oz.; silver, 96,844.8 fine oz.; domestic coinage, gold, $2,980,000; silver, $72,000; copper, $14,000; and for the Philippines, silver ₱47,000. Gold, bullion, etc., on hand at the end of the month amounted to $264,708,040.19.

CRUDE OIL SHIPMENTS from Tampico, Mexico, to the United States in January amounted to 841,355 bbl., as against 1,093,431 bbl. in that month of 1914.

Mineral Production of Canada, 1914

John McLeish, chief of the Division of Mineral Resources and Statistics, Canada, presented his preliminary report on the mineral production of Canada for 1914, the figures being subject to revision, at the Canadian Mining Institute meeting, March 3. The total value was $128,475,499, as compared with $145,634,812 in 1913, being a decrease of $17,159,313, or 11.8%. The total value of the metallic production was $58,870,028, as against $66,361,351, a decrease of 11%. The production of the more important minerals was as follows: Copper, 75,738,386 lb.; value, $10,301,935; decrease, $1,451,671. Gold, 770,374 oz.; value, $15,925,044; decrease, $673,879. Pig iron, 783,164 tons; value, $10,002,856; decrease, $6,537,156. Lead, 36,337,765 lb.; value, $1,627,568; decrease, $127,137. Nickel, 45,517,937 lb.; value, $13,655,381; decrease, $1,247,651. Silver, 27,544,231 oz.; value, $15,097,269; decrease, $3,943,651. Other metallic products, value $1,123,919, decrease $189,813. In making up the total value as above given, $8,863,944 is deducted from the figure for pig iron, being credited to imported ores. Of the non-metallic products, the principal decreases are in coal, which was produced to the amount of 13,433,108 tons, of the value of $33,433,108, a decrease of $3,901,832, and clay products valued at $7,090,898, a decrease of $2,413,416.

Thomas W. Gibson, Deputy Minister of Mines for Ontario, in presenting the report of the mineral production of the province for 1914, said that the decrease as compared with 1913 was principally in the items of silver, nickel, and pig iron. In his opinion the maximum production of Cobalt had been reached, and future years might be expected to show a diminution in the output of silver. The lessened production of nickel and pig iron was mainly due to the war, and the slackening of activity in the building trade naturally affected building material. On the other hand, there had been an increase in gold production due to the development of the Porcupine field. The report gave the total value of mineral production at $46,632,105, of which $33,869,497 was metallic, as compared with $53,232,311 total production, of which $37,507,935 was metallic, in 1913. The principal items on the metallic list were as follows: Gold, 268,942 oz.; value, $5,529,767. Silver, 25,999,374 oz.; value, $13,209,726. Copper, 14,453 tons; value, $2,081,332. Nickel, 22,760 tons; value, $5,109,088. Iron ore, 240,059 tons; value, $531,379; and pig iron, 556,112 tons; value, $7,041,079.

Theo. C. Denis, Superintendent of Mines for Quebec, stated that the decrease in production in that province amounted to 13.7%. The main falling off was in asbestos, for which Germany is an important customer, but the industry is recovering, and shipments to the United States are increasing. The production of magnetite is also likely to increase. The preliminary report showed a total production of the value of $11,325,428, as compared with $13,119,811 for 1913. D. B. Dowling presented some statistics furnished by John Stirling, mine inspector of Alberta, showing that the coal output of that province showed a decrease of some 445,039 tons. This was largely due to a decline in railway activity, and the opening up of other mines farther west. The production for 1914 was 3,667,816 tons.

Costs at the Lake View & Star Mines

These properties and mill are at Kalgoorlie, Western Australia, and costs according to the last annual report were as follows:

	Cost per Ton		
Development	$0.40	Preliminary grinding	$0.17
Ore extraction:		Agitation	0.50
Breaking ore	$0.92	Filter-pressing	0.25
Filling stopes	0.09	Clean-up	0.06
Tramming and hoisting	0.63	Disposal of residue	0.11
Total mining	$1.64	Total milling	$2.23
Treatment:		General expenses:	
Rock-crushing	$0.05	Salaries and wages	$0.11
Ore transport	0.06	Sundry	0.02
Stamping	0.34	Maintenance and supplies	0.01
Concentrating	0.14	Rent and insurance	0.04
Roasting concentrate	0.12	Total general	$0.18
Cyaniding concentrate	0.06	Realization of bullion	0.04
Fine grinding concentrate	0.04	Grand total	$4.49
Fine grinding sand	0.33		

Mining is being done below 1900 ft. in the Lake View mine, and 900 ft. in the Hannan's Star, which are about a half mile apart. The mill treated 216,043 tons of ore averaging $6.52 per ton.

The Hollinger Mill's Record in 1914

The report of the general manager (P. A. Robbins) of the Hollinger Gold Mines, Ltd., for the past year contains the following information:

Hollinger ore treated, tons	208,936
Average value per ton	$13.676
Total value sent to the mill	$2,857,398
Ore treated, tons per day	583.59
Time operated, per cent of possible	92.2
Ore treated per 24 hours of running time, tons	632.97
Stamp-duty per day of running time, tons	13.3
Unrecovered gold:	
Concentrate stored for re-treatment	$53,686
Lost in filter residue	$116,879
Total	$170,565
Bullion recovered	$2,719,354
Value of tailing, per ton	$0.56
Chemical consumption, pounds per ton of ore:	
Cyanide	0.525
Lime	1.557
Zinc	0.532
Acid	0.216
Lead acetate	0.003
Solution precipitated per ton of ore, tons	2.315
Zinc added per ton of solution, pounds	0.230
Average value of pregnant solution	$5.698
Cost per ton	$1.237

DISCUSSION

Readers of the MINING PRESS *are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.*

Precision of Thought

The Editor:

Sir—It does not seem to me that you, in your editorial of November 7, 1914, or Mr. Prosser, in the issue of December 5, or Mr. Nevius, on January 16, have taken the right view of the use of the verb in the sentence: "Of the tonnage hoisted, 626,000 tons *were* crushed." Your editorial states that your correspondent made an error in using *were*, because "to say that 600,000 tons *were* crushed would imply that each ton was separately crushed, like 600,000 walnuts cracked with a hammer. But this was not the process employed; a quantity which is expressed in terms of tons was crushed, and no individual entity is implied."

In my opinion your correspondent's use of *were* is fully justified by the usage of educated people—the only criterion that we have for correct English—and in changing *were* to *was* you have abused your editorial privilege: I also think that your reasons for making this change are wrong. However, realizing that my own views are of but little importance, I have asked the opinion of several authorities whose opinions ought to convince you of your errors.

What struck me very forcibly when I discussed this question with various linguistic experts is that there is no known authority whose word they recognize as final in disputes as to correct English. It would certainly save a vast amount of discussion if English-speaking peoples had something corresponding to the French Academy. I fancy that few engineers realize the intricacy of English grammar, but foreigners are rendered frantic by its confusion, and I once met a Russian who was so irritated by struggles with spelling and grammar that he became convinced that English was not a real language, but a mere jargon of French and German. As regards printed grammar, he certainly had some ground for his assertion, and the following quotation from the report of the Joint Committee on Grammatical Nomenclature is illuminating. This committee was appointed by the National Education Association, the Modern Language Association of America, and the American Philological Association. I quote from the preface to the report: "* * * the present state of things is deplorable. In the very desire for betterment, we have reached a multiplicity of terms, even for grammatical relations about the nature of which there is no real difference of opinion, as, for example, those seen in the italicized words in 'John is *good*,' 'This is *John*,' 'I admire *John*,' 'We made John *president*.' For the first of these, there are nine different names in twenty-five of the English grammars in use in the United States today; for the second, ten; for the third, seven; and for the fourth, eighteen. Thus 'good' in 'John is *good*' is variously called, according to the grammar used, *attribute complement, predicate adjective, subject complement, attribute complement or predicate adjective, subjective complement, complement of intransitive verb, predicate attribute, adjective attribute*, and *predicate*. The result of such a state of affairs is almost hopeless confusion. * * *"

The above quotation shows such a great variety of views as to the structure of English that it seems likely there will be considerable divergence of opinion as to what constitutes correct English; and this is true, for there are a number of books in which the English of our best writers is said to be full of errors, and a second lot of books in which the English of these critics is criticized. As far as I know, the last book of this sort is 'The King's English,' wherein the authors find the English of a very large number of our best writers violating rules of grammar. The following list is representative of the authors criticized, and could easily be enlarged: C. Brontë, Carlyle, De Quincey, Dickens, George Eliot, Emerson, Gladstone, Huxley, Kipling, Macaulay, Meredith, Prescott, Ruskin, Scott, Stevenson, H. Sweet, Thackeray, and R. G. White.

But, in spite of the conflict among grammarians and the difference of opinion as to what constitutes correct English, all authorities agree that we cannot go wrong if we follow the usage of educated writers; this rule is well set forth in the following:[1]

"It cannot indeed be laid down too emphatically that it is not the business of grammarians or scholars to decide what is good usage. Their function is limited to ascertaining and recording it. This can only be done by the prolonged and careful study of the language, as it has been employed by its best authors. It is they who settle by their practice what is correct or incorrect, and not the arbitrary preferences or prejudices of writers on usage or grammar. These constantly assume an authority to which they are not entitled. Ignorant of their own ignorance, they condemn because they fail to understand. The grammar of different periods does, it is true, vary to some extent. What is right at one time may be wrong at another. Still, as a general rule, he who studies faithfully the great masters of English literature need rarely feel any hesitation about adopting the

[1]Lounsbury, T. R., 'History of the English Language,' p. 187.

words or phrases or expressions which have received the sanction of their usage."

Another author states:[2] "If we know what a man means and his usage is in accordance with that of a large number of intelligent and educated people, it cannot justly be called incorrect."

As our only guide for correct writing is usage, I have thought it worth while to find out the usage of educated and intelligent men, namely, the professors of science in Stanford. In order to obtain an independent opinion, I handed your editorial to the professors mentioned below, and without giving them any hint as to my own views, asked them what they thought of it. G. H. Clevenger, metallurgy, said that before he read the editorial he would have written *were*, but is now convinced that *was* is better. D. M. Folsom, mining, has had the question called to his attention before, and would naturally have written *were*, but now would write either *were* or *was*, depending whether he wishes to give the impression of unity or continuous operation. C. F. Tolman, geology, would use *were*. Victor West, political science, considers *was* wrong and would use *were*. In all these cases it seems evident that *were* would have been the natural usage, and that any preference for *was* is due to your editorial.

I think that the opinion of the above professors is enough to show that *were* is justified by good usage and that there is no use in adding further testimony to the same effect. Thinking that you might perhaps remain unconvinced by the above testimony, I also thought it worth while to obtain the opinion of scholars who have made the study and teaching of English their life work and who have for years constantly discussed this question of the agreement of subject and verb, and I have procured the following statements:

Raymond M. Alden, professor of English, Stanford:

I have read the editorial you showed me with interest. Its general doctrine is certainly a good one; the only trouble is with the particular case on which it is based. 'Ton,' of course, is not a collective noun in the sense in which the writer uses the word; otherwise we could say "a ton were broken up," as he—very properly—points out that we can use a plural verb with 'football team.' In any case, the rule that a collective noun may take either a singular or plural verb does not mean that it can ever be used *in the plural* with a singular verb. That is, we can never say "the football teams was." In one case only could '40,000 tons' be used with a singular verb, viz., such a sentence as "40,000 tons was the phrase he uses;" in this case the subject of the verb is thought of as the *phrase* '40,000 tons'—not the mass of coal as a whole.

W. H. Carruth, professor of Comparative Literature, Stanford:

The article on 'Precision of Thought' in the *Mining and Scientific Press* contains some good illustrations of the difficulties arising over agreement of verb and subject where the noun is collective. However, in the case under discussion the subject is not a collective noun, but a noun of measurement, 'ton.' In the sentence quoted it seems to me to depend on the writer's thought and intention whether the verb is to be 'were' or 'was.' Looked at from the editor's point of view, 'was' is correct. If the writer thought of the ore as fed out in tons or parcels, he was justified in using 'were.'

G. R. Noyes, associate professor of Slavic Languages, University of California:

Personally I should prefer "626,000 tons *was* (Editor—Please spell crusht.) crusht," on the ground that the idea is that of a singular collective; '1,252,000,000 pounds' would express the same idea—whether one specifies tons or pounds is a matter of convenience. "626,000 bars of iron *was* crusht" w'd of course be wrong, since one thinks of the crushing of each separate bar, not of the whole heap. But while I prefer "626,000 tons was crusht," I should not regard "626,000 tons were crusht" as incorrect. I agree with you that the decision of the question depends on the intention of the writer and is a question of taste rather than of right and wrong.

S. S. Seward, Jr., assistant professor of English at Stanford:

The question you put does not seem to be one of right or wrong, but one of precision. I agree with you that the context makes 'were' preferable. If another chooses to use 'was,' I should have no quarrel with him. But if he should declare that 'was' alone is right, I should think that his attitude toward the English language was pedantic.

C. S. Downes, assistant professor of English, University of Illinois:

In regard to the editorial, I showed the clipping to Professor Scott, one of the older professors here. He and I agree that both forms are used. 'Was' is more logical, in this passage; but good writers of English are not always the most logical. Scott said he considered 'was' better when you mean "a quantity of so many tons, pounds, etc." But he added that he should not change anybody else's 'were' to 'was.' I agree with him perfectly.

A study of all the opinions[3] that I have given above convinces me that you are in error in condemning the use of 'were' by your correspondent, for it is justified both by the usage of the technical professors whom I have quoted and by the authority of the language professors. It seems that besides being in error with regard to the use of 'were' that you are also wrong in some of the reasons that you have given for the use of 'was.' You base the use of 'was' on the assumption that ton is a collective noun, which is an error—as pointed out by professors Alden and Carruth. But even if ton were a collective noun you should have written 'were,' for a collective noun in the plural is always followed by a plural verb (see professor Alden's statement).

Although the English professors who prefer 'was' are very likely to show good taste in such preference, yet, as a mining engineer, it seems to me that your employment of 'was' is likely to divert a reader's thought from a consideration of the technical subject under discussion to a question of grammar. And thus you are probably violating what Herbert Spencer calls the principle of 'economy of attention.' For a technical writer should have "for his supreme object" the conveying of "his

[2]Mathews, Brander, quoted from G. R. Carpenter in 'Parts of Speech,' p. 98.

[3]I wish to express my thanks to the gentlemen who have so kindly given me their opinions on the 'was' *versus* 'were' problem.

thought into the minds of his readers with the least friction.'' And certainly anyone who reads your sentence with its 'tons was' attentively would instinctively stop and ask what led you to use this singular verb with a plural subject instead of following the discussion with regard to the ore. From the point of view of a mining superintendent your use of *was* is forced and unnatural, for the image evoked by the sentence is that of plurality. Apparently you do not have the same vision that I do. When I think of 'tons hoisted' I see a shaft with cages rising and lowering and men handling cars, and when I think of a mill I have the image of stamps dropping and multiplicity. You, on the contrary, evidently see a mine in which a block of 626,000 tons is detached by some unknown method and hoisted in one lump by some monstrous mechanism. And your imagination must have invented some gigantic mill that crushes the whole 626,000 tons at one fell blow.

The above seems a lot of writing about a minor matter, and I think it as well to explain that I do not object to your use of 'was' or of 'were' in the sentence under discussion. I do, however, decidedly object to your correcting your correspondent's perfectly good English.

W. H. Shockley.

Palo Alto, California, February 15.

[It gives us great pleasure to print Mr. Shockley's interesting letter, and even greater to point out that his argument from usage sustains us, instead of himself, since of the nine men consulted five agreed to the use of 'was,' and only four adhered to 'were.' Mr. Shockley also goes astray in failing to recognize that mining men are the guardians of their own gates of speech, and as to the best use of words in literature dealing with mining the opinions of two well educated, thoughtful, and careful mining men are more weighty than the views of a half-dozen professors of non-professional literature. A distinction must be drawn between common usage and the best usage. If it were possible to ascertain the usage of all of the hundred million people of the United States it would undoubtedly be found that a majority of them say 'ain't' instead of 'are not.' Pushing this argument to its conclusion, it is quite possible that the usage of one thoughtful writer may be the best usage, as compared to the practice of many other writers who have never given special thought to all the factors governing that case. For example, a few years ago, T. A. Rickard alone made a distinction between the use of 'tailing' and 'tailings.' Now probably a majority of careful writers in the mining profession use 'tailing' to designate the product of a single mill or machine and 'tailings' to indicate the product of several; a distinction that obviously tends toward clarity and precision. Finally, it gives us malicious pleasure to point out that Mr. Alden, professor of English at Stanford, with whom Mr. Shockley concurs, is clearly in error. We can not, indeed, say ''the football teams was,'' but not for the reason he assigns. 'Football team' is a collective noun; 'football teams' is a plurality of collectives, and requires a plural verb for exactly the reason cited in the original editorial, since the football teams do not act as a unit, but as different, and commonly opposing, collectives.—Editor.]

Amalgamation in Hardinge Mills

The Editor:

Sir—The following data cover a definite case. I was the man on shift; I fed the quicksilver: I crawled inside the Hardinge mill at clean-up time, and I know the condition of the amalgam as I found it. The sketch shows the flow-sheet, excepting the Pierce amalgamator.

The articles by Messrs. Caetani and Kiliani, and the comment and questions by Mr. Girard seem to show that much interest has been aroused among millmen by the departure from standard practice at the Plymouth mill. From reading Mr. Caetani's article, one might assume that he built a very efficient crushing unit and lost sight of the fact that the business of a gold mill is to get the gold. I see no reason why amalgamation in the stamp-battery followed by the Hardinge mill should be attended by any more difficulty than amalgamation in the stamp-battery alone.

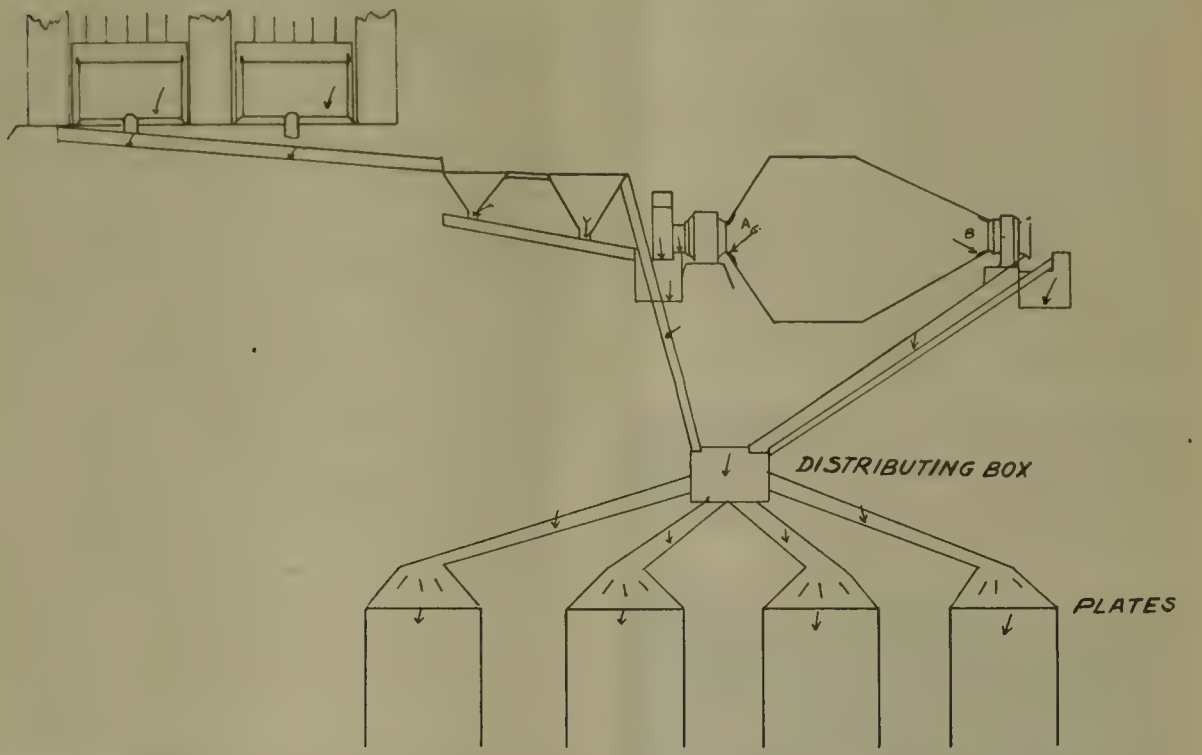
When I arrived at the plant referred to, amalgamation was done on the plates only. Shortly after, this was changed to feeding quicksilver to the Hardinge mill, with a marked improvement in results. Later this was again changed to feeding quicksilver to the batteries, with a further improvement in results, as we were informed. During the first part of the campaign the amalgam on the plates was maintained very hard, being removed by scrapers, one of the plates being cleaned up each 24-hr. period. The Hardinge mill was cleaned up at the end of the month, by having the manhole cover removed and the screen adjusted, and the mill was revolved and all sand and possible amalgam allowed to fall out. The screen was then removed, and a man entered the mill to see what was inside. Considerable amalgam was found in the spaces between the silex brick, but by far the largest amount of the amalgam found in the Hardinge was stuck fast just inside the throat of the mill at the points marked A and B on the diagram, and was very hard, a hammer and cold chisel being necessary to remove it. Considerable amalgam was also found in the throat, both at feed and discharge ends, and also in the feed scoop, stuck tight, and I recall that we removed the scoop to get at it better. No hard balls of amalgam were found in or around the Hardinge mill, but we did get the hard balls in the batteries around the dies. Also, the small cones, feed, and discharge boxes of the Hardinge mill and the distributing box above the plates seemed favorite places; hard chunks would build up in most unexpected places. Nail heads in launders and boxes were always covered with amalgam. I do not recall that we got anything from the sand and loose material inside the Hardinge mill.

Later on the plates were kept softer and the amalgam more pasty; scrapers were scrapped, and the rubber

used. Amalgam built up much faster on the plates, one being cleaned every day, or more than one if it seemed advisable. At the monthly clean-up the Hardinge mill was a disappointment, also the mortar-boxes, and the largest quantity of amalgam on this run was obtained from the plates; and we were told that the extraction had reached expectations. I have no means of knowing the mercury losses, but do not believe that they were excessive. The ore was principally limonite, some quartz and clay. A Pierce amalgamator placed below the plates never got anything but dirt, although dressed daily once each 8-hour shift.

FRANCIS O'BOYLE.

Luning, Nevada, January 28.



ARROWS SHOW THE POINT AT WHICH AMALGAM WAS FOUND. OLD STYLE DOUBLE-DISCHARGE BATTERIES. DRY CRUSHING. REAR DISCHARGE CLOSED BY STEEL PLATE AND PLANK, FRONT DISCHARGE THROUGH SPOUT.

Gold Production of the Philippines

The Division of Mines of the Bureau of Science, in a preliminary estimate published on February 6, places the value of the gold produced in the Philippine Islands during 1914 at ₱2,406,867. These figures are not final, inasmuch as returns from the various mining companies are not yet all in, and it is probable that later data will vary slightly from the above total. The 1914 production was nearly 39% greater than in the previous year, which was ₱1,736,724. A little more than half of the 1914 production is the result of lode mining, the remainder having been produced by dredging.

The estimated value of the silver produced in 1914 is ₱16,000. There is no mining of silver ores in the Philippines at present, this production being the by-product from gold ores, or dredging.

Estimates are not yet completed for the output of other mineral products during 1914, but the returns are coming in rapidly, and within a few weeks the total mineral production for the past year will be available.

MINERAL PRODUCTION of Quebec in 1914 was valued at $11,325,428, compared with $13,119,811 in 1913, and $11,187,110 in 1912. The principal contributors last year were as follows: asbestos, 107,401 tons, valued at $2,895,935; cement, 2,840,436 bbl., and $3,325,055; brick, 136,885,000 and $1,093,731; copper and sulphur ore, 117,778 tons and $801,129; limestone and marble, $1,566,-145; and granite, $561,900. Gold, silver, zinc, and lead ores were worth $21,084, $31,809, and $15,490, respectively. There were 6756 men employed in mines, quarries, and plants, against 8611 in 1913, receiving $4,138,-059 in wages. Out of 133 accidents there were 9 fatalities.

AT the recent meeting of the Lake Carriers' Association, held at Detroit, and attended by about 350 vessel owners, it was decided, in view of the limited freight in sight for the coming season, that no vessels would be placed in commission for the sailing year of 1915 until June. This action will result in shortening the season and allow a more equitable distribution of the business.

CONCENTRATES

Readers of the MINING PRESS *are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.*

SHAFT SINKING at the Brunswick Consolidated mine, Grass Valley, California, cost $91.94 per foot in 1914.

OSMOTIC PRESSURE is a force which operates the phenomenon of diffusion. The measurement of osmotic pressure is a means of sharply distinguishing between crystalloidal and colloidal matter.

TEMPERATURE affects anthracite coal consumption considerably. February was 6.5° above the normal daily average to the 26th, and the output will not be over 4,120,000 tons, about the same as in that month of 1914. A period of heavy water has also added to the operating expense.

SOME 'DONT'S' for steam-shovel operators are as follows: Don't start to swing until the dipper has cleared the bank, too much haste eventually will mean broken boom and dipper sticks; and don't continue to pull the dipper through the bank after the dipper has become filled, otherwise power will be wasted.

ANTHRACITE is eminently a product to be used in great cities, and the existence of New York, Philadelphia, Pittsburgh, Buffalo, Newark, Jersey City, Rochester, Syracuse, Scranton, Paterson, and Albany, whose populations aggregate 8,600,000 persons, accounts to a large extent for the great proportion of the output sold in the states of New York, New Jersey, and Pennsylvania. The city of New York alone absorbs over 10,000,000 tons of anthracite per year.

AN EFFICIENT quicksilver reduction plant of 50-ton daily capacity will cost about $25,000, according to C. A. Heberlein, and there should be a considerable tonnage of ore in sight to warrant such an outlay. At the Oceanic mine, Cambria, California, mining costs are very low. Reduction costs are as follows in a 50-ton plant:

Labor.	Per shift.	Charge.
Three charge men	$2.50	$7.50
Three furnace men	2.50	7.50
One helper	2.50	2.50
One foreman	3.50	3.50
One-half cord of wood	5.00	2.50
Total on 50 tons		$23.50
Per ton of ore		0.47

Adding the handling of the soot in the retort, the total cost is about 50c. per ton of ore. With a recovery of 91%, or 5.91 lb. of quicksilver per ton, worth 50c. per pound, the value recovered would be $2.95 per ton, and the total cost would be $1.50 ($1 for mining and 50c. for reduction), leaving as net profit per ton of ore, $1.45. This is but a small margin of profit, and it is evident that at the figures named, close management and a large tonnage of ore are necessary to make a successful business.

ACCIDENT DATA at the Raritan Copper Works, Perth Amboy, New Jersey, were as follows in January:

Men employed	562
Total accidents	6
Incapacitating accidents	6
Non-incapacitating accidents	0
Men injured, per cent	1.07
Men injured, January 1914, per cent	2.78
Decrease, per cent	61.51
Average injuries per hundred men since September, 1914, per cent	1.18
Total hours lost during January, 1915	677
Equivalent wages	$153.98

GRANITES are generally regarded by operating miners as unfavorable country rocks in which to look for workable gold-bearing veins. The ground for this belief doubtless is found in the fact that granitic magmas are more likely to be the source than the home of quartz veins, though the dike material in which the great Treadwell orebodies occur is an albite-diorite which was formerly designated as granite. Granites are important in giving rise to contact orebodies, but the ore is apt to occur in the limestones or aluminous rocks which have yielded to the contact metamorphism. It must be remembered that many of the granites are very ancient rocks, and observation goes to show that most orebodies are the product of comparatively recent geologic processes.

THE METHOD of shooting old drill-holes to prove them, rather than to drill a new hole near them, is being done by J. M. Short, operator of many large mines in the Joplin district, Missouri. He has found the system satisfactory, and at the same time has shown that some of the early-day drill records were much exaggerated. He uses a heavy wire to lower the powder into the old holes. He makes loops in this wire one foot apart for a distance equal to that of the unopened orebody. For example, if the old record stated that pay-dirt was found at 100 ft., and continued down to 150 ft., he makes 50 loops and attaches thereto 50 clusters of 60% dynamite, using from six to ten sticks in each cluster, according to the hardness of the ground. He uses insulated wire for firing, placing exploders in at least two of the sticks of each group. The shooting loosens the dirt on every side of the old hole, and an average of the ground can be obtained by hoisting out several sand-buckets of the ore and having it assayed.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

HOUGHTON, MICHIGAN

FULL TIME BEING WORKED IN THE COPPER MINES, AND DEMAND FOR METAL.—HANCOCK RESUMES.—QUINCY WAGES AND FIRST AID.—NOTES ON THE IRON RANGES.

With the return of the large producers to full time schedule, the mines of the Lake Superior copper district are showing noticeable gains in production each month. The Calumet & Hecla, Copper Range Consolidated, Osceola Consolidated, Quincy, Ahmeek, and Isle Royale all showed increases in February. If this increase can be continued, by the end of March the district should be showing practically normal production again. The mining companies of the copper district have experienced trying conditions in the past 18 months, and the return to normal production will mark a notable event in the history of the district. In one or two of the mines richer ore is being found in the lower levels. The increased production is forcing the mills to their full capacity.

There appears to be an urgent demand at present for immediate shipment of copper from the Michigan district. Instead of storing the refined copper, as has been the custom in previous years, the smelters are making large shipments daily by rail to the East. With the close of navigation last fall, the smelter docks and yards were entirely cleared of copper, another unusual condition in the Michigan district. So urgent is the demand, that a few weeks ago, when a shipment was made to a firm in New Jersey, the consignee furnished a man to accompany the consignment from the smelter in Michigan to the works in the East.

The Hancock mine resumed operations with a large number of men on March 1. The mine had been closed for seven months, and the present force will get the workings in shape for production. Hoisting will commence as soon as possible, and all the ore will be stored until the Franklin mill is ready to start. R. M. Edwards, president of the Franklin Mining Co., states that the Company contemplates reopening the stamp-mill in about 60 days, or as soon as the Allouez conglomerate lode is ready to supply 'rock.' Arrangements have been made to treat Hancock and New Arcadian 'rock,' as well as South Lake when that mine starts shipping.

The Champion Copper Co. has declared a dividend of $1 per share. No dividends were paid during 1914, the last being $1 paid October 15, 1913. The St. Mary's Mineral Land Co. owns 50,000 shares of Champion.

It is reported that the Nonesuch sandstone, the copper-bearing formation at the White Pine mine, carries appreciable amounts of gold and platinum. It is further reported that gold has been found in the same formation ten miles west at the Smith explorations.

It has been reported that the Quincy Mining Co. has granted an increase in wages to employees, beginning March 1. In the deeper levels, Quincy is finding a richer grade of ore. This fact will be well worth studying, and may perhaps help to answer the question as to whether the copper content of the Keweenawan 'rocks' actually decreases with depth. Thirty-one employees of the Quincy company have been presented with 'First Aid to the Injured' certificates. These were received by graduates of the course commenced two years ago by A. F. Fischer, chief of the medical staff. A new and larger class has been started in this study. The certificates state that the holder has attended the full course of lectures, which consists of a 20-minute address and one hour of demonstration, once a week for three months. Physiology and anatomy are studied in the class periods. The certificate bears the name of the graduate, his picture, the first aid corps seal, and the date of issue. A drilling record of 11 ft. in one shift was recently made at the Quincy mine with one of the new machines, which was taken down and set up four times during the shift.

During February there was some improvement in the Michigan iron districts. However, stockpiles are too large, and this interferes with securing favorable market prices. With large stocks of unsold ore at nearly all the mines, and storage room generally crowded to the limit of capacity, things have been quiet on the Marquette range.

The Lake Angeline mine at Ishpeming was closed the first of the year. The Company was loading its output into railway cars which were to be held at the mine until the opening of the shipping season next spring, and had filled 140

STAMP-MILL, BOILER-HOUSE, AND CRUSHING PLANT AT THE WHITE PINE MINE OF THE CALUMET & HECLA.

of these when the railroad company sent word that it could supply no more. Mining was then discontinued. The ore was coming from the side-hill above the old workings, and could be handled at a profit only in this way. F. Braastad, of Ishpeming, applied to the Jones & Laughlin Co. for an option on the Lake Angeline mine and offered to buy the property at a price equal to the amount of assessment or to lease it on a royalty basis. The option has not been granted, and it is probable that the Company will reopen the mine and take out the ore still remaining, as soon as the shipping season opens.

The American is one of the few properties in the iron districts operating a large force. The mine was closed for several months, during which time the shaft was repaired and other improvements made. The mine was reopened about a month ago, and with the recent increase in force it is believed that it will be operated to capacity in the coming season.

The report comes from Negaunee that the Hartford and Cambria, the two Negaunee mines of the Republic Iron & Steel Co., will soon reopen with a large force of men.

On the other Michigan iron ranges the mining industry

seems to be improving. Orders were received early last month to start work at the Indiana mine on the Menominee range. This property has been idle for years. It is controlled by the Thomas Furnace Co., of Milwaukee. The ore runs about 40% iron, and is low in phosphorus. The ore can be used in mixture with richer grades.

The Rogers-Brown Ore Co. has canceled its lease on the Iroquois mine at Mt. Iron, Mesabi range, and most of the machinery has been moved to one of the Company's properties on the Menominee range. The Iroquois was opened in 1913 and still has considerable ore in sight.

The working force at the Bristol mine, Crystal Falls, has been increased by 250 men.——One hundred men have been put to work at the Dunn mine, to work orebodies found last year after the mine had been reported to be about exhausted. ——Seventy men have been added at the Tully mine.——Work has been resumed at the Rogers-Brown company's mines in the Iron River district.——The Hollister Mining Co. has closed down its Ravenna mine at Crystal Falls. Pumping is being continued, so it is hoped that mining will be resumed in the near future.

On the Gogebic range, hoisting of ore was resumed at the Ashland mine on March 1. During the several months of suspension extensive repairs were made to the shafts.——All of the employees of the Newport mine are now working on full time schedule.——The Oliver Iron Mining Co.'s Ironwood mines are still working only three days per week.——In the Bessemer district, the Newport Mining Co. has increased its force at the Anvil mine and returned to full time.

NEW YORK

THE SMALL INVESTOR AND LOW-PRICE SHARES.—COPPER.—CALUMET & HECLA AFFAIRS.

One of the significant movements in the investment market during recent years has been that looking toward the making of low-price shares. It has long been the custom to issue shares in prospects, pure and simple, on a 'penny' basis. Outside of this field, however, it has been almost a universal practice, until recently, to make trading units as large as possible and at the same time secure distribution of the stock. This is a tendency that is now being overcome rapidly. It is coming to be recognized that the small investor, in the aggregate, is the most powerful of financial influences, the most capacious absorbent, and the most retentive. We are coming to the English idea of the £1 share. The unwieldy character of shares selling at a great premium is instanced by the Ahmeek, which has 50,000 shares, now quoted around $260. On the basis of New York Stock Exchange quotations as ordinarily given, $100 worth of Ahmeek par value would be quoted at $1040. Thomas L. Chadbourne, who is the largest individual holder of Ahmeek, has just mailed a letter to the shareholders, suggesting the issuance of four shares of stock for one now held, in order to make the issue more liquid in trading, and in handling the bank loans required by traders and brokerage houses. At the present market figures, Ahmeek has a valuation of about $13,000,000. The property is the feature among the Lake coppers, and only needs a move like that suggested by Mr. Chadbourne to make it the market leader of the Boston coppers. It may be doubted if it would not be wiser to make the face value of the stock still lower. The mining successes which have been market successes in New York have been put down within reach of the small investor, and the opportunity has been appreciated. London and Paris have long recognized the quality of buying which comes from the little man. He will speculate, from an investor's point of view, and ordinarily his purchases 'stay put.' Some of the best students of economic conditions are emphatic in their opinion that, just as fast as the country can work to it, we are preparing for a period of constructive enterprise and expansion. Such a move is more than due. Whether it is to come in the near future or not, it is quite certain that the financial interests that take the little investor into consideration, and break away from some of the old outworn traditions of Wall Street, will greatly profit thereby.

It may or may not herald any protracted period of great activity, but it is gratifying to note the continual general improvement in the copper situation. There are so many hazards impending that it is quite impossible to look forward with tranquil assurance, but the general inclination seems to be to claim a strong position for the copper industry, and to praise highly the manner in which the metal market has been handled during a most trying time. The Lake country is particularly active, and seems to be somewhat ahead of the producers farther west in getting back to normal production. The Michigan mines are back on full time, and February showed a marked increase over January, notwithstanding its being a short month. The increase in production was due in part to larger tonnage and in part to richer 'rock.' The refined copper production for the month is estimated as 19,180,000 lb. The over-sea shipping situation is one of the most important factors in copperdom right now. Copper prices are just a trifle easier, due to the fact that little metal can be sent out at present.

The work of undoing the Calumet & Hecla consolidation, which did not go through, is still going on. The Osceola Consolidated held its annual meeting this week, when the Calumet & Hecla representation on the Osceola board was reduced by two. One of the new directors chosen is J. M. Longyear, of Marquette, Michigan. Mr. Longyear, in connection with Charles F. Ayer, of Boston, has long been one of the largest factors in the mining industry in the northern peninsula of Michigan, both in iron and copper, and next to Calumet & Hecla they are the largest owners of the White Pine, which is expected to prove the next important addition to the list of Lake producers. The same interests also operate in Sweden, where they are large producers of iron ore.

WASHINGTON, D. C.

ONLY ONE MINING BILL MADE LAW IN THE LAST CONGRESS.—FATE OF MINING LAW AND FERRIS BILLS.—LACK OF INTEREST BY MINING MEN, AND OPPOSITION.

Despite the large mining program of the late Sixty-third Congress, only one measure became law, the Foster (chairman of the House Committee on Mines and Mining) bill providing for mine safety stations and experiment stations. This bill had passed in both Houses, and was rescued from the congestion after amendment in the Senate, in which the House later concurred. The bill as amended in the Senate provides for seven mine safety stations, in addition to those already provided for, instead of 15 as proposed in the House bill. The bill as it reads as signed by the President is as follows:

"*Be it enacted, etc.*, That the Secretary of the Interior is hereby authorized and directed to establish and maintain in the several important mining regions of the United States and the Territory of Alaska, as Congress may appropriate for the necessary employees and other expenses, under the Bureau of Mines and in accordance with the provisions of the act establishing said Bureau, 10 mining experiment stations and 7 mine safety stations, movable or stationary, in addition to those already established, the province and duty of which shall be to make investigations and disseminate information with a view to improving conditions in the mining, quarrying, metallurgical, and other mineral industries, safeguarding life among employees, preventing unnecessary waste of resources, and otherwise contributing to the advancement of these industries; *Provided*, That not more than three mining experiment stations and mine safety stations hereinabove authorized shall be established in any one fiscal year under

the appropriations made therefor. That the Secretary of the Interior is hereby authorized to accept lands, buildings, or other contributions from the several states offering to cooperate in carrying out the purposes of this act."

It will be noticed that the bill carries no appropriation to make it effective. The mine safety stations would have cost $10,000 each. The appropriations were purposely omitted, or the measure would not have passed. It will take a year to get the money, so that the act so necessary to the health of the miners will not be available for a whole year at least, probably not before July 1, 1916.

The bill creating a commission to codify the mining laws of the land died on the calendar of the House. Such a bill had already passed the Senate. In the last days, to pass the House, unanimous consent was required to pass the bill, and this could not be obtained, so this enterprise fell through after it had seemed last year that the measure would surely go through. It contemplated an expenditure of $25,000, and its enactment was much sought by mining engineers.

Another measure which failed to pass was the Ferris bill to authorize exploration for and disposition of coal, gas, phosphate, or sodium, and the famous leasing properties. This had passed both houses of Congress, but in the Senate the important parts of the measure were dropped, especially the leasing sections, so that the bill as shorn of its essentials became merely a bill for the relief of the oil and gas men.

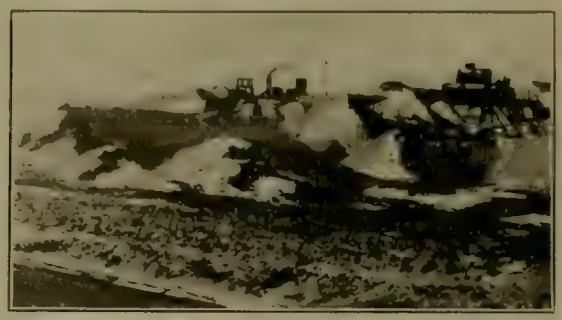
The mining members of Congress take some pride in having increased the appropriations this year from $25,000 to $35,000 for the tests in gas and oil in consequence of which important discoveries were made last year, as announced by the Bureau of Mines. The Bureau has also been permitted to continue the enjoyment of the appropriation of $100,000 for experiments in metallurgical mining.

All these make small crumbs to be thankful for. That more has not been done is the fault of the mining world itself. It is acknowledged as being lacking in unity on any matter that may be broached for enactment by Congress. No matter how simple the proposition, surprising opposition seems to develop quickly among the mining people, and nothing results, for Congress is loath to embark on legislation about which it understands but little and with regard to which opposition develops. A notable instance is the simple proposal to create a commission to codify the mining laws.

LEADVILLE, COLORADO

EXTENSIVE SHOOT OF ZINC CARBONATE ORE OPENED IN THE WOLFTONE MINE.—TWIN LAKES DISTRICT.

The most important discovery of ore that has been made in the Leadville district for a number of years recently occurred in the Wolftone mine of the Western Mining Co. A body of carbonate of zinc, whose exact dimensions are as yet unknown, has been opened in the upper levels of this famous property. Those in charge of the mine state that from the appearance of the shoot at the present time it will prove to be larger than the immense deposits that were mined in the lower workings. The ore that has been opened so far has been thoroughly sampled and averages about 25% zinc. The discovery of the carbonate came about in a rather accidental manner. A contract had been given for the driving of a 450-ft. cross-cut on the first level of the Wolftone property, to make an air connection with the Castle View shaft. This work had been under way only a short time when the drift cut the ore. Since that time the breast has been pushed steadily ahead for a distance of 70 ft. in the carbonate. At this point an old winze was found which led to another system of old drifts that were driven when the property was a producer of lead and silver ores. The winze has been retimbered, and a part of the old drifts has been cleaned out. All of these old workings are in the carbonate, and have opened for mining one of the largest orebodies that has been found in this district. The general manager of the Western Mining Co., S. D. Nicholson, has thoroughly examined the new orebody and has made arrangements for hiring all the additional men that can be used in stoping the ore. The Company has a long-term contract with one of the largest zinc buying concerns which allows shipment of all ore that will assay over 20%. With high spelter prices, the ore will be put on the market as rapidly as possible. The Wolftone is now producing nearly 500 tons of ore per day, and when the increase in tonnage comes with the working of the new orebody, the property will go on record as the largest producer in the state.



WOLFTONE MINE, CARBONATE HILL, LEADVILLE.

The Twin Lakes district will be the scene of the erection of a number of concentrating plants during the coming summer. Several new mines have been opened in that region, but the long haul necessary to get the ore out makes concentration indispensable. The larger mines are steadily getting out gold ore, which keeps up to $100 per ton, and the ground promises to be of great importance. A new company including mining engineers from Wales has been incorporated to operate in the Lackawanna and upper Twin Lakes section this coming summer, a fact that has added no little interest in that territory.

ROCHESTER, NEVADA

RICH GOLD ORE OPENED IN LINCOLN HILL CLAIM.—THE NEW MILL.—GOLD NEAR NENZEL HILL.—PACKARD COMPANY'S OUTPUT.

The recent development in the Blowback claim proves to be a genuine find of high-grade gold ore. The owners have driven 15 ft. along the quartz, and are now taking down the ore stripped, and will have about eight tons that is estimated to be worth $2000 per ton. This shoot is in the lower adit of the Lincoln Hill Co.'s mine, at a depth of 120 ft. below the upper workings, and about 160 ft. below the outcrop of the vein. There is 16 to 18 in. of this ore. On the upper level they are extracting ore valued at $300 per ton, and have followed it for about 150 ft. along the vein. In the upper workings there are three veins from which ore is being mined, but so far they have only investigated the one vein in the lower adit. This Company has produced about $40,000 in its two-stamp mill in Rochester cañon since November, mostly from its own mine. Several lots of ore from other mines on Lincoln and Wilson hills have been crushed.

This rich discovery has resulted in a great deal of interest in the Lincoln Hill area, and several claims have been bonded, and new leases have been taken on other claims.——The Forvilly lease on the Raven claim has been sold to L. J. Kaiser and H. L. Gleason. At a depth of eight feet they have one foot of $42 ore, which is good shipping ore in this district. ——The Grindley lease on the Gothem claim is sacking $200

ore.——H. L. Potter is sacking ore from his adit on the Nonpareil.——W. B. Borland, on Nonpareil No. 1, is almost to the vein with the cross-cut from the bottom of a 45-ft. winze. ——U. W. Harwood is making another attempt to locate the vein from which the rich float comes that he finds all over the Casey Jones claim.

California people are here examining the Buck & Charley mine, and have an option on the control of the stock. This mine has a good record as a shipper, and is in fine condition. ——The shoot on the Flunkey claim is being opened in the winze, and at eight feet depth shows nearly three feet of good ore.

The last of the three transformers for the sub-station was brought on February 26 on the Nevada Short Line, and was in place that night. As everything is ready for them, the mill should be ready to run next week. The tramway from the tunnel to the ore-bins on Nenzel hill is being constructed as fast as the snow will permit.

The Cole and Kallaher leases have a large amount of milling ore blocked out, and a road has been built from their adits to the head of the tramway for sending the ore to the mill when their turn comes. There is enough ore in the five leases on Nenzel hill to keep the mill supplied for over two years, besides considerable ore in many smaller properties.

A new discovery of gold has been made about four miles southeast of Nenzel hill, which seems quite promising, and a number of prospectors have gone over there.——On Fisher cañon, which is about eight miles south of American cañon, several locations have been made by Hildebrand, Logan, Alston, and Bailey. Some good specimens of free gold ore have come from their ground.——On Troy cañon, the next north, Bishop, Farthing, Odin, and Chambers have locations. They have given a bond and lease of the Prosperity No. 2 claim to A. E. Ferguson and Fred A. Long, who have started an adit to cut the vein at a depth of about 50 ft. On the surface this vein showed some heavy pannings of gold from the decomposed vein matter.

The last report of the Packard company shows that over $103,000 has been shipped from the Company's workings and those of the Kromer-Hampton lease, the ore assaying from $60 to $80 per ton.

The Nevada Short Line expects in another week to have the road extended into the town from the mill, and to be building its permanent station and freight depot. The new mill is now at work. About 100,000 tons of ore is ready in the mines for treatment.

LORDSBURG, NEW MEXICO

DISTRICT OUTPUT.—ORE HAULAGE.—EIGHTY-FIVE, BRUNO MOUNTAIN, AND EMPIRE ZINC COMPANIES' WORK.—POTASH DEPOSITS.—MISCELLANEOUS NOTES.

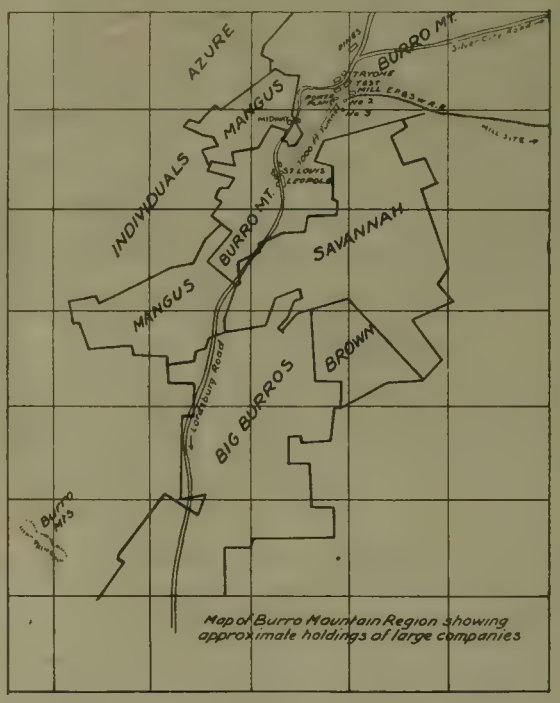
The output of the Lordsburg district in February was 143 carloads of highly silicious ore.

A caterpillar tractor has been shipped from the Holt Manufacturing Co., Stockton, California, to be used in hauling ore between Lordsburg and the mines, three miles southwest. The tractor is the first of its kind to be used here, and its success is looked forward to by those interested in ore transport. The project is headed by J. B. Downey and Mr. Rowan, of the Arizona Copper Co. of Clifton. If the tractor works well here as it does in other parts of America, it will be used on other roads. Six steel trailers have been shipped with the 'cat,' and all the ore freighting contracts of J. Olney with the mining companies, have been subleased.

The Eighty-Five Mining Co. has ordered an 82-hp. Ottumwa electric hoist, which will be installed in the main adit level and replace the old gasoline hoist. The new one will have a double drum 40 in. wide, with a capacity for 800 ft. It will also be equipped with Wuest herring-bone gears. The Company has also purchased five new machine drills and is preparing for an increased output.——The Octo Mining Co., has built a new brick foundation at its new shaft, for boilers, engine, and compressor.

At Tyrone, in the Burro mountains, the Burro Mountain Copper Co. has staked out its new townsite, and a road is being graded up the mountain side to the El Paso & Southwestern station. The new townsite is about a half mile above the Pines. It is understood the Company store and offices will be located there. Work is progressing rapidly at the Tyrone millsite.

At Hanover, the Empire Zinc Co. has completed construction of its tramway from the Thunderbolt claims to the site of the proposed new mill west of Hanover gulch. A two-compartment shaft is being sunk on the Thunderbolt sulphide zinc property. The Pinos Altos-Silver City narrow-gage tramway of the Empire Zinc Co. is nearing completion, but work has been delayed on account of bad weather. The tramway will be used for hauling ore with mules from the Cleveland



Map of Burro Mountain Region showing approximate holdings of large companies

mine to the railroad. The Company has not as yet commenced the erection of its Pinos Altos mill.

The nitrate and potash deposits near Rodeo are open for entry, according to advice received from the U. S. Geological Survey. Many claims are being staked and experimental work is being done in the East on the material found.

The Calumet mill in the Black range of Sierra county, was destroyed by fire last week. The plant was new, and it is reported that insurance papers had not been signed up to the time of the fire. The Company has been employing from 50 to 75 men.——J. C. Combs and associates, operating the Sherman group at Hillsboro, Sierra county, have opened high-grade gold ore in No. 1 adit. It is reported that a compressor and drills will be installed.——The Grand Central mine has been taken over under lease and bond from Oliver Wilson by the Owen Bros. of Santa Rita.——The Wicks mine at Kingston has been bonded to Hirch and Salem, who plan to mill the ore.——At Lake Arthur, oil drilling has been resumed by the Pecos Valley Petroleum Company.

THE MINING SUMMARY

The news of the week as told by our special correspondents and selected by the local press.

ALASKA

JUNEAU

On March 5 the federal mine inspector, Sumner S. Smith, instructed a class of 20 men at Treadwell in the use of Draeger and other rescue apparatus. A new fire-alarm system is being installed.

ARIZONA

GILA COUNTY

The Old Dominion produced 2,074,000 lb. of copper in February, compared with 1,745,000 lb. in January and 3,066,000 lb. in February of 1914.

A report issued by the Miami Copper Co. shows that ore reserves consist of 37,000,000 tons of 1.85% sulphide ore and 6,000,000 tons of 2% mixed sulphide and oxide ore. Alterations to the mill will result in the six units treating 700 tons per day each by the middle of the current year. The output in 1914 was 33,000,000 lb. of copper, at a cost of 9.333c. per pound. Three dividends of 50c. per share were paid amounting to $1,120,375. Concentrate is being shipped to the new smelter of the International company at Miami. At the east end of the mine the ore is cut off by a fault, the result of the overlying Gila conglomerate slipping down, but geologists believe that the orebody will extend east of this fault.

GREENLEE COUNTY

At the Shannon mine the concentrator, smelter, and converters are in full blast.

MOHAVE COUNTY

(Special Correspondence.)—One of the most important mining deals in the history of the Tom Reed-Gold Road district, with a bearing on its future development, was closed on March 4, when A. L. White, of Lima, Ohio, and D. S. Richards, of Kingman, Arizona, sold the Victor and Virgin mines to the Orion Mining & Milling Co., represented by William H. Wise, C. J. Rhodes, G. E. Burnell, and others of Los Angeles, and J. L. Humble, a prominent Montana banker. The transaction covers 40 acres of patented ground one mile south of the Tom Reed mine, and represents an expenditure of over $500,000, including the sum spent by former owners for underground development and surface equipment. This is the third transaction of importance which has been closed in this district during the past 30 days, the other two being the $67,500 Big Jim claims, negotiated by S. M. Warmbath, of Los Angeles, and the $87,500 deal of J. H. Hoffman, of the Arizona Southwestern Copper Co. with the Tom Reed Jr. Mining Co. For several weeks past the Victor-Virgin deal has been in course of negotiation, and was closed after an inspection of the property by the new owners and their engineers, namely, F. F. Brush, electrical engineer, of Los Angeles, who passed on the surface equipment, and Richard Lloyd, a mining engineer of that city, who reported on the mine. The latter will remain at the mine for several days for the purpose of making a thorough inspection of the Victor, Virgin, and adjoining claims owned by the Orion company, and his report will form the basis for the future development of the holdings, which aggregate 120 acres. The new owners are authority for the statement that operations will at once be resumed, and that they will be on an extensive scale. There is no property in the district better equipped for large development, as the surface plant is modern. It includes an electric power-plant at Needles, California, 11 miles of 4-in. pipe extending from the Colorado river to the mine, together with a 10-stamp mill, cyanide plant, tube-mill, hoisting, and other machinery. The property has approximately 2500 ft. of underground workings, and in the past has produced a considerable tonnage of ore. The north end of the ground, however, has never been prospected to any extent, despite the fact that all of the orebodies trend in that direction. The recent development in the United Eastern having proved the advisability of cross-cutting at depth, the present owners will have the territory just purchased thoroughly explored. On the Company's Oversight claim, adjoining the Victor on the north, a good body of ore is exposed, and is to be opened at depth by means of a drift which will cut three parallel veins before reaching its objective.

Oatman, March 4.

YAVAPAI COUNTY

Rich copper ore has been cut at 1400 ft. in the United Verde Extension mine. At 1200 ft. the drift has been driven 40 ft. in ore to 7 to 8 ft. wide, a shipment from which averaged 37% copper.

CALIFORNIA

AMADOR COUNTY

The Plymouth Consolidated company reports as follows for February:

Ore milled, tons	9,300
Value of output	$48,731
Working expenses	19,890
Development charge	7,537
Surplus over above	21,304

The mill worked only 26 days on account of power being off.

Instead of sending injured employees to Sacramento or elsewhere, the Plymouth Consolidated will now be able to treat them in its own hospital at the mine.

BUTTE COUNTY

(Special Correspondence.)—In the case of the Success mine, mentioned in the *Press* of March 6, the facts are not quite as stated. They are as follows: During the third week in February a stranger from a town in Missouri came to Oroville and started to buy the whole of Butte county, including all its mines. He went to the Success drift-gravel mine, owned by G. W. Rumble, and wanted to see it, which he was allowed to do. After a week he again wanted to see it with his mining engineer, and did so. The next week he asked again to see it with another engineer, and, as the miners were timbering, the request was refused. That night, with three men and an automobile, he robbed the mine, taking away nine sacks of high-grade material, but was caught as he drove into Oroville with it. Both the Missouri man and his friend were arrested, being caught in a barn, but the nine sacks had been seized and removed. There was, however, one small sackful overlooked, which weighed 11 lb., which was panned and yielded about 10c., equal to about $12 per cubic yard of gravel. For spite the stranger had the owner of the mine arrested, and later fled from the district.

South Berkeley, March 8.

At Oroville the suit of William C. Pershbacker *v.* the P. B. Steifer Mining Co. for $50,000 damages, is being heard. The plaintiff alleges that the defendants broke a contract with him when he was engaged to examine the Company's gravel mine. The above suit suddenly stopped on March 10

when plaintiff's attorneys asked that it be dismissed without prejudice, the plaintiff agreeing to pay all costs.

CALAVERAS COUNTY

The new 6-cu. ft. dredge of the Oro Water, Light & Power Co. has been started on the Mokelumne river. Unfavorable weather hindered construction to some extent. Ben Fowler is dredgemaster.

NEVADA COUNTY

Less than half an acre of ground in the centre of the mineralized area of the North Star Mines Co. had not been located by that Company, and R. Jones, of Grass Valley, recently staked it.——The old Pennsylvania Consolidated Mining Co., whose property was acquired in 1912 by people connected with the Empire company, is to distribute $3 per share, about $150,000. This is part of the payment of $500,000 for the mine.

According to Elmer Banning, of the You Bet Mining Co., an attempt was made to rob the mine two weeks ago, but the reported loss of $2000 was not true, as the thieves had insufficient water for washing the gravel.

SAN BERNARDINO COUNTY

The Oro Belle gold mine, at Hart, has been taken on option by the Tonopah Belmont Development Co. of Nevada. Considerable work has already been done, and if the Company is satisfied at the end of a year a plant of not less than 50-ton capacity is to be erected.

SHASTA COUNTY

Of the greatest importance to this county's copper smelters was the decision of Judge Van Fleet, last week, that the Mammoth Copper Co.'s plant at Kennett was doing no damage to agricultural lands, as alleged by the farmers of the district. The plaintiffs were left to pay costs of the case. The Company has resumed work, after about six months' shutdown, on the Spread Eagle, Stowell, Sutro, and Friday-Lowden mines.——Prospecting with a Keystone drill has been started on the Indiana Gold Dredging Co.'s option in Happy Valley along Dry creek. Shafts also will be sunk in the gravel. O. C. Perry, of Oroville, is in charge.

TRINITY COUNTY

The Golden Jubilee mine, near Carrville, has been reopened by San Francisco people after several years' shut-down. Equipment includes a hoist and 10-stamp mill. C. L. Probestel is manager.——It is reported that work is to be started again at the Headlight mine, one of the largest lode properties in the county.——A $108 nugget was found on the Pickett mine, near Junction City, last week.

COLORADO

GILPIN COUNTY

It is probable that the Fifty Gold Mines Corporation property at Black Hawk, now in the hands of the referee in bankruptcy, will soon pass into the hands of a new company.——The Pittsburg mine, in lower Russell gulch, continues to ship ore returning up to 7.20 oz. gold, 57 oz. silver, and 17.80% copper.——Some rich gold ore is being extracted from the Gilpin-Orion mine on Bobtail hill.

LAKE COUNTY (LEADVILLE)

Ore output of the district in February was a trifle over 2200 tons per day. The Arkansas Valley smelter blew in another furnace, making five in blast.

The Western Zinc Mining & Reducing Co.'s zinc oxide plant, which is described by E. H. Leslie in this issue of the *Press*, has been acquired by the Western Zinc Oxide Co., composed of Leadville men. A. B. Augustine, who was in charge during construction, is to be manager. It is stated that the oxide which was made as a by-product for paint manufacture, will be put on the market as a concentrated zinc ore. The oxide assays 75% metal. The plant will resume as soon as possible.

To dredge placer ground near Malta, Colorado Springs capital has organized the Derry Mining & Land Co., with a capital of $100,000. Tested areas return 25c. per yard.

OURAY COUNTY

The Wanakah smelter at Ouray is treating 300 tons of ore per day.——The Forester zinc concentrator has a capacity of 100 tons, and is producing a high-grade product.

TELLER COUNTY

At a meeting of the El Paso Consolidated at Colorado Springs last week, Harvey McGarry, vice-president of the Golden Cycle company, was elected president of the El Paso company.——Considerable development is under way in the Gold Hill properties of this district.——Now that the El Paso mine has been equipped with new plant in place of that burned last year, work is to be resumed in the extension of the Roosevelt drainage tunnel, the face of which is approaching the Elkton mine

IDAHO

IDAHO COUNTY

In listing the Idaho Placer Mines Co. on the Spokane Stock Exchange, the following information was given out: The 1000 acres of land is between Newsome and Baldy creeks in the Bitter Root forest reserve. The estimated quantity of gravel is 100,000,000 cu. yd. There is 5000 miner's inches of water available for 70 to 100 days in the spring, with a maximum and minimum of 7000 and 700 in. Actual sluicing has yielded 20c. per yard. It is proposed by the general manager, R. H. Bailey, to drive a tunnel the full length of the deposit, near bedrock, and the earth from the full face of the deposit is to be worked into the flume, where a sufficient flow of water is to be maintained to extract the gold, and a head for the giants to cave the face of the deposit is to be provided by a large capacity pump, to be operated by a Pelton wheel.

SHOSHONE COUNTY (COEUR D'ALENE)

The manager of the Hunter mine at Mullan, T. M. Brennan, has secured a five years' bond on the Idaho Giant mine, near Mullan, for $100,000, according to terms ratified by the stockholders of the Idaho Giant in a meeting held at Spokane. The bond specifies that operations are to be started on April 1.——High-grade silver ore has been opened at 800 ft. in the Samson company's property on East Eagle creek, near Wardner. The drift on this level is in 140 ft., showing 18 to 30 in. of ore.——The stockholders of the Tamarack & Custer Consolidated Mining Co., of Wallace, recently received a financial statement of the present condition of the Company, showing the following: liabilities, capital, $2,000,000; accounts payable, $23,916; profit and loss, $244,752; total, $2,268,668. Assets, property, $1,755,160; unissued stock, $223,712; accounts receivable, Ohio Smelting & Refining Co., $66,810; cash, Wallace National Bank, $202,920; Exchange National Bank, Spokane, $65; total, $2,268,668.——The Ontario company has started another suit against the Stewart, alleging extraction of ore worth $25,000.

MICHIGAN

HOUGHTON COUNTY (THE COPPER COUNTRY)

In 1914 the Hancock Consolidated Mining Co. sold 488,678 lb. of copper, netting $65,427. Expenses totaled $214,971. The loan outstanding is $164,267. Operations were suspended in August. Development totaled 2300 ft., mainly driving on veins at No. 13, 18, 39, 44, 49, and 53 levels. Stoping was done on No. 14, 15, 16, and 18 levels on No. 3 lode; No. 13, 39, and 44 on No. 4; No. 49 and 53 on No. 8; and No. 13 and 18 on No. 9 lode.

The prospecting cross-cut on No. 32 level of the Franklin is advancing over 50 ft. per week with two drills. To the eastern boundary it will be over one mile long.

The report of the Cliff Mining Co. for 1914 shows that

$10,270 was spent on prospecting and development, against $16,448 in 1913. Rock cut by No 16 and 17 diamond-drill holes is badly shattered. In No 18 it is less disturbed. The hole reached the boundary at 638 ft., from where it was continued by the Tamarack company on its property to 1155

THE ISLE ROYALE MILL AFTER THE FIRE.

ft. Little copper was disclosed by this work. These holes complete the exploration planned from the Kearsarge amygdaloid to the eastern boundary.

The output of the Lake Superior copper mines is estimated as follows for February, an increase of about 15% over the previous month:

Mine.	'Rock,' tons.	Copper, pounds.
Copper Range Con., including Baltic, Trimountain, and Champion	144,000	3,600,000
Osceola Con., including North and South Kearsarge and Old Osceola	100,700	1,800,000
Ahmeek	59,000	1,500,000
Wolverine	30,000	600,000
Mohawk	62,000	1,200,000
Centennial	12,800	170,000
Allouez	33,500	600,000
Superior	16,000	320,000
Isle Royale	48,000	850,000
Mass Con.	23,000	460,000
Calumet & Hecla	227,000	6,000,000
Victoria	7,000	100,000
Winona	4,000	80,000
Quincy	95,000	1,800,000
Total	862,000	19,080,000

MISSOURI

Jasper County

Ore production of the Missouri-Kansas-Oklahoma district during the week ended March 7 was as follows, in pounds:

Class of ore.	Av. value per ton.	Week.	Ten weeks of 1915.
Blende	$67.53	5,602,740	91,194,230
Calamine	41.23	1,006,100	8,232,680
Lead	46.91	1,243,530	14,223,150

On a 15-acre lease on the Rex land, east of Joplin, C. W. Edwards and others have cut 13.5% zinc-lead ore at 103 to 120 ft. depth. A shaft is soon to be sunk to prove the drill records.

St. Francois County

Full-time operations were resumed at the four great lead mines in this county on March 16. Since October the capacity has been curtailed by 25 per cent.

MONTANA

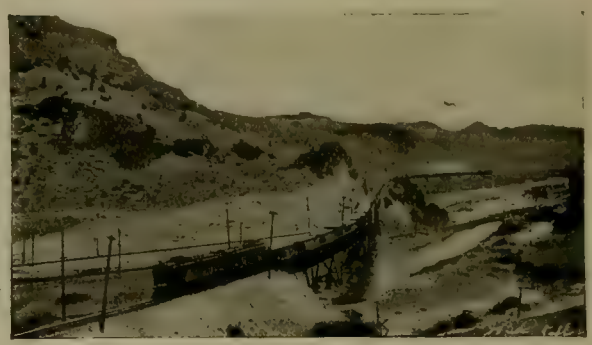
Madison County

The Galena mine, known as the Jackson, at Sterling, has been sold to F. S. Mitchell, of Butte, and H. F. Fulton, of Cleveland, Ohio. The new owners will erect a modern mill and cyanide plant. Lessees have extracted about $200,000 from the property.

Silverbow County

The report of the Tuolumne Copper Mining Co states that the ore mined during 1914 averaged 4.1%, producing 1,945,286 lb. copper, 115,355 oz. silver, and 150 oz. gold. The gross and net returns were $201,652 and $133,513 respectively. The shaft was sunk 206 ft., and a large station cut at 2600 ft. Indications at the bottom level are very favorable, and the vein should be thoroughly developed at this depth. The shaft will also be sunk another 200 ft. There is a decrease in the percentage of zinc at 2600 ft. Work was stopped on October 24 on account of the metal market.

The Pilot-Butte Mining Co.'s superintendent, Paul A. Gow, in his annual report stated that the Pilot shaft was sunk from 2090 to 2420 ft. It is proposed to sink 400 ft. deeper. Work on the south, middle, bornite, Gow, and glance veins is detailed.



ORE TRAIN ON BUTTE, ANACONDA & PACIFIC LINE HAULED BY GENERAL ELECTRIC LOCOMOTIVES.

The mine and smelter of the East Butte Copper Mining Co. is to resume work about the middle of April, according to a semi-official report in Butte on March 12. The plant is being overhauled.——The Anaconda has 14 of its main shafts in operation, eight being still shut down.——Some concentrate from the Butte & Superior is now being shipped to the Caney and Deering smelters in Kansas, and within 30 days the quantity sent there will be increased to 5000 tons per month.

NEVADA

Churchill County

After cross-cutting 1000 ft. on the 1300-ft. level, the ore-shoot in the Nevada Wonder mine has been cut, according to J. S. Austin, president of the Company. On the 1000-ft. level, two shoots totaling 500 ft. in length, were opened. The average production is $15 per ton. The mill is doing better work, as the superintendent, E. E. Carpenter, installed additional Dorr thickeners and zinc-boxes. During six days in February the plant treated 200 tons per day.

Nye County

The mines at Tonopah produced 10,586 tons of ore worth $216,508 during the second week of March.——In the Monarch Pittsburg mine the rise on the vein is up 16 ft. in good ore. The cross-cut is out 90 ft. with no foot-wall, but no ore in commercial quantities has been found yet. Several assays returned from $4 to $13.85 per ton.——At 700 ft. in the Jim

Butler a cross-cut has found the displaced portion of the vein, showing 24 to 30 in. of good ore.——Arguments in the Jim Butler-West End suit were concluded on March 11. Judge Averill expects to deliver his decision within a month of the time when the notes are transcribed.

White Pine County

Accidents at the Nevada Consolidated Copper Co.'s properties in February were as follows: Copper Flat, eight minor injuries; concentrator, nine, only one causing loss of time; and the smelter, seven non-disabling accidents.

NEW MEXICO

Socorro County

Residue from the mills at Mogollon flows into the Frisco river, which joins the Gila, and it is said that the material is becoming a nuisance to the land in the valley, so the canal companies are discussing a means of preventing the mining companies from continuing this practice.

UTAH

According to the March trade and finance letter of the National Copper Bank, the mines of the intermountain states, Utah, Idaho, and Nevada, have shown good increases in latter years, as follows:

	Utah.		Idaho.		Nevada.	
Metal.	1910.	1914.	1910.	1914.	1910.	1914.
Silver, ounces	10,445,900	11,752,000	7,027,000	13,000,000	12,366,000	15,200,000
Copper, pounds	125,185,455	155,901,000	6,877,515	5,500,000	64,494,640	60,561,000
Lead, pounds	114,162,000	181,553,000	199,848,000	345,000,000	4,390,000	13,794,000
Zinc, pounds	14,442,000	14,297,000	6,908,000	38,614,000	3,032,000	13,000,000
Gold, value	$4,312,700	$3,300,000	$1,035,000	$1,115,000	$18,873,700	$11,320,000
Total value	$31,655,049	$38,000,000	$14,870,288	$24,141,000	$34,099,007	$28,800,000

Minerals other than the above are produced to the extent of over $9,000,000 per year in Utah, and over $500,000 in Idaho and Nevada.

Juab County

In the south drift of the 1700-ft. level of the Eagle & Blue Bell mine, 30% lead and 30-oz. silver ore has been cut. This shoot is probably the downward extension of that worked at 1550 ft. In 1914 this property shipped 32,736 tons of lead, copper, and gold-silver ore valued at $513,236, of which $121,536 was net profit. The Bingham Mines Co., of Salt Lake county, received $104,250 in dividends from this Company.——About 1000 tons of lead-silver ore is ready for shipment from the May Day. Most of it is worth $50 per ton. Some zinc ore will be sent out from the Chief Consolidated claim, on which the May Day company has a lease.——Some lessees in the Gemini mine have started a suit for $25,000 against the Gemini Mining Co., alleging failure to pay the plaintiffs a certain percentage of the value of all ores mined in certain parts of the property.

Salt Lake County

The Utah-Apex mine produced 4082 tons of shipping and 9701 tons of milling ore in January. The latter yielded 3276 tons of concentrate. Out of $67,365 gross income, the net was $22,129. Costs were as follows: shipping ore, all charges, $2.70 per ton; milling ore, mining, and general, $2.86; and milling, 66.2c.; a total of $3.522 per ton. The average of all ore was $3.28 per ton.

The tunnel being driven by the Alta Tunnel & Transportation Co. has cut from 3 to 6 ft. of zinc ore, near a porphyry dike.

Summit County

The Silver King Coalition will distribute 15c. per share, amounting to $187,500, on April 1. Dividends total $13,395,500 to date.——The Silver King Consolidated will pay 10c. per share, or $62,000, on April 1, making a total of $619,000 to date.

WASHINGTON

Stevens County

Near Valley, the Vulcan Copper Co. is preparing the Admiral, Double Eagle, and Vulcan mines, in the Colville district, for an active season, when ore is to be shipped. Roads are being repaired for this.

CANADA

Alberta

No. 2 well of the Alberta Petroleum Consolidated Co., at Calgary, was down 2725 ft. in the Dakota sands on March 5. The formation is considered favorable.

British Columbia

As soon as the weather improves, the British Columbia Copper Co., at Princeton, will resume extensive development. The manager, Oscar Lachmund, is in New York attending the annual meeting of the Company. Probably the smelter at Greenwood will soon be blown in.——During the first week of March, Rossland mines shipped 8450 tons of ore to the Trail smelter. Production from the Le Roi company's Josie mine in February was 1082 tons of ore and 86 tons of concentrate. The revenue was $18,875, and expenditure $9375.

The Omineca district is described in this issue of the *Press*.

Ontario

The Nipissing report for February shows that the high-grade mill treated 165 tons of ore, and the low-grade plant 4696 tons, the yield being valued at $164,140. The refinery shipped 376,709 oz. silver. Development generally was satisfactory. At No. 73 shaft most of the work was from No. 4 level. One rise is up 101 ft., 30 ft. of which showed 3 in. of 2500-oz. ore. At No. 64 shaft driving was done on the 1000-ft. level, 53 ft. of the vein being opened, but results are not encouraging. Three men have been arrested in connection with the attempt to destroy the Nipissing powder magazine late in February. Over 8000 sticks of dynamite were found.

At the Hollinger, 20 of the 40 new stamps are crushing ore from the Acme mine. The rest of the stamps will be dropping at the end of March.

KOREA

The Oriental Consolidated company's output in February was valued at $125,100. Details of the December operations are as follows: ore treated, 28,682 tons; bullion from all plants, $148,216; extraction at the Taracol cyanide plant, 87 per cent.

According to a consular report, an Industrial Competitive Exhibition is to be held in Seoul from September 10 to October 31, 1915. Only articles produced, taken, refined, or manufactured in Chosen (Korea), or designed for use in this country will be accepted for exhibition.

The Seoul Mining Co., operating the Suan Concession in Whang Hai province, reports the following results for February:

Stamps working	40
Time, days	27
Ore crushed, tons	6,480
Total recovery	$62,100
Operating expenses	25,000
Net earnings	37,100

PERSONAL

W. H. Howard is at Los Angeles.

Stanly A. Easton is visiting San Francisco.

C. H. Benedict has returned to Lake Linden.

E. E. Olcott was in San Francisco last week.

Lewis Searing has been in Los Angeles and San Francisco.

R. J. Barber is now manager for the Banker mine, at Leadville.

Otto Ruhl is in charge of the Missouri state mineral display at the Exposition.

J. H. Price is in charge of the Nevada state mineral display at the Exposition.

Karl Eilers was in San Francisco during the week and is returning to New York.

Edward Schwerd is in charge of the Idaho state mineral display at the Exposition.

E. S. Bardwell is in charge of the Anaconda Copper Mining Co.'s exhibit at the Exposition.

T. C. Woodworth, consulting engineer for the Fortuna Mines Corporation, was at Boston recently.

Claude Ferguson has been appointed superintendent of the Jessie mine for the Chaparal Mining Co., at Chaparal, Arizona.

E. P. Mathewson has recovered nicely from an operation which he underwent in Montreal, and expects to go to New York about the end of the month.

D. H. Newland, who has been in San Francisco superintending the installation of the New York mining exhibit at the Exposition, has returned to Albany.

R. L. Agassiz and James MacNaughton, of the Calumet & Hecla, were guests of William E. Corey at a dinner given at Sherry's, in New York, one night this week.

Fred Brule, formerly superintendent of the surface department at Anaconda, has been appointed superintendent of the surface department at the Great Falls smelter.

Baylies C. Clark has been appointed temporary superintendent and secretary of the Bunker Hill Consolidated Mining Co., during the absence of Mr. Hampton, who is on leave on account of illness.

Dr. James Douglas was presented with a certificate of honorary membership in the American Mining Congress, which was voted to him at the Phoenix convention of the Congress, at an informal luncheon given at the Engineers' Club in New York on February 17.

Roy L. Oliver, formerly assistant engineer and mining captain at the Franklin mine, has been appointed superintendent of the Franklin mill, which will start operation on Franklin and Hancock ore on April 1. Mr. Oliver succeeds the late E. S. Warne.

Pierre de P. Ricketts and John H. Banks have dissolved partnership and will independently carry on business as metallurgical and chemical engineers. Mr. Ricketts will remain at 80 Maiden Lane, New York, and Mr. Banks has taken offices at 61 Broadway.

James F. Kemp, has been selected as the speaker at the Michigan College of Mines class-day exercises on April 15. Professor Kemp is at present making a geological examination in Montana, and on his return to the East, will stop at Houghton to deliver the class-day address.

H. G. Wright, formerly chief draftsman at the Anaconda works, has been appointed superintendent of construction, to take charge of the construction work that is to be done at the converter and reverberatory smelting plants. J. B. Johnson, formerly assistant chief draftsman, has been appointed to fill the vacancy caused by the promotion of Mr. Wright. S. Bishop has been appointed assistant chief draftsman to fill the vacancy caused by the promotion of Mr. Johnson.

OBITUARY

A. R. Parsons, one time in charge of the Desert mill of the Tonopah Mining Co., Nevada, died at Las Vegas in the first week of March.

John Gray, who died March 3 at Los Angeles, was the largest individual stockholder and the general manager of the Wasp No. 2 mine in the Black Hills, South Dakota. He was obliged to retire a year ago on account of bad health. He was born at Newcastle-on-Tyne, England, February 28, 1864, and came to Scranton, Pennsylvania, as a young man, where he followed coal mining for two years, later going to Rock Springs, Wyoming. He went, in 1876, to the gold rush in the Black Hills, where he stayed until the early eighties, when he went to the Coeur d'Alene district, where he remained for two years, returning to the Black Hills. With his wife, he conducted a miners' hotel at Terraville for fifteen years, meanwhile investing his savings in mines, and in the latter nineties made his fortunate investment in Wasp No. 2. He was buried at Deadwood, March 8, and is survived by three brothers and sisters in England.

William H. Cole, of Duluth, one of the foremost mining men of the Lake Superior region, passed away on March 9 at Pasadena, California. William H. Cole was born near Ontonagon, Michigan, 58 years ago. He became interested in diamond-drill work when a young man and did considerable exploration work on the Marquette iron range. In 1885 he went to Tower, on the Vermilion range in Minnesota, as superintendent of drilling for the old Minnesota Iron Co. In 1892 he resigned from the Company to go into business as an independent diamond-drill operator. In 1893 the Cole & McDonald Co. was organized, the name of the firm being changed ten years later to the Cole & McDonald Exploration Co. As president of these two companies, he was an authority on mining exploration work and was directly responsible for the opening of many of the mines which have made Minnesota famous as the greatest iron-producing district of the world. With O. D. Kinney he started the Kinney mine, now operated by the Republic Iron & Steel Co. Mr. Cole was interested in the Whiteside, Agnew, Buffalo & Susquehanna, and other mines on the Mesabi range. The company of which he was president has been credited with the opening of most of the largest iron producers on the Mesabi range.

James Geikie, younger brother of Sir Archibald Geikie, and son of the late James S. Geikie, died at his home in Edinburgh on March 2. He was born in 1839 at Edinburgh, and after passing through the High School and University there, followed the tradition of the family by engaging in geological work and was soon district surveyor on the Geological Survey of Scotland, of which his older brother was then director. In 1882 he succeeded his brother as Murchison Professor of Geology and Mineralogy at the University of Edinburgh, eventually becoming also Dean of the Faculty of Science. His attention was directed largely toward glacial geology and his best known book is 'The Great Ice Age,' written in 1874, though he published many others on physiography and general geology. Many honors came to him in the course of a busy life, such as the Brisbane medal of the Royal Society of Edinburgh, the Murchison Medal of the Geological Society of London, and the Gold Medal of the Royal Scottish Geological Society. He was also honorary editor of the *Scottish Geological Magazine*, past president of the Royal Scottish Geological Society, fellow of the Geological Society, and fellow of the Royal Society of Edinburgh. A distinguished member of a distinguished family, his loss will be keenly felt throughout the geological profession.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, March 18.

Antimony	25 —25¾
Electrolytic copper	15½ 15¾
Pig lead	4.30—5.30
Quicksilver (flask)	$80.00
Spelter	10¾—11
Tin	40 —41½
Zinc-dust, 100-kg. zinc-lined cases	15

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, March 18.—Copper is strong, lead is strong and advancing and spelter is weak.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Mch. 11	14.50	Feb. 3	14.50
" 12	14.50	" 10	14.29
" 13	14.63	" 17	14.30
" 14 Sunday		" 24	14.42
" 15	14.63	Mch. 3	14.38
" 16	14.63	" 10	14.50
" 17	14.63	" 17	14.59

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	....
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	....	Sept.	12.02	....
Apr.	14.19	....	Oct.	11.10	....
May	13.97	....	Nov.	11.75	....
June	13.60	....	Dec.	12.75	....

Exports during the first week of March totaled 11,829,657 lb., England taking 7,061,165 lb., and France 1,064,938 lb. Imports totaled 6,511,217 pounds.

The following returns are published for January, in pounds:

Mine.	Jan. 1915.	Dec. 1914.	Jan. 1914.
Chino	3,563,681	2,827,891	5,319,948
Ray Consolidated	4,090,025	3,126,538	5,705,000
Utah Copper	8,009,646	6,795,567	10,649,036

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Mch. 11	3.95	Feb. 3	3.80
" 12	3.95	" 10	3.80
" 13	3.95	" 17	3.85
" 14 Sunday		" 24	3.85
" 15	4.00	Mch. 3	3.87
" 16	4.10	" 10	3.95
" 17	4.10	" 17	4.01

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	....
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	....	Sept.	3.82	....
Apr.	3.86	....	Oct.	3.60	....
May	3.90	....	Nov.	3.68	....
June	3.90	....	Dec.	3.80	....

The National Lead Co.'s report for 1914 shows the following: net earnings, $2,476,293; preferred dividends, $1,705,732; common dividends, $619,662; surplus, $150,899 ($132,912 in 1913); and total surplus, $5,252,232.

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date		Average week ending	
Mch. 11	7.50	Feb. 3	7.58
" 12	8.00	" 10	7.75
" 13	8.00	" 17	8.24
" 14 Sunday		" 24	8.25
" 15	8.00	Mch. 3	9.05
" 16	8.00	" 10	8.00
" 17	8.00	" 17	7.92

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb. 25	5.12	9.05	Aug.	4.45	....
Mch.	5.12	....	Sept.	5.16	....
Apr.	4.98	....	Oct.	4.75	....
May	4.91	....	Nov.	5.01	....
June	4.84	....	Dec.	5.40	....

The spelter market continues to display strong movements. In London it is £44 10s. per ton.

Zinc ore shipments from Joplin during the first week of March amounted only to 2800 tons, the smallest in years. Buyers were dealing light, 50% of the usual amount. During the second week prices were $1 to $3 weaker, the lowest basis, 60% ore, being $65 per ton for carloads. It is reported by the attorney general, John T. Barker, that suit has been filed against certain smelters, alleging that they are members of a trust. An investigation was made at Joplin by the assistant attorney, W. T. Rutherford.

The Butte & Superior output in February was as follows: ore treated, 39,310 tons; recovery, 91.1%; assay of concentrate, 52.64%; and zinc in concentrate, 12,295,000 pounds. The American Zinc, Lead & Smelting Co. is to treat 4500 tons of concentrate per month for the Butte & Superior.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.		Average week ending	
Mch. 11	51.50	Feb. 3	48.52
" 12	51.12	" 10	48.20
" 13	51.12	" 17	48.42
" 14 Sunday		" 24	48.70
" 15	51.50	Mch. 3	49.02
" 16	51.12	" 10	49.81
" 17	50.75	" 17	51.18

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	....
Feb.	57.53	48.45	Aug.	54.35	....
Mch.	58.01	....	Sept.	53.75	....
Apr.	58.52	....	Oct.	51.12	....
May	58.21	....	Nov.	49.12	....
June	56.43	....	Dec.	49.27	....

The tone of the silver market has been steady, and Samuel Montagu & Co. of London states that the main reason for this feature is the scanty selling from the United States and the interruption of supplies from Mexico.——The first forecast of the wheat crop of the Punjab district of India states that the season was exceptionally favorable.——It is thought by many bankers that the plan for a new coinage in Cuba will provide an increased market for silver. It is estimated that the amount of silver coins already contracted for will require 4,000,000 oz. of bar silver, and a greater amount would be needed should Cuba decide that more silver coins of Cuban denomination are needed to replace those of various nations now in circulation.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Feb. 18	62.50	Mch. 3	70.00
" 24	62.50	" 10	80.00
		" 17	80.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60.00	Aug.	80.00	....
Mar.	39.00	....	Sept.	76.25	....
Apr.	38.90	....	Oct.	53.00	....
May	39.00	....	Nov.	55.00	....
June	38.60	....	Dec.	53.10	....

The quicksilver market is bare of supplies, resulting in the above advance during the week.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	....
Feb.	39.76	37.23	Aug.	50.20	....
Mch.	38.10	....	Sept.	33.10	....
Apr.	36.10	....	Oct.	30.40	....
May	33.29	....	Nov.	33.51	....
June	30.72	....	Dec.	33.60	....

Tin is strong at 51.50 to 54c. In London it is quoted at £190 per ton for spot metal.

COMPANY REPORTS

TONGKAH HARBOUR TIN COMPANY

This is an Australian company operating dredges in Siam, and the report is for the year ended September 30, 1914. The boats handled 2,199,408 cu. yd., yielding 1126 tons of black tin, against 3,336,180 cu. yd. for 1329 tons in the previous period. The average yield was 1.147 lb. per yard, equal to 23c. per yard. The net value of the tin was $490,000, and profit $168,000. Four dividends were paid totaling $1.68 per share, and including previous balances a credit of $250,000 remained. Owing to the price of tin, the past year's profit was $221,000 less than that for 1913. Every dredge required considerable repair, No. 2 and 3 being idle for three months. Costs totaled 13.05c. per yard. The output to date is 6241 tons of black tin sold for $3,080,000, and dividends paid $1,080,000.

ASSOCIATED NORTHERN BLOCKS (W. A.), LTD.

This English company owns the Iron Duke lease at Kalgoorlie, and the Victorious leases at Ora Banda, Western Australia, and El Refugio in Mexico. On the last, nothing was done during the year ended September 30, 1914, owing to the disturbed state of the republic. The Iron Duke property was mainly worked by tributers, and old residue was re-treated; while at Ora Banda a sulphide mill was erected, the oxide mill working only four months. Development in the Ora Banda mine, according to the general manager, G. M. Roberts, amounted to 4425 ft., at a cost of £14,715. From the character of the orebody it is difficult to estimate reserves, but there is certainly several months' ore in sight for the new plant. Capital expenditure on this property was £35,282.

At the Iron Duke, tributers mined 7891 tons of ore, paying royalty of £3462; and 68,205 tons residue yielded £12,285. The Victorious oxide mill treated 26,402 tons for £28,390. The revenue from all sources was £69,099, of which £9246 was profit. Investments are valued at £37,210, besides which are stores and other assets of good value. Costs in all departments were high, owing to the irregular operations.

WASP No. 2 MINING COMPANY

According to the annual report of this Company, operating at Flatiron, South Dakota, there was treated during 1914 176,140 tons of ore having an average value of $2.015 gold and 28.7c. silver per ton. There was saved 73.31% of the gold and 34.77% of the silver, a total of $1.533 per ton. Costs totaled $226,683, or $1.287 per ton. Profits for the year, including small revenues from sales of coal, mail contract, and rents, totaled $45,465, of which $30,000 was paid in dividends. In addition to the expenditures as given above in calculating the costs, other items called for disbursements as follows: dividends, $30,000; real estate, $1850; mine buildings, $57.18; mill buildings, $221; buildings, $915; mine machinery, $5014; mill machinery, $925.30; horses, wagons, and harness, $125; and bills payable, $6000. A profit was made on mail contract, $62; coal sales, $450; and rents, $1658; a total of $2169. At the end of the year the Company had a cash balance on hand of $6035. D. A. McPherson, cashier of the First National Bank of Deadwood, is president and treasurer, and Edward Manion, Lead, general manager.

Mining in open-cuts, using a steam shovel for stripping as much as 20 ft. of overburden to obtain 20 ft. of ore, cost 66.1c. per ton, and milling, which consists of crushing the hard quartzite to pass a screen having openings 0.25 by 0.75 inch, followed by simple leaching with cyanide, cost 59.1c. per ton.

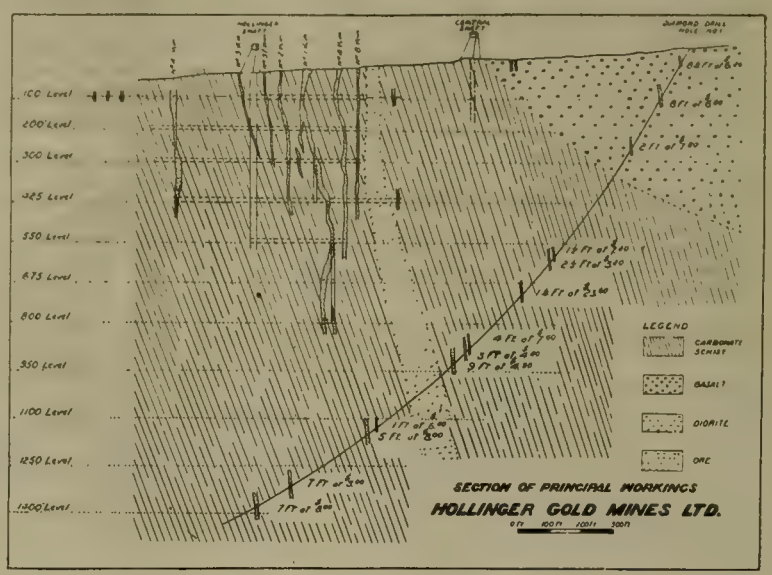
Early in 1910 the Company suffered the loss by fire of its first mill. It was immediately replaced by the present plant, which has a capacity of 15,000 tons per month, and which began operations in December 1910. The Company's records show the following accomplished since that date:

Year.	Tonnage.	Yield.	Value per ton.	Dividends.
1911	160,860	$ 286,160	$1.779	$ 60,000
1912	158,840	308,175	1.940	85,000
1913	127,680	219,333	1.718	55,000
1914	176,140	269,979	1.533	30,000
Total	623,520	$1,083,647	$1.738*	$230,000

*Average.

HOLLINGER GOLD MINES, LTD.

This is the largest gold producer in Canada, and the report



is for the year 1914. It consists of 23 pages with good plans and sections of the mine. The mill treated 208,936 tons of ore, averaging $13.67 per ton, and recovered bullion to the value of $2,688,354, an increase of $222,134 over the preceding year. Net profits in 1914 were $1,786,679, or practically 60% of the $3,000,000 issued capital. Dividends amounting to $1,170,000 were paid. The surplus carried forward was $1,126,743, and of this amount $664,603 represented cash and bullion. Expenditure for plant amounted to $305,621, and when the present additions to the mill, now under way, are completed, the capacity will have been raised from 500 to 1600 tons per day. Operating costs were reduced to $4.50 per ton, but at present these are about $4.37. Further reductions will be made as the capacity of the plant is increased.

Ore reserves are estimated at 1,162,960 tons averaging $11.49 per ton, or a total of $13,358,420. This represents an increase in gross value over the preceding year of about $2,000,000. In addition there are a large number of known veins which have not been developed and on which it is impossible to estimate any tonnage. So far a total of 54 veins has been found on the

property, and of these, only 12 have been opened underground. Development totaled 10,662 ft., and 10,227 ft. of diamond drilling. One of the most interesting sections of the report deals with the deep drilling. One hole was bored to a depth of 2000 ft. on the incline, equal to 1450 ft. vertical, and cut 13 mineralized zones. Of these, six were five feet or more in width, and nine assayed $6 or over per ton. The information furnished by this hole, shows that there is no change in the formation to a depth of 1450 ft. vertically, and also that there is no change in the vein characteristics at that depth. The management states that the assays obtained are such as might be expected if the hole had been bored at any random point below the 200-ft. level. Costs and other data will be given in another issue of this journal.

STANDARD OIL COMPANY (CALIFORNIA)

The report of this great corporation is for the year 1914. The output of crude oil from its own wells was 12,727,291 bbl., against 9,700,209 bbl. in 1913. Net pipe-line runs showed a daily average of 109,949 bbl, compared with 85,902 bbl. Stocks of crude oil at the end of 1914 amounted to 26,058,077 bbl., an increase of 1,747,767 bbl. About 8,000,000-bbl. capacity of steel tanks was constructed, also additions to the pipe-lines, service stations, and marine department.

The financial results were as follows:

Profits	$12,771,398
Depreciation	2,713,061
Net earnings	$10,058,337
Dividends paid	4,856,098
Carried to surplus	$ 5,202,239
Total surplus	40,290,983

The capital stock authorized is $100,000,000, of which $49,686,655 has been issued. Assets total $97,298,283, plant account absorbing $65,415,338. Dividend No. 25, of $2.50 per share, the regular quarterly disbursement, was paid on March 15, 1915.

RICO-WELLINGTON CONSOLIDATED MINING COMPANY

This Company is controlled by Utah people, and operates a gold-silver-lead-copper-zinc property at Rico, Dolores county, Colorado. The report for 1914 states that the year was not remarkable for production or profits, but the future is bright. Early in 1914 shipments of copper ore were stopped on account of freight charges, resumed on July 23, and stopped again on August 12 owing to the war. Development amounted to 2004 ft., mostly in new ground, resulting in opening a good tonnage of copper ore. There is also in reserve several hundred thousand tons of iron sulphide, containing about 2% copper, and 3 oz. silver per ton. This will be treated locally as soon as possible.

The output was as follows:

Ore.	Tons.
Copper	2,278
Lead	1,604
Iron	656
Zinc concentrate (lessees)	67

The revenue was $34,704 from all sources, and the debit balance $1913. The credit balance at the end of 1914 was $102,620.

BUCKEYE BELMONT MINES COMPANY

This Company is developing 72 acres of ground adjoining the Tonopah Belmont and Halifax mines at Tonopah, Nevada, and the report, which contains a considerable amount about the Company's prospects and costs, is for the year 1914. Letson Balliet is in charge.

Underground progress was 1030 ft., which cost $14,546, or $14.12 per foot. Of this, labor cost $7836, and material the remainder. No. 1 shaft is 1234 ft. deep, and cross-cuts have been driven north and south in the rhyolite dike for two-thirds of the distance. From these points drifts were started east and the ore-bearing trachyte was entered. Since December 1, 1913, hoisting has been done by the Balliet counterbalance system, and the total cost per trip has been reduced from 30c. in November of that year to 6.5c. throughout 1914, save in the first two months.

OSCEOLA CONSOLIDATED MINING COMPANY

In 1913 this Michigan copper company, with others, had a strike of miners, and in 1914 work was stopped on account of the copper market. Results of the past three years are as follows:

	1914.	1913.	1912.
Rock stamped, tons	1,108,447	735,044	1,246,557
Mining cost, per ton	$1.29	$1.60	$1.23
Mineral, pounds	20,997,000	14,945,645	24,282,312
Ref. copper produced, pounds.	14,970,737	11,325,010	18,413,387
Copper in mineral, per cent...	71.296	75.775	75.830
Copper per ton, pounds.....	13.5	15.4	14.8
Total cost per pound, cents...	10.79	12.30	10.36
Copper sold, pounds	14,970,737	10,958,926	17,175,066
Price per pound, cents	13.14	15.50	16.63
Copper unsold, pounds	.....	336,084	1,238,321
Receipts from copper	$1,967,725	$1,753,626	$3,041,408
Other income	.....	21,184	30,140
Total income	$1,967,725	$1,774,810	$3,071,818
Mine expenses	1,425,205	1,176,811	1,536,472
Smelting, freight, etc.	167,733	128,662	197,727
New construction	21,009	87,370	174,331
Total expenses	$1,614,048	$1,392,843	$1,908,530
Net profits	353,677	381,967	1,163,288
Dividends	289,541	721,125	1,153,800
Previous surplus	1,549,300	1,888,458	1,832,183
Total surplus	1,613,436	1,549,300	1,888,458

MASS CONSOLIDATED MINING COMPANY

The report of this Michigan copper company covers the year 1914, during which the strike of 1913 and the European war affected results. Operations resulted as follows:

'Rock' hoisted, tons	247,692
'Rock' stamped, tons	209,354
Mineral produced, pounds	4,487,425
Refined copper produced, pounds	2,944,952
Mineral in rock, per cent	1.072
Copper in mineral, per cent	65.62
Refined copper per ton of 'rock' stamped, pounds.	14.07
Cost per ton of 'rock' stamped, at mine	$1.706
Cost per pound refined copper at mine, cents.	12.132
Cost of smelting, freight, and marketing copper, cents	1.394
Total cost per pound refined copper, cents.	13.526
Total cost per pound refined copper, including strike expense, construction, and interest, cents.	14.052

	1914.	1913.	1912.
Sales of copper, pounds	2,955,952	1,213,545	2,045,006
Average price received, cents...	12.751	15.6	17.0205
Copper receipts	$ 375,530	$ 189,325	$ 248,070
Total receipts	481,076	189,557	349,354
Total expenditure	416,530	217,564	338,364
Surplus	64,546	*28,006	10,000
Previous cash assets	*18,660	9,347	30,710
Total surplus	45,887	*18,658	41,770
Profit and loss surplus	45,887	*18,658	9,348

*Deficit.

Ore reserves are estimated as 1,250,000 tons, the Butler lode adding 287,559 tons to the total. In B and C shafts it is increasing in width, according to the superintendent, E. W. Walker.

MINING DECISIONS

Oil Lands—Right of Adjoining Owners

Oil in the earth belongs to the owner of the soil. It resembles water as it exists in the earth, its original source is uncertain, and even the exact location thereof may not be known. The owner of the fee has a right to pump, use, and sell it, even if his wells are so located on his premises as to lessen the flow of his neighbor's wells dug prior to his.

Rumsey v. Sullivan (New York), 150 New York Supplement, 287. November 11, 1914.

Millsite in National Forest—Reinstatement

A decision by the Department of the Interior canceling a millsite entry, without passing upon the validity of the millsite claim or location or the claimant's possessory rights or ownership in the premises, in no wise affects the legal rights, if any, the claimant may have in the millsite claim; and where the land is included within the limits of a national forest, but excepted from the operation of the proclamation creating the same, by reason of being covered by the millsite claim, the subsequent cancellation of the millsite does not have the effect to make the land a part of the national forest or deprive the Secretary of the Interior of jurisdiction to reinstate the canceled entry with a view to the issuance of patents theron.

Alaska Copper Co. *et al.* (Land Department), 43 Land Decisions, 257. May 28, 1914.

Assessment Work—Failure to Perform

A miner went on a group of mining claims owned by his brother's estate to perform the annual assessment work thereon, in order that, by protecting the title of the estate he might eventually recover a claim he held against it. While on the ground he occupied a cabin built by and belonging to the estate. He was unable to furnish sufficient money to do the work himself, and although the representative of the estate promised to raise some more, this was not done until after the first of the following year, when the claims were re-located by himself and another. Held, that he did not occupy a fiduciary relation toward the estate, that insufficient work having been done prior to the first of the year, the claims on that date became open to relocation, and that the subsequent performance of work by the former owners could not validate their forfeited claims.

McDonald *v.* McDonald (Arizona), 144 Pacific, 950. December 9, 1914.

Mineral Locations in National Forests

The banks and beds of non-navigable, unmeandered streams on lands belonging to the United States containing valuable mineral deposits may be included in locations and entries under the mining laws. The general mining laws are operative with respect to deposits of gold or other metalliferous minerals within the limits of national forests or power-site withdrawals the same as with respect to like deposits elsewhere on the public domain. If the evidence is convincing that the claims in question contain deposits of gold of such quantity, quality, and value as would warrant a prudent man in the expenditure of labor and means with a reasonable prospect of success in developing valuable mines, they are disposable under the mining laws, notwithstanding their possible or probable value for or in connection with the development of electrical power.

Cataract Gold Mining Co. *et al.* (Land Department), 43 Land Decisions, 232. April 27, 1914.

RECENT PUBLICATIONS

Sixth Biennial Report of the Commissioners of the State Geological and Natural History Survey, 1913-1914. *Bulletin* 25. P. 24. Hartford, Connecticut, 1915.

Mining Industry of Idaho in 1914. Sixteenth Annual Report. By Robert N. Bell. P. 55. Boise, 1915. A résumé of this report was published in the *Press* of February 27.

The Physical Properties of the Metal Cobalt. By H. T. Kalmus and C. Harper. Part II. Researches on cobalt and cobalt alloys, conducted at Queens University, Kingston, Ontario, for the Mines Branch of the Department of Mines of Canada. P. 49. Ill., plans, 14 plates. Ottawa, 1914. Gives the results of interesting tests made on this metal, recovered from the smelting of ores from Cobalt.

From the Fifth Annual Report of the Florida State Geological Survey:

Origin of the Hard Rock Phosphate Deposits of Florida. By E. H. Sellards. P. 58. Ill., maps. The hard rock deposits extend through a distance of about 100 miles, with variable width. Forty plants were operated in 1912.

Mineral Industries and Resources of Florida. By E. H. Sellards. P. 94. Illustrated. The output of all minerals in 1913 was valued at $10,646,628, of which phosphate rock accounted for $9,563,084, the value of 2,545,276 long tons.

United States Geological Survey publications, Washington, D. C., 1914:

Folios of the Geologic Atlas of the United States:

Van Horn Folio, Texas. By G. B. Richardson. No. 194. P. 9. Ill., 3 maps, 9 plates.

Raritan Folio, New Jersey. By W. S. Bayley, R. D. Salisbury, and H. B. Kümmel. Surveyed in co-operation with the Geological Survey of New Jersey. No. 191. P. 32. 5 maps, 1 plan.

Eastport Folio, Maine. By Edson S. Bastin and Henry S. Williams. In co-operation with the Geological Survey of Maine. No. 192. P. 13. Ill., 4 maps, 23 plates, and 1 page descriptive of fossil formations.

Mineral Resources of the United States, 1913. Part I.—Metals. P. 901, ill., chart, index. Part II.—Non-metals. P. 1617, maps, 3 charts, index. These volumes contain all that valuable data issued by the Survey first in the form of press *Bulletins*, and then as *Abstracts*, from which copious abstracts have been published in the *Press* as they are published. It is therefore not necessary to cover any of the same matter again. The authors are well known officials in the department. The volumes continue to grow, the total of the pages being 2518 against 2297 in the previous publication.

San Francisco Folio, California. By Andrew C. Lawson. No. 193. P. 24. Ill., 15 maps, 1 plan, 10 plates. A review of this work appeared in the *Press* of March 6. The field edition of the folio is now ready for distribution. It contains topographic, geologic, and structural maps of five rectangular areas known as quadrangles, which embrace the San Francisco and Marin peninsulas, San Francisco bay, and the east shore of the bay almost as far as Mount Diablo. In the text accompanying the maps, the character of the different rocks is described in detail and the mineral deposits of economic value are pointed out. The folio also contains a number of halftone views of feafures that are of geologic interest, including one showing clearly the trace of the fault along which occurred the earthquake of 1906. The field edition of the folio is sold by the U. S. Geological Survey at 75c. per copy.

New Machines and Devices

Diesel Engine Operating at the Exposition

There are many working exhibits in the Palace of Machinery at the Panama-Pacific Exposition, and one of the most interesting is that of the Busch-Sulzer Bros.-Diesel Engine Co., of St. Louis, represented in San Francisco by W. S. Heger. Considerable expense and care has been taken in exhibiting this machine. It is known as the type 'B,' vertical, 4-cylinder, single-acting, 4-stroke cycle, enclosed crank case, medium-speed Diesel engine, with 3-stage air-compressor integral. In the factory at St. Louis only Diesel engines are manufactured, so that it is a specialty of the plant. The floor space occupied by this 500-hp. engine is 16 ft. 4 in. long, and 26 ft. 6 in. with alternating-current generator direct connected, 16 ft. high from floor to top of cylinders, and 10 ft. 8 in. wide. An inspection of the engine and claims by the makers reveal the following

500-HP. DIESEL ENGINE AT THE PANAMA-PACIFIC EXPOSITION.

points: The machine, fitted with a 15-ton flywheel, is direct connected to a Westinghouse 335-kw., 250 volt, 1340-amp. generator, running at 200 r.p.m. The cycle of operation is as follows: cylinders charged with compressed air are used to start the engine. When in motion the down stroke draws in atmospheric air. The up stroke compresses this air to from 450 to 500-lb. pressure, during which time a temperature of 1000°F. is reached. At the top of this stroke, fuel oil of 23°B. is sprayed into the cylinder for 10 to 15% of the stroke, by air at 1000 lb., compressed by the 3-stage compressor which is part of the unit. The oil burns and the next stroke is the power stroke. The final part of the cycle is where the up stroke expels the gases produced. Oil consumption under operating conditions is 30 gal. per hour for the 500-hp. set. Below 50% load the proportion of oil used increases. The cost for fuel is 0.2c. per kw. hour. By heating to about 120°F., oil of 14° gravity can be used. The governing apparatus consists of a ring, which flies out when the speed is too high, and knocks a trip which cuts off the fuel. The governor runs on ball bearings. As to the fuel pump, the control of which is the chief duty of the governor, its function is to measure out and pump the fuel to the fuel valves. Two measured quantities of fuel are pumped by it to each fuel valve before each opening. For an engine operating at 200 r.p.m., with a power impulse each revolution, this means that the fuel delivered to the atomizers with each fuel pump discharge stroke, is the exact quantity necessary to care for the load for just one four-hundredths of a minute interval. All lubrication of the engine is done by a pump, and if the temperature of any bearing should rise, the pressure can be raised to 65 lb. Thermometers are placed at the oil inlet and outlet. Cam-shafts run in oil, and cams are so spaced as to leave no chance to move. Each cylinder being practically an engine in itself, makes repairs to valves an easy matter, and the whole engine works without trouble even if one cylinder is not giving power for a time. All cylinders are water-jacketed. Objections to the Diesel engine have included the carbonization of oil, air pockets in the cooling system caused by dead air or formation of steam, and the operator getting burned by exhaust pipes. These defects are claimed to have been successfully overcome by the Busch-Sulzer company. In the starting of this exhibit at the Exposition, on February 20, President Wilson in Washington closed a circuit there, which in turn closed the wireless key at Tuckerton. This sent the impulse to be caught by the antennae on the tower of jewels at the Exposition, the first time that the wireless had been used across the continent on power service. The impulse sent operated a galvanometer at the base of the tower, which in turn closed the local circuit that operated the electric release on a 500-hp. Diesel engine. This released a weighted lever which started the engine.

Small Mazda Lamps With Concentrated Filaments

The distinctive features of the concentrated filament Mazda lamps of high wattages have proved so popular that the Edison Lamp Works of the General Electric Co. has developed vacuum Mazda lamps of similar appearance in the 25, 40, and 60-watt sizes. This concentrated filament construction gives greater vertical distribution of light than the regular Mazda lamps of corresponding wattages. The new lamps will, therefore, be employed where natural distribution of light downward is required. They can be used in existing sockets and fixtures. These lamps will be made in the same sized bulbs as the corresponding regular Mazda lamps, will have the same spherical watts per candle-power efficiency, and will have a rated average life of 600 hours.

Commercial Paragraphs

The West Kentucky Ore Co., of Marion, Kentucky, has given the DENVER QUARTZ MILL & CRUSHER Co., of Denver, Colorado, a rush order for a 50-ton Denver quartz mill and an Isbell concentrator to be used on zinc ore.

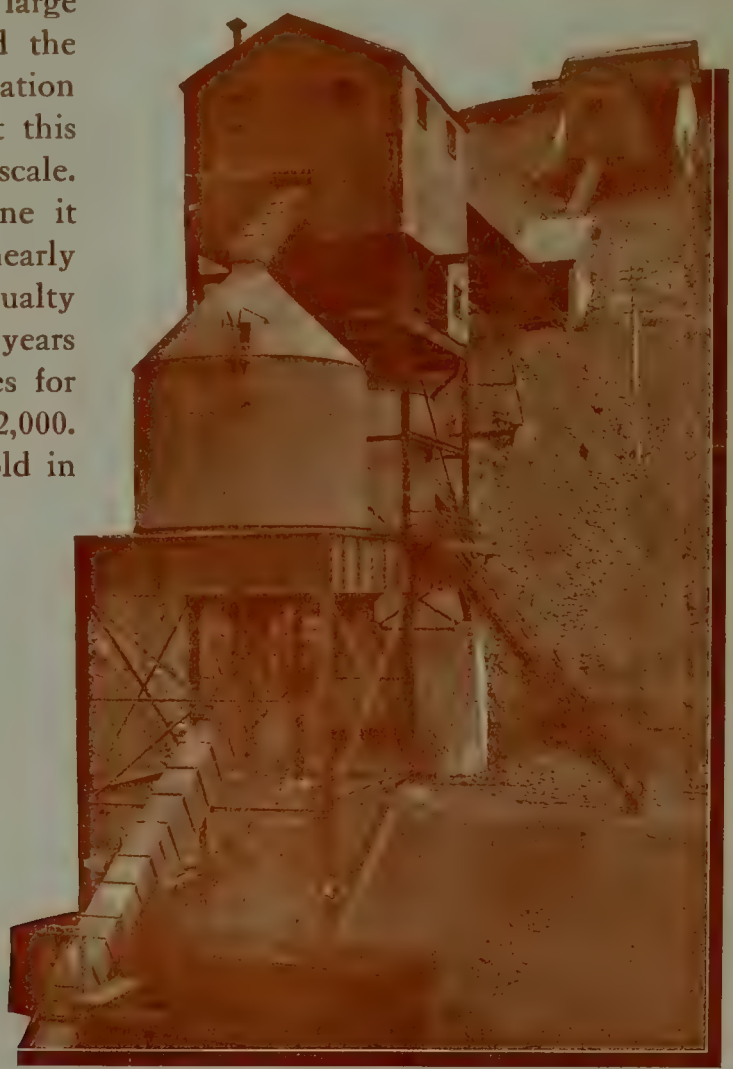
F. O. Williamson, special sales representative for the Hardinge conical mills, has removed his office from room 330 to room 545 Old Colony building, Chicago. Mr. Williamson has been identified with the Hardinge mills for the past six years.

In illustrated *Pamphlet* No. 605, the HAYWARD Co., of New York shows actual use of the 'Hayward' buckets. These are doing the following work: transferring cement clinker; handling coal and ash at a power house; moving run of mine bituminous coal; rescuing a locomotive crane from a river; foundry work; an electric motor-clam-shell bucket, on which the motor is arranged in the upper centre of the bucket itself; a three-blade orange-peel bucket handling boulders up to 10 tons weight; and in cofferdam work for bridges and similar construction.

MINING PRESS

Volume 110 SAN FRANCISCO, MARCH 27, 1915 Number 13

CARE of the health and happiness of workmen has become an integral part of the management of large business enterprises. Begun from humanitarian motives it soon became evident that wherever labor is an important factor in the cost of operation great economy can be effected by careful attention to the human mechanism, making sure that it is in good repair, well lubricated, and working smoothly. Because of the large number of men employed the United States Steel Corporation has been able to carry out this work on the most advanced scale. In accident prevention alone it was found that a saving of nearly five million dollars in casualty expenses was made in three years and, deducting expenditures for safety, a net gain of $2,772,000. How it is being done is told in this issue.



Safety, Sanitation, and Welfare; the United States Steel Corporation
—Page 474

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SAN FRANCISCO, MARCH 27, 1915

Buyers Directory—Page 28
Advertisers Index—Last Page

TABLE OF CONTENTS

EDITORIAL Page.

Notes 467

Constitutionalist Extortion and the Worcester Affair.... 468

Taking Care of the Human Mechanism 469

ARTICLES

MILLUNI TIN-MINING DISTRICT, BOLIVIA.

By Francis Church Lincoln..... 470

The Milluni district was a large producer of silver in the early days of the Spanish occupation of Bolivia, but the tin was not discovered until 1890. French capital has been secured and a number of mines are now producing. The ore occurs in veins of good size and is concentrated in small mills of modern design. The cost of mining and milling is only about $3.50 per ton of ore, but freight and export amount to $140 per ton of 64% concentrate.

ENGLISH PRODUCTION OF CYANIDES 473

English cyanide plants are now being worked to full capacity to supply Australia, South Africa, India, and other countries. Detail figures as to exports for 1913 are given.

SAFETY, SANITATION, AND WELFARE IN THE UNITED STATES STEEL CORPORATION EXHIBIT.

By Arthur A. Willoughby..... 474

The United States Steel Corporation, through its subsidiary companies, employs 225,000 persons, representing a population of a million souls. Labor is a large item in the cost of production; it has been found good business to devote as much study to the care and operation of men as of machines. The returns are surprisingly high, and the work has been developed to a further extent by the Corporation than by any other organization.

OPPORTUNITY FOR WORKMEN AT ANACONDA..... 480

The Anaconda Copper Mining Co. is affording means for its smelter workmen to acquire small farms on which they can raise a large part of their food requirements as an avocation from their daily work.

PLATINUM ANALYSIS.

By F. Mylius and A. Mazzucchelli..... 481

Separation of the metals of the platinum group is both difficult and tedious. The authors give a scheme which they have devised which offers certain advantages as compared with present methods.

ROBERT H. RICHARDS—AN APPRECIATION.

By David H. Browne..... 483

It is only rarely that a college professor is able to contribute much to the practical development of an art, especially such an art as mining. One who is at once teacher, thinker, investigator, scholar, and practitioner of the art of ore dressing commands corresponding respect. One who has the gift of Irish wit here pays tribute to him.

DEPARTMENTS

DISCUSSION:

The Design of Belt Elevators.

By M. G. F. Söhnlein..... 485

An engineer of experience gives in detail his investigations on the features to be observed in designing a belt elevator and relates his experience.

Banding of Ore Deposits.

By Chester T. Kennan..... 487

An engineer thinks we have overlooked a possibility.

CONCENTRATES 488

REVIEW OF MINING 489

Special correspondence from:

Sacramento, California

New York

London

THE MINING SUMMARY 493

PERSONAL 497

THE MARKET PLACE:

Metal Prices 498

COMPANY REPORTS 499

Homestake Mining Company.

BOOK REVIEWS 500

'Carranza and Mexico,' by Carlo de Fornaro.

RECENT PATENTS 500

RECENT PUBLICATIONS 501

MINING DECISIONS 502

NEW MACHINES AND DEVICES:

Severe Tests for an Auto-Truck 503

Mine-Rescue Parties Telephone to the Surface..... 503

Commercial Paragraphs 504

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WORK on the Marysvale potash deposits is to be started with a $3,000,000 plant, to be built by the Armour interests, according to reports from Utah.

THE School of Mines at Virginia City, Nevada, is to continue its useful work; the legislature having increased its appropriation for the support of the school.

FATAL accidents in the coal mines of the United States showed a decrease of 334 in 1914, according to a report made by Mr. A. H. Fay to the Bureau of Mines.

NEW regulations of the Customs Service provide for a wet assay of imported ore and bullion. The detailed regulations can be obtained on application to the Treasury Department.

MISSOURI has thrown its hat into the ring and will proceed to 'bust the smelter trust,' according to an announcement made by the Attorney General. The daily papers do not state whether the lead or zinc smelters are to be the first object of attack. Those who know the affectionate regard in which the various smelting companies hold each other will be especially interested in the outcome of the suits.

IT is particularly opportune that just at this time, when the attention of Americans is directed so largely toward California, an excellent report on the petroleum industry, one of the most important of the state, should be issued. This has been prepared by Mr. R. P. McLaughlin, under the direction of Mr. F. McN. Hamilton, State Mineralogist of California. As yet, only the atlas, of the same size as the geologic folios of the United States Geological Survey, is available, the accompanying text being still in the hands of the State Printer. The atlas, an excellent piece of work, not only contains large scale topographic and geologic maps of all the oil-producing districts of California, but is also illustrated with photographs and line drawings of the fossil flora and fauna of the oil series. The State Mineralogist and the author are to be congratulated on having made such a report available in time to be of service to the many geologists and oil men who will doubtless be drawn to California by the Exposition and the scientific congresses which are to be held in connection with it during the summer and autumn.

IT is a pleasure to record the dedication, March 16, of Julius Rosenwald hall, a magnificent structure at the University of Chicago which is to be devoted to research and instruction in geology and geography. Walker Museum can now be devoted to its original purpose, the housing of the collections of the departments concerned. The new building is a steel and stone structure admirably adapted to its purpose and including, we are glad to note, rooms to be devoted to special research on problems relating to ore genesis. This will give Mr. A. D. Brokaw the needed facilities for further studies of problems in secondary enrichment such as he has so well begun. The building as a whole will be mainly, and properly, regarded as a tribute from one of Chicago's public spirited business men to the work done both in investigation and teaching by Messrs. T. C. Chamberlin and R. D. Salisbury, the two men whose work in geology has done so much to clear up fundamental problems and afford a basis for specific research in many lines.

ON March 18 the gold medal of the Mining and Metallurgical Society of America was presented to Mr. Robert H. Richards, professor emeritus of mining in the Massachusetts Institute of Technology. The presentation was made at a dinner of the Society and in the presence of a thoroughly representative gathering of professional men. Mr. W. R. Ingalls occupied the chair, from which he delivered an appropriate summary of the work done by the great authority on ore dressing. Other speakers were Messrs. William L. Saunders, F. A. Lidbury, Charles W. Goodale, and David H. Browne. The last of these made a speech that had all the qualities of an oration; it was intellectually stimulating and highly appropriate to the occasion. We take pleasure in giving our readers the text of this appreciation of Professor Richards. For ourselves, we desire to record our high respect for him as an enthusiastic teacher, a persistent investigator, a systematic recorder, and a successful seeker after scientific truth. Assuredly the two landmarks in the story of ore dressing are Rittinger and Richards. His books are part of our metallurgical heritage. It was a keen delight to us to be present on the happy occasion when the Professor, in his cheerful and vigorous old age, received the sincere thanks and respect of his fellow practitioners. We trust that his kindly personality and useful labors may continue to exert a characteristic influence for many years to come.

RETIREMENT of Mr. O. M. Bilharz from the service of the St. Joseph Lead Company loses to that concern one of its most capable employees, and one whose sound ideas of technology and sterling character have contributed greatly to its success. The St. Joseph and Doe Run companies, now joined, have succeeded in spite of rather than by virtue of the direction given them by their titular managers. Our readers are already informed of the situation, which is, in effect, that the control of the companies has been inherited by men who have at the same time failed to inherit the knowledge and genius for hard work that marked the pioneers of the Company. Second-growth hickory has always been at a discount in the Middle West, and the second generation of mine owners often warrants the same prejudice. The recent substitution of Mr. C. H. Crane for Mr. D. A. Jones as president has not helped greatly. The fundamental trouble is that men not skilled in technology insist upon passing upon technical questions and the able men on the staff of the St. Joseph company are not given a free hand. A designer of power boats may be an excellent business adviser and so properly the head of a board of directors, but he is not, unless otherwise qualified, fitted to handle the complex management of so technical a business as mining and smelting lead ore, while long-distance management will break any company that is not too rich to spoil, as seems true of the St. Joseph.

VALUE of geological work as an aid in directing and developing mining operations can scarcely be too much emphasized. At the South Lake mine in the Michigan copper mining district, a vertical shaft was sunk to a depth of 626 feet. This shaft cut two beds of amygdaloid, carrying copper and dipping to the north. At the 600-foot level, a cross-cut was driven 1379 feet southeast. This cross-cut shows that the dip changes from north at the shaft to distinctly south at 900 feet from it. As the cross-cut was continued, the various beds of amygdaloid, trap, sandstone, and conglomerate cut were found to be identical in character and relationship, one to the other, with the beds exposed dipping to the north in the shaft. This cross-cut confirms the theory of Mr. L. L. Hubbard, consulting geologist for the Company, deduced from diamond drilling done several years ago, that the beds dipping south were simply one limb of an anticline, the top of which had been eroded and covered with about 250 feet of drift. Another case where geological study might have been of value is at the Mass mine. It is reported that the important discovery has been made at this property within the past few months that only part of the full width of the Butler lode was being mined. Mining has always been confined to the lode between two well defined walls, but on following a shoot of ore on the ninth level, the foot-wall was cut and additional ore of good copper content was disclosed. The nature of the ore deposits in the Michigan district almost demands an investigation for parallel lodes, as has been clearly shown at the Quincy.

CONSTITUTIONALIST EXTORTION AND THE WORCESTER AFFAIR

The operation of mining properties in Mexico during the past three years has been fraught with difficulties both numerous and varied. Constitutionalist domination of northern and central Mexico brought with it a marked change in the status of the mining industry that has been particularly pronounced with those properties formerly controlled by sympathizers of the so-called *Cientifico* party. Almost without exception the properties so held have been confiscated by the Constitutionalists and are at the present time either idle or being worked under lease to followers of Francisco Villa. This leasing system of confiscated property, it would seem from a recent report from Chihuahua, has resulted in many evils. In one instance, which has been forcibly brought to our attention by the unwarranted imprisonment of our correspondent in Chihuahua, this system is being used as a blind for the practice of extortion by Constitutionalist authorities.

On February 13, Mr. Leonard Worcester, Jr., manager of the Chihuahua Ore Testing & Sampling Company of Chihuahua, Mexico, and our local correspondent, was confined in the Chihuahua penitentiary without cause, as reported to the State Department at Washington by Consul Marion Letcher, and until March 12, the time at which the report was sent to us from Chihuahua, had been held at the penitentiary; a good part of the time *incommunicado*, or in solitary confinement with no connection with the outside world. Those of our readers who have lived among the Mexican people and are familiar with what Mexican penal institutions are like, will appreciate Mr. Worcester's position and surroundings; to those who have not, we would recommend a perusal of Carlo de Fornaro's description of a night in Belem prison.

Mr. Worcester wrote us from the penitentiary that he is charged with conspiring with the Granby Mining & Smelting Company, of St. Louis, which he represents in Chihuahua, to defraud Francisco Rueda Quijano of money due to him on ore purchased from him by the Granby company and mined at the Compañía Minera Ignacio Rodriguez Ramos property, which had been confiscated by the Constitutionalists and leased to Sr. Quijano. The Granby company had instructed Mr. Worcester to attend to the shipment of the ore from Chihuahua and to pay Sr. Quijano, the lessee, 75 per cent of the value of the ore, export duties, and other necessary expenses, from funds furnished by the Granby company for this purpose; Mr. Worcester being in no way responsible for the payment of any money. After the negotiations for 15 cars of ore were begun, the Granby company, fearing action against it by the original owners of the property, deemed it advisable not to close the sale of this shipment, and as a result Sr. Quijano had Mr. Worcester placed under arrest.

Ample documentary evidence has been offered to

prove Mr. Worcester's innocence of the charge of attempt to defraud; the Granby company has assured the authorities that Mr. Worcester was not responsible in any way, and has offered to settle in full for all the ore according to the contract. As the Granby company showed a willingness to fulfill the contract for the purchase of the ore, upon Mr. Worcester's imprisonment, Sr. Quijano took it upon himself to increase the valuation of this shipment to a price which was absolutely prohibitive. His 'reason' for this was that Sr. Villa was personally interested in this shipment and was to receive 80 per cent of the sale price, and that he, as Villa's representative, did not propose to arbitrate the value of the ore and would hold Mr. Worcester in prison until he received the amount demanded.

Mr. Worcester was refused bail, although Sr. Diaz Lombardo, the Constitutionalist Minister of Justice and Foreign Relations, had promised it to Consul Marion Letcher. Mr. Worcester remained in prison in surroundings which are beyond endurance to even the peon *ratero*. Consul Letcher, after a careful personal investigation, advised the State Department of the facts in the case, declaring, according to the report furnished us, that Mr. Worcester was entirely innocent and showing clearly that the entire case was a flagrant attempt at extortion by the Constitutionalist authorities, a practice which has become popular with those in power, although foreigners, and American citizens in particular, have been generally exempt.

There is an adage in Mexico which has been handed down from one generation of *gringos* to another, that when a European resident is in difficulty the proper procedure is to go to his consul, but with the American the proper procedure is to go to jail. Mr. Letcher the American consul at Chihuahua, is an exception to this rule and holds the esteem of all Americans in that part of Mexico. However, when his hands are not upheld by the State Department his personal protection is of little avail. Such is reported as the status of the Worcester affair. Mr. Carothers, the special agent to whom this matter was referred by the State Department, and whose record of inefficiency is a by-word with Americans on the other side of the Rio Grande, made a subsequent visit to Chihuahua in company with Mr. Duval West, but apparently made little effort to investigate the matter, not even taking the trouble to see Mr. Letcher or Mr. Worcester in regard to the affair. However, he reported to Washington that Mr. Worcester had not applied for bail, which would be allowed upon application, and that in his opinion the Constitutionalist government was not interested in holding Mr. Worcester. The State Department accepted this report in place of the report based on Mr. Letcher's personal investigation, and although bail had repeatedly been applied for before and since Mr. Carothers' visit to Chihuahua, it had been as often refused and Mr. Worcester remained in prison.

Upon being advised of the position of our representative, we took the matter up through President Wilson and are pleased to learn from the following telegram that Mr. Worcester is about to be released:

"Washington, D. C., March 20, 1915.

"E. H. Leslie, care *Mining Press*, San Francisco.

"Reference your telegram to President: Department has made earnest efforts through Consul Chihuahua and special agent Carothers to obtain release of Worcester on bail, as a result of which it has been advised that he will be so released upon his application.

"W. J. Bryan,
"*Secretary of State.*"

TAKING CARE OF THE HUMAN MECHANISM

One of the most interesting phenomenon apparent to the student of the problems of society is the slowness with which new ideas progress until they reach a certain point, and the velocity with which they attain general acceptance thereafter. For many years it has been apparent that the most important factor in American industry is the labor item in production cost, since wages have rapidly increased in the face of continuous attempts to decrease market prices for finished products. For a long while efforts to decrease production costs were chiefly directed at replacing hand work by machines, speeding up the workman, and eliminating useless work. Careful thought and detailed study has been devoted to improving the design of machines, while careful inspection assures that they are always kept in repair and operate under the most favorable conditions. It is a trite saying that the human body is the most wonderful mechanism in the world, but the obvious implication which this involves seems never to have been perceived until recently. Any kind of man would be put at any kind of a job, except in the case of railroad engineers no one stopped to consider whether his eyesight was good enough to see well what he was doing, or whether the light in which he worked was too dim or too bright. No superintendent would allow machines to work under conditions under which they became overheated and so dissipated energy, but few superintendents gave a thought as to whether their men were working in air that was too hot or too cold or lacking in freshness. Everybody knows that the mind has such a powerful effect on muscles that bad news will sometimes cause a person to faint. It seems evident that if a workman is disturbed in his mind by unsatisfactory conditions at home his work at the plant will inevitably suffer. The management of some of the large organizations finally perceived these relations and proceeded to take them into account, with the immediate result that surprisingly large improvement in the work of their employees was brought about. Work of this sort must needs be performed chiefly by the corporations, for what an individual cannot afford to do for himself can be done to advantage by an organization for the benefit of all. In this issue, Mr. A. A. Willoughby describes what has been done by the United States Steel Corporation, and from his account operators of small properties should be able to glean many valuable suggestions.

Milluni Tin-Mining District, Bolivia

By FRANCIS CHURCH LINCOLN

The Bolivian tin deposits lie along a line some 400 miles in length which follows the general trend of the main range of the Andes southeasterly from Carabuco, near the Peruvian boundary, to Portugalete, not far from Argentine territory. The northernmost producing district is that of Milluni, which is in the northern part of the department of La Paz, a short distance north of the city of La Paz. This district is in the western foothills of the main range, a few miles southwest of Mount Kacaca, a magnificent snow-clad peak which towers to an altitude of more than twenty thousand feet above sea-level. The tin mines themselves

MAP OF VICINITY OF LA PAZ.

are situated at elevations ranging from 14,000 to 17,000 feet.

The Milluni District

The Milluni district was a large producer of silver in early Spanish times. The ancient silver mine was called Huayna Potosí ('Little Potosí' in Aymará Indian), after the famous camp of Potosí. It was abandoned long before the discovery of tin in the district, and the tin mined today comes from other veins. Don Ramon Irusta showed Sr. Collao a piece of ore from the Milluni district in 1890. Sr. Collao thought it might contain tin, and turned it over to Domingo Lorini to assay. Tin was found in the sample, and Collao, Lorini, Irusta & Co. located the Milluni mine.

Other mines were soon discovered in the district, including the Huayna Potosí tin mine, near the ancient Spanish silver mine of that name. The mines of Milluni and Huayna Potosí were united under the control of a French syndicate which is said to have expended $2,800,000 in the development of the ground and the construction of tramways, mills, and buildings, but was unable to make a success of the enterprise. This syndicate recently sold out to Huet Brothers, Frenchmen living in La Paz, and they are at present successfully operating the property. The other mines in the district are worked on a very small scale. The following table shows the names of the various mines, the names and nationalities of their owners, and the rate at which they were producing in the spring of 1914.

Mines in the Milluni District

Mine.	Operator.	Nationality.	Mo. prod., tons of tin conc.
Milluni	Huet Hermanes	French	20
Huayna Potosí	Huet Hermanes	French	50
Churihumani	Francisco Sanchez	Bolivian	4
Vesuvio	Compañía Minera Vesuvio (E. L. de Romano, manager)	Peruvian	*
Chacaltaya		German	†
Ventanani	Lorini, Olivia y Alborta (Hector Lorini, mgr.).	Bolivian	½
Kala Uyu	Lorini, Hijos y Compañía (Hector Lorini, mgr.).	Bolivian	2
Vilaque placer	Vilaque (Bolivia) Tin Mines, Ltd. (H. Lancaster Hobbs, mgr.)	English	*

*Under development. †Shut down.

All the operators have offices in the city of La Paz as well as at their mines.

The general appearance of the Milluni district is shown in the illustration. The Milluni mine is in the foreground, and the Vesuvio, Ventanani, and Churihumani mines in the background. The view was taken looking southward. The Kala Uyu and Chacaltaya mines are still farther south, on the opposite side of the range shown, while the Huayna Potosí mine and Vilaque placer are in a similar range to the north. The whole region is above timber-line, and the vegetation is seen to consist of coarse grasses and occasional shrubs. The topography of the district is glacial. The country rock consists of alternating thick beds of slate and quartzite of Lower Devonian age, with dips ranging from 0 to 45°. Intrusive dikes of quartz-porphyry occur in both the Milluni and Huayna Potosí mines. The ore deposits appear to be of pneumatolytic origin and genetically connected with these igneous rocks.

The Milluni mine is 12 miles by good road north from the city of La Paz. Starting at an elevation of 11,800 ft. above sea-level, a rapid ascent of 1400 ft. is

FIG. 1. MILLUNI.
FIG. 2. MILLUNI MILL.
FIG. 3. HUAYNA POTOSI MINE.
FIG. 4. HUAYNA POTOSI MILL.

made to the tableland of the Alto, seen in the illustration. Crossing this plateau and gradually and continuously ascending, the traveler passes the Indian village of Milluni ('Alum' in Aymará), whose inhabitants are gypsum burners; and thence beside Milluni lake, whose waters supply La Paz with electric power, into the foothills of the snow-clad mountains where the mine is situated.

Milluni, 15,150 ft. above sea-level, is shown in Fig. 1. The black slate and gray quartzite at the Milluni mine strike S.20°E. and dip about 25° southwest. They are cut by a series of roughly parallel veins, with strikes

FIG. 5. LA PAZ; ALTO TABLELAND IN BACKGROUND.
FIG. 6. VIEW OF MILLUNI DISTRICT.

ranging from N.10°W. to N.20°W., and nearly vertical dips. The vein filling consists of slate, quartzite, quartz porphyry, quartz, limonite, pyrite, arsenopyrite, and the ore mineral cassiterite.

In some of the veins, the sulphides have been leached out near the surface, leaving caves, in the bottom of which the cassiterite is found mechanically concentrated and mixed with quartz and limonite. Rich, loose ore formed in this manner is called *llampu*, which in Aymará means soft.

The ore as a whole is low grade, but fairly regular. The veins are of good width, ranging up to 20 ft. The vein matter is frequently soft, but the walls are usually firm, and stand well without timbering. All the drilling in the district is done by hand. Some 270 Aymará Indians are employed in the Milluni mine. The miners receive from $1 to $1.20 per day, helpers $0.64 to $1, and women $0.48 to $0.56.

The Milluni mill, shown in Fig. 2, has a capacity of 60 long tons per day. About 80 men are employed in and around the mill. Of these, 10 or 12 are millmen paid at the rate of $1.20 to $2.40 per day, the rest being helpers and women paid as at the mine. The mill is connected with the principal mine openings by a system of aerial tramways. Power is furnished by a Pelton water wheel, which derives its water supply from a series of small glacial lakes. When the ore arrives at the mill, it is dumped upon a 4 by 8-ft. grizzly, with 2-in. openings between bars. The oversize is crushed in a jaw crusher and falls into a bin, while the undersize passes directly into the same bin. This bin feeds two Harvey pneumatic stamps. These stamps were originally provided with 18-mesh screens, but the screens wore very rapidly and have now been removed, the large particles which collect in the launder being shoveled back to the stamps, while the finer pulp runs to a 4-spigot classifier.

The first classifier spigot feeds two Wilfley tables, while the second, third, and fourth spigots each feed one table. The tailings from these five Wilfley tables, together with the overflow from the classifier, go to two more Wilfleys. When the table middling contains sulphides, it is collected and roasted in a reverberatory furnace, ground in a Reynolds Chilean mill, and treated on four other Wilfley tables. The tailings from all the Wilfleys are re-treated on 11 circular convex buddles. The milling system is thus seen to be rather crude, being especially poor through lack of provision for the concentration of slime; so while the loss is said to be 10%, it is probably higher. This mill produces about 20 tons of tin concentrate, containing about 65% metallic tin, per month.

Going up the mountain back of the Milluni mine past the glacial lakes that supply the mill with water to an elevation of 16,200 ft., one comes to the Ventanani mine. The country rock flattens as one ascends, having a 5° westerly dip at the mine. The veins are similar in all respects to those at the Milluni mine below. Only a few men work this property, and there is no mill.

What is probably the southeast continuation of these veins is found on the farther side of the mountain at the Kala Uyu and Chacaltaya mines. The range is, however, well-nigh impassable, and to reach these mines, which are situated on the La Paz river, a 3½ hours' detour on muleback toward the south is necessary. From these mines down the river to La Paz is a 4 hours' muleback ride over good roads, so La Paz is their shipping point, whereas the other mines in the district ship from Alto station on the edge of the tableland above La Paz.

The country rock at the Kala Uyu mine has a steeper and more irregular dip than at the Milluni and Ventanani mines, averaging about 20° in a northwest direction. Development work has not been carried to the same extent as upon the opposite side of the range. The veins are nearly vertical, and as far as developed appear to be richer, narrower, and more irregular. The ore is oxidized and seems to be confined to the quartzite instead of occurring in both country rocks as at Milluni. A small quantity of ore is produced from the Kala Uyu mine. It is milled by hand by Indian women using buddles.

The Huayna Potosí mine is 6 miles, by poor trail, north from the Milluni mine. Two ridges, 15,970 and 16,170 ft. in altitude respectively, are crossed to reach the camp at the mine. This is shown in Fig. 3. It is situated at an altitude of 15,970 ft. above sea-level on the opposite side of a broad glacial valley from Mount Kacaca. The country rock is similar in character to that of the other mines in the district, but the ore deposits are lenticular veins parallel to the formation and with richer content than at Milluni. These veins range up to 25 ft. in width. Cross-veins also occur, cutting the formation, but they are of minor importance. The adit shown in Fig. 3 cuts the Carmen and Aliaga veins, which strike S.60°E. and dip 45°SW. Their fillings are similar to those at Milluni, save that bismuth minerals—bismuthinite, native bismuth, and bismite—are found. On top of the hill back of the adit is the Aurora tin-bismuth vein, parallel to the slate formation, which there strikes north-south and dips 72°W. This vein contains slate, quartz, pyrite, arsenopyrite, cassiterite, chalcopyrite, hematite, galenite, sphalerite, molybdenite, bismuthinite, native bismuth, and bismite.

Continuing his journey onward across the hill into the neighborhood of the ancient Spanish Huayna Potosí silver mine, the visitor comes to the Santa Rosa tin-bismuth vein, not shown here. This is at a contact between slate and quartzite strata, striking N.45°W. and dipping 75°NE. The minerals are the same as those in the Aurora vein. For 20 ft. from the vein little lenses of bismuth minerals occur between the slate laminae. The wages paid at the Huayna Potosí mine are as follows: Miners, $1 to $1.20; laborers, $0.60; boys, $0.40; women, $0.40 to $0.48. The women and boys are mainly employed on the surface, sorting ore. The ore from the Aurora and Santa Rosa veins

is picked for bismuth, and some shipping tin ore is also produced by hand picking.

The Huayna Potosí mill is 3½ miles north down the glacial valley, at an elevation of 15,080 ft. An aerial tramway carries the ore from the mine to a bin at the bottom of the valley, whence a surface tram takes it to the mill. The cars run down by gravity and are hauled back by mules. The mill is shown in Fig. 4. It is similar in most respects to that at Milluni, the principal difference being in the method of treating pyritic middling from the tables. This is roasted, ground, and concentrated on a magnetic separator instead of on Wilfley tables.

Costs and Profits

I took 21 samples at random from the four mines described above. These samples had a metallic tin content ranging from 0.26 to 21.40% and averaging 3%. Taking this figure for the tin content of the ores of the Milluni district, and assuming the loss in milling to be 33⅓%, the recovery from the ore is about 2% tin. Since the tin content of the concentrate or *barrilla* produced is usually under 65%, the average concentration is about 32 into 1. The cost of mining and milling at the Huayna Potosí and Milluni mines one month was $3.43 per long ton, divided as follows:

Management	$0.52
General expenses	0.26
Labor	2.22
Explosives	0.05
Steel and iron	0.04
Combustibles	0.03
Stores (mainly for mills)	0.09
Freight (to and from Alto station)	0.22
Total	$3.43

This cost was said to be somewhat below the average, and $4 per long ton is probably a better figure.

With Straits tin at £186 10s. in London, the tin in a long ton of 64% concentrate is worth about $580. The total charges for export taxes, commissions, freight, and smelting amounted to $140 per ton. The net value at the railroad was therefore $440. It cost $128 to mine, mill, and ship to the railroad the ton of 64% concentrate representing 32 tons of tin ore. Deducting this from $440, we have $312 as the net value of a long ton of tin concentrate, equivalent to nearly $10 per ton of original ore. The costs of mining and milling at the smaller properties are higher, and their owners are unable to obtain as good prices for their product. Thus a shipment from the Kala Uyu mine, at about the same time as that from Huayna Potosí and Milluni noted above, costs $200 per ton instead of $140, for the reason assigned.

Gold production of Dutch Guiana, South America, totaled 918,594 grams (31,495 oz.) in 1914, against 858,455 gm. (24,933 oz.) in 1913. Two small mills of the Chilean type and two small dredges operated during the year.

English Production of Cyanides

*Cyanides of potassium and sodium are produced in large quantities in the United Kingdom, but the production of cyanide of sodium is largely outstripping that of cyanide of potassium, owing, it is stated, to the fact that the former can be more economically produced than the latter. The comparative prices of the two cyanides during the first six months of 1914 and on February 12, 1915, were as follows: Cyanide of sodium, first six months 1914, 14c. per pound; February 12, 1915, 17c. per pound. Cyanide of potassium, first six months 1914, 15c. per pound; February 12, 1915, 30 to 36c. per pound. The greater relative increase in the price of cyanide of potassium is accounted for by the increased cost of potash. Carbonate of potash during the first six months of 1914 sold at $68 per ton, whereas the current price is $170.23 per ton.

The returns of the British Board of Trade do not distinguish separately the quantities and values of potassium cyanide and sodium cyanide exported from the United Kingdom, the two cyanides being combined in the returns. In 1913 the quantities and values of the salts exported were as follows, the countries of destination being indicated (hundredweight = 112 lb.):

Destination.	Hundredweight.	Value.
Portuguese East Africa	13,058	$257,053
Japan	7,680	127,712
United States	3,283	59,946
Mexico	14,300	287,785
Brazil	3,257	63,459
Other foreign countries	7,985	137,829
Total foreign countries	49,563	$933,784
Transvaal	27,765	557,482
British India	3,797	76,827
Australia	33,348	681,485
New Zealand	6,375	130,281
Canada	8,147	132,383
Other British possessions	11,477	223,854
Total British possessions	90,909	$1,802,313
Grand total	140,472	$2,736,097

There are no imports of cyanide into the United Kingdom.

From the American consul at Glasgow it has been ascertained that the largest individual cyanide factory in the world is in that city, and is now being worked at its full capacity. It is furnishing the requirements of the Transvaal and also makes occasional shipments to the United States. The manager of the company states that since January 1, 1915, the value of the shipments to the United States has amounted to $7715. The same company has exported in the past to Mexico, but at present that country is not importing. It was also stated that Great Britain was able to supply all British requirements and to export to other countries, as an ample supply of raw materials is available.

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*Report of consul general Robert P. Skinner, London, February 17.

Safety, Sanitation, and Welfare in the United States Steel Corporation Exhibit

By ARTHUR A. WILLOUGHBY

The work undertaken by the United States Steel Corporation in the matter of the physical, moral, and social welfare of its employees is generally considered as model practice and has been widely copied by various industrial enterprises. The high standard attained by the Corporation in its eight years of work along these lines is further advanced in point of organization and results obtained than in Germany where similar methods have been in vogue for the past thirty years. A large portion of the exhibit space occupied by the subsidiary companies of the Corporation in the Palace of Mines and Metallurgy at the Panama-Pacific International Exposition is given over to a portrayal of the work of the Bureau of Safety, Sanitation, and Welfare by means of charts, models, safety devices, and moving pictures. Charles L. Close has been at the head of the Bureau since its inception, and under his direction large appropriations have been made to carry out a system of work that has no equal in industrial history. Mr. Close has been affiliated with the iron and steel industry for twenty-one years, commencing as an ordinary laborer in a seamless tubing plant and later working up to the superintendency of a plant employing 750 men. The success attained by the Bureau under his supervision has been phenomenal.

ENTRANCE TO MINE AT No. 6 PLANT; STEEL FAN AND CONCRETE SUBSTATION.

Briefly stated, some of the accomplishments of the Bureau are as follows: Sanitation work was begun in 1911, and much valuable work has since been effected. The voluntary accident plan went into effect May 1, 1910, before any of the states had put workmen's compensation laws into effect. The vegetable and flower garden idea was taken up in 1911 and has been the means of beautifying the yards and homes of thousands of employees. In 1910 the first playground was built near Pittsburgh at the Pennsylvania works in a congested district. The district nurse plan was inaugurated in 1913 and five practical housekeeping centres have already been fitted up. The number of employees of the subsidiary companies of the Corporation is estimated in round numbers at 225,000, and those dependent on these makes a total of probably a million human beings coming within the scope of the Bureau.

Bureau Operations

Prior to 1906 the various companies had endeavored to do accident prevention and safety work along their own lines with varying success. In an attempt to systemize and standardize the work, a meeting was held in May 1906, participated in by the casualty managers of the various companies, and a committee of safety of the United States Steel Corporation was formed. The original membership of the committee was six, and was later increased to eight, an officer of the Corporation acting as chairman and the other members representatives from the subsidiary companies. The first work undertaken by the committee was that of inspecting the various plants and works with the idea of reducing the accidents and safeguarding the workmen in every way possible. The inspectors were given wide latitude in reporting every place where improvement might be made. The work of this committee led to the organization now in force. The Bureau acts as the central clearing house for all operations. Affiliated with it are the safety and sanitation committees of the Corporation. Branching out from these are the Central committees of the subsidiary companies. The work is further subdivided into

the plant committee on safety and sanitation, the department and special committees, and the workmen's committees. The importance of the committee work is noted when it is learned that 7399 workmen served at various times during 1913 in this capacity on the workmen's committee. No figures on the work during 1914 will be available for several months. Mr. Close gives his entire time to superintending the operations of the Bureau, and has personally supervised the installation of the exhibit made by his department. The moving pictures of the work accomplished by the Bureau, and shown for the first time in the fire-proof theatre installed in the exhibit, will prove of especial interest and will be shown daily throughout the Exposition.

MAN CAGE LOADED WITH MEN, NO. 5 SLOPE, MUSCODA DIVISION.

The Bureau carries on the administrative work of the various committees, distributes to the subsidiary companies comparative statements of accident prevention in the various plants and works so that mutual benefit may result, superintends the installation of the various enterprises looking to the betterment of the workmen's physical, moral, and social being, and is on the alert to gather new information on all matters of interest in its work. The central committee is composed of important officials from each of the plants or mining divisions and holds meetings periodically at the Corporation offices in New York city. The plant committee is made up of superintendents, assistant superintendents, master mechanics, and safety inspectors. Regular meetings are held. Each department of a plant has a committee of foremen who make inspections and look after the installation of safety devices. This committee conducts investigations of all serious accidents occurring in the plant and sends its findings, together with any suggestions, to the Bureau. Each plant manager is held as responsible for the safe operation of his plant and the health of his employees as he is for the successful carrying on of regular work. This is one of the important features of the Bureau's work. The workmen's committee usually consists of three members taken from the rank and file of the workmen. The committeemen are allowed sufficient time to make inspections as often as is necessary on full pay. Their special duties are to look for defects in buildings or equipment, careless practices of workmen, and to suggest improvements. The membership of this committee is changed periodically so that each workman may serve at some time or other. The intent of this feature of the work is to bring the employees into close touch with the workings of the Bureau and to secure active co-operation with it at all times, even when not serving on the committee.

The success of the work has become so well known that it is now being taken up by some of the technical schools and incorporated into courses. It is only a question of a short time until it will be recognized as a regular part of the curriculum, and the technically trained man of the future, on graduating will have studied in his school work one of the vital features of the modern industrial world.

Statistics

The figures which have been compiled with reference to accidents to workmen and the causes and the best methods for prevention, are illuminating. These statistics have largely determined the trend of the Bureau's activities and the form the accident prevention work must assume to secure maximum results. The general

classification of the causes of accidents in the various lines of industry represented in the Corporation's activities, is as follows: hand labor, 43.88%; railroads, 4.22%; mines, 15.10%; machinery, 5.20%; burns, 6.94%; falls, 7.73%; and all other causes, 16.93%. Of accidents ascribed to iron and coal mining operations the causes are grouped as follows: haulage or skip track, 35.23%; fall of slate, rock, ore, or coal from roof, 26.62%; fall of slate, rock, ore, or coal from side, 16.76%; slides or cave-ins, 6.95%; steam-shovel in open-pit work, 4.11%; livestock, 2.25%; chutes and rises, 0.99%; fall of slate, rock, ore, or coal from face, 0.93%; gas and smoke, explosions, and burns, 0.73%; cage accidents, 53%; premature explosions, 0.47%; shaft, 1.06%; delayed blasts, 0.26%; and fall of slate, rock, ore, or coal in blasting, 3.11 per cent.

The figures given relative to the decrease in accidents since 1906 are of great interest as showing what intelligent effort coupled with scientific organization can accomplish. Those saved from serious injury, including all fatal accidents, all permanent injuries, loss to member or portion of member of body, loss of an eye or disabled more than 35 days, during the period from 1906 to the close of 1913 were 11,074. In 1907 the number saved was 532, or a decrease over 1906 of 10.40%; in 1908 the decrease over 1906 was 783, or 18.21%; in 1909 it was 1236, or 25.28%; in 1910, 2215, or 43.4%; in 1911, 2012, or 41.26%; in 1912, 2023, or 36.06%; and in 1913, 2273, or 38.29%. The slight increase noted in 1911 is due to a change adopted in the reporting of serious accidents, a standard system having been installed for all the companies to follow. The percentage of increase over 1906 in payments to injured workmen is as follows: in 1907, 504%; 1908, 91.9%; 1909, 95.6%; 1910, 248%; 1911, 280.6%; 1912, 308.1%; and 1913, 373.1 per cent.

During 1911, 2012 workmen were saved from serious accidents. The total casualty expense was $2,071,407.54. At the 1906 rate of accidents, the casualty expense would have been $3,516,522, a saving of $1,445,144.46. In 1912, the number saved was 2023 and the total casualty expense, $2,587,516.18. At the 1906 rate, the expense would have been $4,033,616, a saving of $1,446,099.82. There were 2273 saved in 1913, and the casualty expense was $3,013,638.12; at the 1906 rate, the expense would have been $4,898,086.48, a saving of $1,884,448.36. The expenditures for safety in 1911 were $747,469.27; in 1912 they were $595,649.18; and in 1913, $660,593.84, a total of $2,003,712.29. The total men saved from serious injuries in the three years numbered 6038, the gross saving in casualty expenses was $4,775,692.64; this, less the expenditures for safety, leaves a net saving in casualty expense of $2,771,980.35.

A résumé of the operations for 1913 shows that the investigation of water supply sources and the installation of improved drinking water systems cost alone $130,000. The common drinking cup around the mines and plants has been practically abolished through the extensive use of sanitary drinking fountains. The expenditures for the betterment of employees were as follows: accident relief, $3,013,638.12; accident prevention, $660,593.84; sanitation and welfare work, $1,600,242.69; pension fund for superannuated employees, $966,194.68; employees' stock subscription plan, $1,000,000; making a total of $7,240,669.33 expended for improving the conditions of the workmen during that year alone. During 1912 the total expenditure was $6,166,364.82. The figures for 1914, when available, will make interesting reading.

Accident Prevention

The safety work has been divided into three branches as follows: organization, safeguarding, and education. Organization is the most important and the preliminary step in effective safety work, a proper spirit of harmony being necessary between employer and employee to obtain beneficial results. The Corporation has expended through the Bureau, since 1906, approximately $5,000,000 in safety work and has practically eliminated the principal causes of accidents for which the employer might be held responsible.

Carelessness on the part of workmen has been responsible for the majority of accidents, and a vigorous educational campaign has been adopted toward helping to bring the workman to a proper realization of his part in the work. Numerous lectures are given at the mines and plants in an attractive way. Typical safe and unsafe practices are shown. Motion pictures and stereopticon views play an important part in this work. Cash prizes and bonuses are awarded to superintendents and foremen for good records in safety promotion, and accident prevention Safety mottoes are used in large calendars, bottoms of drinking cups, on watch fobs, lead pencils, cigars, and on pay envelopes. Conspicuous warning signs are used at all danger points. Rule books are furnished the workmen, and in some plants, where the work is extra hazardous, they are required to pass an examination on the rules. Many pictures are shown in the exhibit which illustrate dangerous practices indulged in by workmen and which the Bureau is endeavoring to eradicate by educational work. At the blast-furnaces, platforms equipped with hand rails and tow-boards have been installed at working points. All hot metal mixers are provided with an automatic device which prevents them being tipped over accidentally. Refuge platforms and safety cages are also used.

While many safety devices are used for work underground, yet a strict observance of rules and safety regulations by workmen is more necessary than the use of a few devices. Dangerous mining conditions are less foolproof, with a few exceptions, than any other industry. Some of the more important rules embodied in underground practice are as follows:

Loose or soft ground must be trimmed down at all times, particularly after a blast.

Nails and spikes must be removed from all boards after staging and platforms have been taken down.

Miners are forbidden to ride on trains where mechanical or electrical power is used.

When more than one motor is used in the entry in tramming to the main shaft, colored lights automatically operated must be installed at cross-cuts where the motor is operating.

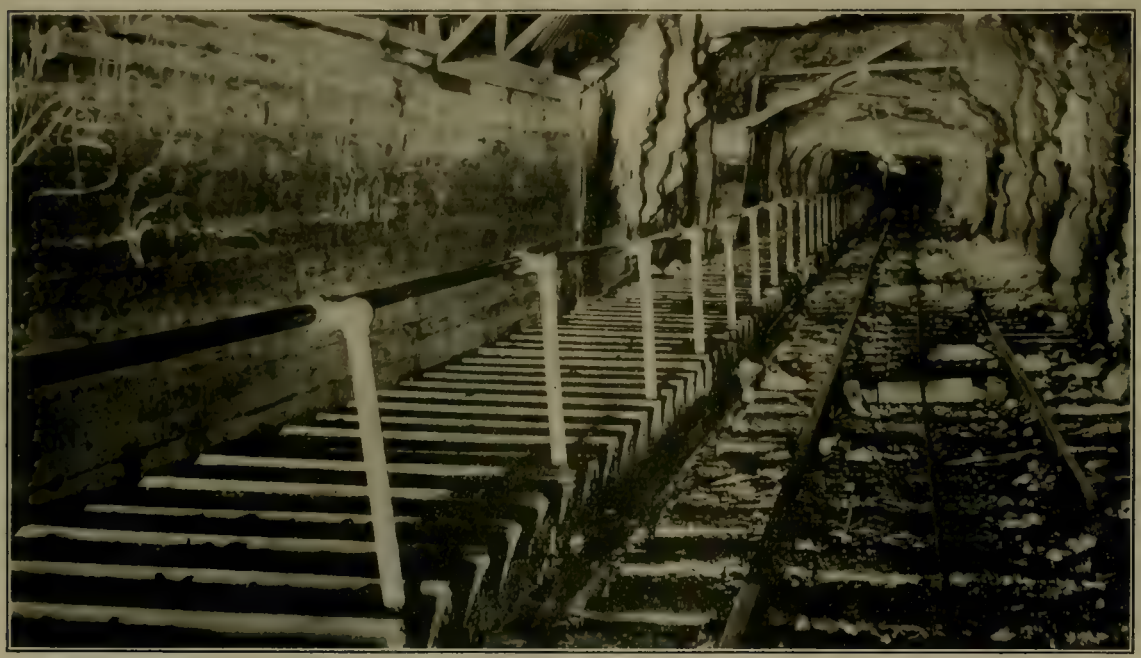
Riding on skips is strictly forbidden. Man cages equipped with arm catchers are provided for raising and lowering workmen in the shaft.

Frequent inspections must be made of the hoisting apparatus.

Extra precautions must be used when hoisting workmen.

No man is allowed to stay underground alone and the shift boss must be the last man to leave.

Extra care must be used during blasting operations. Misfired holes shall be reported in all cases to the shift boss or foreman. Workmen engaged in blasting must have an extra light placed at a safe distance in either direction, and no workman is permitted to blast a hole without having an assistant present.



MANWAY AT EDGEWATER COAL MINE.

All the mining companies have 'first-aid' and rescue crews composed of employees especially trained for the work and provided with a complete equipment of helmets, storage battery lights, oxygen breathing apparatus, and stretchers. Crews are made up of from four to eight men who must first pass a physical examination. They are trained for the work by the Company doctor and special instructors by means of lectures, demonstrations, and drills. A number of crews are assigned to duty at each mine. Emergency hospitals are placed convenient to surface and underground operations. A fully equipped rescue car is operated by the Tennessee Coal, Iron & Railroad Company.

A portion of the exhibit is a standard mine cage used by the Oliver Iron Mining Co. for hoisting workmen in a vertical shaft and for handling cars. It is equipped with safety dogs which engage a wooden rail. The cage is completely enclosed with steel doors which prevent the occupants of the cage from putting out their arms and getting struck by shaft sets. The top of the cage is of heavy sheet steel with hinges for the handling of long mine timbers. The cage is officially tested once a month. In the H. C. Frick exhibit is seen a modern steel headframe and hoist and a concrete lined shaft collar. At the top of the shaft are shown safety devices which prevent the opening of the gates at the surface landing until the cage is in the proper position at the landing. A Safety First sign with the wording in seven languages is shown in a box electrically illuminated and fastened to the head-frame. A circular steel shelter house for the use of workmen in surface blasting operations is shown, as used in the Canisteo district at Coleraine, Minnesota. It is a model of a house 8 ft. diameter and 9 ft. 2 in. high and built of ⅛-in. sheet steel. A safety hoisting bucket equipped with a latched cover is of interest as well as a black powder charging shield for use in charging vertical holes. The Schindler device, which has been adopted by the Corporation as the standard danger signal, is displayed. This consists of a rod with a red revolving disc and a white arrow. The disc can be set with the arrow pointing in any desired direction. Numerous signs such as are used in actual practice are shown. One which is used in conspicuous places about mine shaft stations reads as follows: "Do not try to move skip unless you know why skip was stopped." A safe method of attaching the hoisting cable to a skip car is shown. Many photographs and charts are displayed

about the walls of the exhibit space which are of interest and which give some idea of the scope of the work of the Bureau. An automatic projecting device shows a series of views on a ground-glass screen.

On $5,000,000 which has been spent on accident prevention work, the tangible returns during 1911-12-13 were $2,771,800.35 besides educating the workmen to a higher sense of the necessity of their co-operation to make the work of the Bureau successful and laying the groundwork for future growth, so that the money has been well expended. The average saving by the Bureau's methods in accident prevention will reach a million dollars each year.

Welfare and Sanitation Work

This work is especially important from the fact that the average foreign laborer lives on a much lower scale in this country than he would in his own country. He ordinarily immigrates with the idea that this is a land of golden opportunity and that it is an easy matter to get enough saved up in a few years to retire on and go back to the old country, and he will scrimp in order to hasten the glad day. As a result he pays but little or no attention to his living conditions. The efforts of the Bureau to secure better housing conditions for the workmen and to arouse them to a sense of their home duties have been eminently successful. Several model industrial centres have already been built and have attracted a great deal of attention. Three models are shown which are illustrative of the attempt of the Corporation to secure better surroundings for the employee in his home life. The models are mounted on mahogany pedestals and are surrounded with glass cases. The coloring and reproduction of the foliage, contour lines, and general appearance show careful attention to details. One is of a model construction camp on the site of Bayview, Alabama, which is being built as a new type of mining town. The camp is intended to embody the latest ideas of sanitation and housing in a tent city, in every way and to mark a radical departure from customary construction camp conditions. The following problems were considered; drinking water supply, sanitary work, and camp cleanness, eating quarters, sleeping apartments, bath-house, and hospital.

For the water supply two wells 75 ft. deep were drilled, cased with iron pipe, equipped with iron pumps, and covered over with concrete. In making the camp a model one from a sanitary standpoint, the site was cleared of all brush, stumps, and old logs and the trash and leaves burned. Waste water of all kinds is carried away by suitable drains to a convenient cesspool. To prevent the pollution of the soil and the consequent spread of disease, sanitary dry closets of the can receptacle type were installed, provided with a galvanized iron can and a fly-proof box seat. The closets are placed at frequent intervals, convenient to the sleeping quarters and the scene of work operations. The dining hall and kitchen is a one-story structure. The sleeping quarters consists of 'A' shaped tents set up on the higher grounds of the site and arranged in parallel rows near the work. The bath-house is equipped with hot and cold showers. Adequate hospital and medical service is provided.

Another model shows Bayview as it will appear when completed. It will be a self-contained community in two districts; one for the whites and one for the negroes, and separated by the railroad which runs through the town. The streets are laid out to conform to the natural contours of the site and are curving. The building line is set back 20 ft., and the houses, which are of frame construction, are of the 2, 3, 4, and 5-room type. The houses are not placed in type groups, but each one is arranged with respect to the topography of the lot on which it is to be built. There is a bath-house for all employees and a special one for the women and children built near the centre of population. The negro section is similar in treatment in many respects to the white section. When completed it will be the model mining town of the United States, if not of the world, and the model on display should receive a great deal of attention.

The finest industrial town in the world will probably be realized when Morgan Park, Minnesota, is completed, a model of which is shown in the exhibit. The town is being built to house the employees of the steel plant there. Owing to the severe climatic changes during the year, the winters being long and cold, a great many problems were met with not encountered at Bayview and other points. The neat appearance of the streets and alleys will command favorable attention. Special attention has been given to the housing conditions. Families are placed by themselves and no families keep roomers, provisions being made to accommodate the single workmen. The morals of the young women and girls, which are at a low level in some industrial centres, are thus safeguarded. The houses are equipped with electric lights and water and supplied at low rentals.

The type of bath-houses built by the Corporation is of special interest and a large sized model is shown in the H. C. Frick exhibit. It has a glass roof so that the interior appointments may be easily viewed. It is equipped with shower baths and lavatories of a neat and substantial pattern. An interesting feature is a device by means of which a workman may hoist his wearing apparel out of harm's way while he is performing his ablutions, thus preventing the liability of theft.

Voluntary Accident Relief

This plan which went into effect in 1910 provides compensation for all employees injured or killed in service, and for their families. Relief is paid without legal proceedings and medical treatment is provided by Company surgeons and hospitals. The relief plan covers temporary disability for single and married men, the latter being favored with a higher rate; fixed and stated amounts for permanent disability which are based on the wages of the injured workman and the nature of his injuries; for permanent total disability an amount which will make suitable provision for the injured party,

and in no case less than the death relief; in case of death, the funeral expenses, not exceeding $100, and fixed and stated amounts based on the workman's earnings, the length of his service and the size of his family, with a maximum of $3000. Since this plan went into effect, the Bureau plan of relief is superseded by the provisions of those laws.

Vegetable and Flower Gardens

One of the most successful plans evolved and coming within the scope of the Bureau has been that of encouraging the employees and their families to beautify their homes and yards and incidentally help to reduce the high cost of living. Community gardening was begun at Ambridge, Pennsylvania, on the Monongahela river near Pittsburgh, on vacant land owned by the American Bridge Co. Other points where this plan is being followed are: Cuyahoga Falls, near Cleveland; Elmira, New York; Elwood, Pennsylvania; Morgantown, West Virginia; Johnstown, Pennsylvania; and Lorain, Ohio. In 1910, 270 pieces of unoccupied land were turned over to employees for gardening purposes. One 25-acre plot was divided into 240 plots and many peoples were represented among the gardeners. By this method the employee is given wholesome work to do during his leisure hours that discourages loafing.

The H. C. Frick company offers prizes each year to employees for the best vegetable and flower gardens. The sales made by one supply company showed a remarkable increase in 1913 over 1912 in potted flowering plants, flower seeds, cabbage and tomato plants, onion sets, and vegetable seeds. During 1913 there were 6296 cultivated gardens, being 91% of the total number which could have been planted. During 1914 this percentage was increased to 93. The estimated average value of each garden was placed at $27.50, meaning a saving of $173,140 in the living expenses of the employees of that Company alone. There were awarded by this Company, in 1913, 113 first prizes, 113 second, and 79 third. Many photographs of these gardens are displayed in the exhibit.

Playgrounds

The playground idea has grown into a great enterprise since the first one was built in 1910. It was installed in a badly congested district, closely surrounded by blast-furnaces and railroad car-tracks. Many accidents occurred daily in the vicinity. The playground succeeded in reducing the accidents to almost *nil* and afforded the children of the neighborhod a place to play without fear of danger. In 1913 there were 101 playgrounds, with an average daily attendance of 8688 children. In 1914 the number was increased to 128, and the average daily attendance increased to 16,619, almost double the previous figures. Playgrounds have been installed in 65 Pennsylvania mining towns.

Swimming pools have been constructed in three towns; to these everyone, employees and otherwise, has free access. At McKeesport, Pennsylvania, at the junction of the Monongahela and Youghiogheny rivers, drowning accidents were numerous. Since the building of the large swimming pool and affording of competent instruction, there have been practically no drownings. The moving pictures show some very interesting views of this pool. A model of a playground is exhibited and shows flying rings, swings, seesaws, merry-go-rounds, horizontal bars, slides, and volley ball courts. A large rest tent with cots is set up. There is a miniature theatre, with a glass roof to give a clear view of the interior, which is equipped with a stage and motion-picture outfit. The playground idea for the male grown-ups has taken the form of clubhouses containing dormitories, reading-rooms and libraries, gymnasiums and swimming pools, billiard rooms, bowling alleys, basketball courts, and moving-picture theatres. Concerts are given by the musical societies organized among the employees. Athletic clubs are encouraged. Various educational features, such as study courses and lectures, are provided.

District Nurses

This plan was begun in 1913 and is generally followed by the mining companies and in industrial districts. The nurses are to keep in touch with the employees' families and to give their services wherever necessary. A number of headquarters have been fitted up, at an average expense of $269 each, in West Virginia, Pennsylvania, and Alabama mining districts. One at Duquesne, Pennsylvania, is in an industrial section and has been unusually successful. Sewing and cooking classes, even to instruction in the making of beds and proper ventilation, have been formed among the women and the headquarters have been made practical housekeeping centres. Economical purchasing of household supplies is taught, and every assistance rendered to make ideal housekeepers of the women. The houses selected as headquarters are of the type used by the employees, and the intent is to show a neat, simple, yet inexpensive way of fitting up a home. More than 100 girls are enrolled in the various classes and instructed in the care of babies, first principles of household sanitation, hygiene, cleanliness, household service, and in cooking, darning, washing, and cleaning. The nurses also look after cases of sickness coming to their notice. Their services are a most valuable feature of the welfare work of the Bureau, and this feature is being extended as fast as possible to other sections.

The general exhibit of the Corporation is in charge of A. T. DeForrest, of San Francisco, as general chairman, and H. V. Jamison, of Pittsburgh, as director-in-chief. The installation of the H. C. Frick and allied coal exhibits was made by Thomas W. Dawson, of Scottdale, Pennsylvania, assistant chief engineer of the Frick company.

Coal produced and handled direct by the Pittsburgh Coal Co.'s subsidiary companies in 1914 amounted to 18,295,851 tons, a decrease of 6,411,353 tons.

Opportunity for Workmen at Anaconda

*The officers of the Anaconda Copper Mining Co. knew that the men at Anaconda wanted an opportunity to have little farms, because every available patch of land close to the city was utilized, and men with horses were getting little places, some as far as nine and ten miles from the smelter, and driving in and out to their work. The Company also knew that about six miles from town was several thousand acres of land, some of it so swampy that it afforded merely a nesting place for wild ducks and a home for muskrats. The remainder was so wet that it supported only an indifferent type of agriculture. Here was an opportunity to create, and it appealed strongly to the imagination of the officers of the Company. Constructive effort has converted this swamp into a garden spot. To the worker it spelled opportunity, and Opportunity is the name of the suburb that has been built there.

BUTTE, MONTANA.

First, the land had to be drained, and the most approved trenching machinery was secured. Water was encountered in such quantities that the first three weeks' work found 350 ft. of ditch dug, and the tile which had been laid was full of sand. Finally a machine was constructed which surmounted the difficulty.

Next came the tillage. The first attempt to plow the land was made with horses, but was unsuccessful. Powerful traction engines were then secured, but the most approved would not do the work. A machine for the purpose was therefore designed. Essentially it is the counterpart of a threshing machine cylinder, only the cylinder weighs 1600 lb. and is armed with steel knives which, rotating rapidly, cut and tear up the tough sedge, wire grass, and peat sod. This is followed by burning, and the land is then plowed in the ordinary way.

For the development of this community a block of several thousand acres of land was prepared. The general plan contemplated a community centre embracing a 65-acre park, with a modern school and school gardens in the middle; the division of the unit into ten-acre tracts, all of which have been thoroughly tile-drained and supplied with an equally efficient irrigation system. Transportation facilities have been provided between the town of Opportunity and the smelter, and the car line is so situated that 300 tracts are available, none farther than 1¼ miles from the line. Every tract has a frontage on a 60-ft. street, and each tract is 1000 ft. long and 435.6 ft. wide. The principal roads are being macadamized, and a nursery has been started to provide trees for planting on all the streets.

Of a ten-acre tract, three or four acres are devoted to oats and barley, a similar area to hay with a pasture lot of an acre, and an acre for house, garden, and small orchard. Thus nothing need be bought to feed a horse, cow, some pigs, and chickens. In this way ten acres is completely utilized, while a larger area would assume rather the character of a farm than that of a suburban home for people having outside employment.

Three mountain trout streams cross this garden spot. They are part of the park system and will remain undisturbed for the enjoyment and benefit of all alike. The land when purchased is ready for a crop. To the purchaser who pays for his land outright, means are offered for a loan to cover the cost of improvements. In addition to this, the Company is furnishing, from its large lumbering mills in western Montana, lumber and millwork at cost to the home builder. Monthly payments covering a reasonable period have been arranged for, so that the purchase of the property amounts to little more than rent. Such a plan encourages thrift in the community. To protect the family of a workman who may die before completing his payments, the Company has provided what is essentially an insurance clause, so that a clear title to the tract passes at once to the widow without further payment. Naturally this privilege can not be transferred by sale.

The Company has established a livestock and grain farm adjacent to Opportunity. On this farm provision has been made to supply at reasonable prices tested seed of both grains and grasses of the varieties best adapted to the locality. It is not expected that dairy farmers will be made of all the occupants of these tracts, but it is hoped that ultimately every individual will own a pure-bred Holstein cow, so that when a heifer calf is raised a return of from $150 to $250 can be secured as against a return of $35 to $40 for a grade animal. The new owners are of many nationalities—Servian, Austrian, German, English, French, Irish, and Scotch. Their agricultural experiences are varied; some have had none. The land was placed on the market in June of last year, and already two-thirds of that offered has been purchased.

*Revised from an article by Richard Wardling in *Leslie's Weekly*.

CORUNDUM ORE (uncleaned) amounting to from 100 to 200 tons per year has been produced in the state of Mysore, India.

Platinum Analysis

By F. MYLIUS and A. MAZZUCCHELLI

*A pure platinum solution was prepared by recrystallization as Na_2PtCl_6 from a weak Na_2CO_3 solution; finally by dehydrating at 120°, dissolving in absolute ethyl alcohol, filtering off the NaCl, and precipitating with about 15% H_2O; the metal is then obtained either by reduction with H or with N_2H_4 in HCl solution. The qualitative reactions with 14 different reagents of solutions of Pd, Rh, Pt, Ir, Ru, and Os as chlorides, each containing 1 gm. per l., were determined, and the results are given in tabular form; one of the most characteristic properties of such solutions is the color; Pt being pale yellow, Pd pale brownish yellow, Rh rose red, Os golden yellow, Ru brown, Ir brown; the intensities of the colors increase from Pt to Ir. Rh can be determined colorimetrically in strong HCl solutions when fairly pure; the Ir content of Pt can be determined fairly well in the same manner, due to the great intensity of its color; dissolve 0.01 gm. in aqua regia, evaporate with HCl, dilute with concentrated HCl to 100 c.c., compare with standard Pt and Ir solutions. The properties of several platinum metals were studied from the analytical point of view; a characteristic of the group is the tendency of one metal to interfere with the reactions of another when present. The characteristic violet coloration of Ru salts with KCNS is affected by other platinum metals; Ru is carried down when Pd is precipitated with $Hg(CN)_2$, though by itself Ru is not precipitated by this reagent; Ru also hinders the reduction of Pt salts by N_2H_4. The best separation from Pt is by precipitation as IrO_2 from $IrCl_4$ solutions by NaOH, but this precipitation requires the presence of an oxidizing agent to prevent reduction to $IrCl_3$, which is not precipitated; NaClO or NaBrO is recommended. For the best results the solution should be but slightly alkaline; under these conditions most of the other metals are precipitated with but little contamination by Pt. Pt in Ir can be detected by the reaction with KI, the dark-brown Ir solution being colored yellow, while the yellow Pt solution is colored brown; by comparing with standard solutions 1 part of Pt in 100 Ir can be determined by this reaction. The characteristic reaction of Pd with $Hg(CN)_2$ is not sufficiently sensitive in the presence of other Pt metals, making it advisable to separate the others with NH_4Cl, leaving the Pd in solution as $PdCl_2$; dimethylglyoxime also is less applicable in the presence of other Pt metals. Pd reacts much more quickly than the other Pt metals, *e.g.*, its alloys are violently acted on by aqua regia, and it is instantly precipitated by H_2S; the latter fact can be utilized in its separation. EtSH in 1% H_2O solution gives a yellow coloration with Pd solutions containing 1 part in a million, and on warming a dark yellow flocculent precipitant separates; the reaction can be used to separate Pd and Ir, as the latter is but slowly precipitated. Ru has no reactions which permit its precipitation from the other Pt metals; it is best concentrated in the filtrate by rapid precipitation with H_2S, and subsequent precipitation with H_2S on boiling, reduction to metal, and separation from Ir by fusion with $KHSO_4$. Ru, like Pd, is precipitated cold by H_2S, but the precipitation is not complete, due to reduction; the formation of a blue coloration is characteristic; from Pt alone Ru can be separated by the NaClO method given above, but in the presence of Ir, Ru and Ir oxides carry down some Pt. The following scheme is given for the qualitative detection of Pd, Pt, Ir, Rh, Ru, Au, Ag, Cu, Fe, when 1 mg. of each is present in a chloride solution:

Evap. to dryness, take up with 2 c.c. H_2O, filter.

Sat. filtrate with NH_4Cl; after 1 hr. filter and wash with a little NH_4Cl soln.	Ppt. AgCl; dissolve in NH_4OH, add insol. residue to ppt. I, reppt. AgCl with HNO_3.
Evap. filtrate to dryness with 3 c.c. dil. HNO_3, take up with a little HNO_3 to form a soln. satd. with NH_4Cl, filter, wash with a very little dil. HNO_3-NH_4Cl mixt.	Ppt. I. Double chlorides of Pt, Ir, Ru. Add insol. residues from other sepns. Ignite to white heat in a current of H, ext. with dil. aqua regia, filter, detect Pt by evapn. with NH_4Cl. Ignite insol. residue in Au or Ag dish with 0.3 gm. $NaNO_3$. Ru dissolves to a yellow colored soln. Ir remains as a blue insol. residue.
Evap. filtrate to dryness with HCl, dissolve in 5 c.c. H_2O acidified with a few drops of HCl, sat. quickly at 18° with H_2S; after 10 min. filter, wash with H_2O.	Ppt. Pd, Ir, Ru as double chlorides. Evap. with HCl, take up with 3 c.c. H_2O, sat. cold with H_2S, filter, dissolve sulphide ppt. in aqua regia, test soln. for Pd with $Hg(CN)_2$. Add insol. residues to ppt. I.
Sat. the hot filtrate with H_2S for 30 min., filter, wash with H_2O.	Ppt. AuS and CuS. Dissolve in dil. aqua regia, evap., dissolve in dil. HCl, ext. with Et_2O, test Et_2O layer for Au with SO_2. Ppt. CuS from aq. layer, wash, ignite, ext. with dil. HNO_3, test for Cu with NH_4OH. Add any insol. residue to ppt. I.
Boil filtrate to remove H_2S, oxidize with HNO_3, precipitate $Fe(OH)_3$ with NH_4OH. Confirm with $K_4Fe(CN)_6$. Filtrate should be all NH_4 salts, wholly volatile on ignition.	Ppt. RhS_2. Dissolve in hot dil. aqua regia, evap. to dryness, take up by warming with conc. HCl. Red soln. indicates Rh; confirm by pptn. with EtSH. Traces of Ir may be in filtrate.

The primary separations are carried out first, then the confirmatory separations made in the reverse order, separating the Pt, Ir, Ru last. Details of some of the processes are given below, in the quantitative analysis.

*Abstracted from *Zeitschrift fur Anorganische Chemie*, January 1914, by George W. Morey in *Chemical Abstracts*.

In quantitative analysis two cases are to be distinguished: *A*, the Pt is so impure that the impurities can be separated directly; *B*, the Pt is so pure that the other metals must be concentrated; the two cases are distinguished by dissolving 0.1 gm. in aqua regia, evaporating to dryness with 0.1 gm. NaCl; take up residue with a little H_2O, add a little (0.02 gm.) Na_2CO_3 and heat to 100°, so that the solution remains slightly alkaline, cool, add 1 to 2 drops NaClO or NaBrO solution, warm; a dark coloration, changing to a bluish black precipitate, indicates case *A*, while in case *B* the solution remains orange yellow. For the analysis, in case *A* take about 10 gm., if an accuracy of about 10% is sufficient in the case of impurities present only in amount of 0.1 to 0.2%, though for more accurate determinations more must be taken; in case *B* take 100 gm. In case *A*, heat 10 gm. at 40° with 10 gm. concentrated HNO_3 and 100 gm. HCl (d. 1.14) in a long-necked quartz flask until violent action ceases, add 20 gm. more HNO_3 and heat the solution; evaporate to dryness in porcelain on the water bath after addition of 6 gm. NaCl, add H_2O and repeat the evaporation until all acid is removed, then heat the impure Na_2PtCl_6 to 120° for 1 hr. Treat the residue with 100 c.c. cold H_2O, filter off the insoluble residue and wash with H_2O; it consists of Au, silicates, Fe salts, AgCl, etc.; convert the metallic salts to chlorides and add to the main solution. Dilute the main solution to 500 c.c., transfer to a Pt dish, add 0.8 gm. $NaHCO_3$, heat to boiling, and cool. Litmus must show a slight alkaline reaction. Without regarding a slight precipitate, add a solution of 0.8 gm. $NaHCO_3$ in 20 c.c. saturated Br water, heat on the water bath until a black flocculent precipitate settles out from the dark-colored solution; the solution now should be but slightly alkaline, since the nearer to neutrality the better the separation. If the above treatment fails to flocculate the precipitate, cool the solution, add a little more NaBrO, after 10 minutes a few c.c. EtOH, and heat the solution to boiling. Filter off the precipitate, test the solution for completeness of precipitation with NaBrO and EtOH as above, and add precipitate to the main one; evaporate the filtrate to dryness with some HCl to destroy the NaBrO; the Na_2PtCl_6 so obtained is to be purified as given in case *B*, though for approximate analyses it is pure enough except for the presence of NaCl. The impurities are determined by a scheme in some respects similar to the above qualitative scheme. Wash the bluish black oxide mixture from the filter (a blue-colored filter can be completely extracted with HCl containing a little N_2H_4, which should be destroyed by evaporation with HNO_3), and evaporate repeatedly with concentrated HCl, with addition near the last of a little HNO_3, until the blue color of the solution has changed to a yellow, dissolve the residue (containing generally less than 0.4 gm. metal) in 6 to 8 c.c. H_2O, add 1 gm. NH_4Cl, filter the precipitated Ir, Pt, and Pd, and wash with very little half-saturated NH_4Cl solution; evaporate the filtrate to dryness with 1 c.c. diluted HNO_3 and treat the residue with the small amount HNO_3 required to dissolve the soluble material, collect the remaining double chlorides on a filter, and wash with a half-saturated NH_4Cl solution until the filtrate is colorless; unite the two precipitates and treat as given below. Evaporate the solution to dryness with HCl to remove HNO_3, dissolve the residue in H_2O, add 2 to 3 drops HCl, and pass in H_2S rapidly for a few seconds until the solution has a strong H_2S odor, filter the CuS and wash with H_2O, ignite in the air, dissolve in dilute HNO_3; the insoluble residue consists of Au and Rh; Au is dissolved by dilute aqua regia, leaving a residue of Rh; small amounts of Cu are best determined colorimetrically. If Rh is present the filtrate will be red; after removing H_2S, Rh can be determined colorimetrically; in large amounts it is isolated by crystallization of $(NH_4)_2RhCl_6$, which is difficultly soluble in saturated NH_4Cl solution; to remove small amounts it is necessary to saturate the hot solution with H_2S, filter, ignite, and weigh as crude Rh, since on fusion with $KHSO_4$ it is not wholly soluble; the complete separation of Rh and Ir is not possible. In the filtrate Fe is precipitated as $Fe(OH)_3$ in the usual manner; the Fe_2O_3 may contain Ir, so the Fe is determined colorimetrically and the residue called Ir, or in more exact work the $Fe(OH)_3$ is dissolved in dilute HCl, $FeCl_3$ extracted with Et_2O. The filtrate from the Fe should be tested for Co and Ni by acidifying and adding $K_4Fe(CN)_6$; if they are present the strongly concentrated filtrate should be made slightly ammoniacal, saturated hot with H_2S, then slightly acidified with HCl; the ignited sulphides are treated with aqua regia to obtain the small amount of Ir they contain. The filtrate should now consist wholly of NH_4 salts, with the exception of a small amount of Na_2SO_4; in case the residue after ignition is not wholly soluble in H_2O it indicates contamination from the containers used, or a little Ir. The double chlorides of Ir, Pt, and Pd obtained above, to which had been added the various Ir residues, are reduced by ignition to a white heat in a current of H, the metallic mass extracted on the water bath, with 1 part aqua regia and 2 parts H_2O, until the residue has fallen to a powder and new portions of the solvent are no longer colored, when the Ir is filtered off. The filtrate is evaporated and a concentrated HCl solution free from HNO_3 prepared from which the Pt, contaminated by a small amount of Ir, is precipitated by NH_4Cl; from the color of the precipitate is determined whether or not the amount of Ir present makes necessary the repetition of the reduction and solution process. Evaporate the filtrate from the Pt, precipitate with H_2S in the cold, and ignite in H to obtain Pd; it can be purified by solution in HNO_3 and precipitated with $Hg(CN)_2$. The total Ir is strongly ignited in H, when it becomes insoluble in aqua regia; the Ru which it probably contains is extracted by heating to a dark red with KNO_3 and KOH in a Au crucible, treating the melt with H_2O, and letting stand until the IrO_2 settles; if the supernatant liquid is blue no Ru is present, while if it is greenish Ru is present. To determine the

amount of Ru, the whole must be dissolved, the treatment with $NaBrO$ repeated, and the Ru volatilized in a Cl stream. In case *B*, the sample is dissolved as above, NaCl added, and the Na_2PtCl_6 permitted by recrystallization from 1% Na_2CO_3 solution, the impurities after removal of 95 to 99% of the Pt are in part concentrated in the mother liquor, in part collected in the filters used for clarifying the 1% Na_2CO_3 solutions (see M. and Foster, *Ber.* 25*a*, 665, 1892). The impurities are collected, dissolved in aqua regia, heated to 150°, and treated as in case *A*.

Robert H. Richards—An Appreciation

By DAVID H. BROWNE

*In the stories of olden time we read of many men whom for one reason or another the King delighted to honor. Grave or gay, statesman or buffoon, lawgiver or licentious companion, each commended himself to royal favor and received his reward. Such honor or preference of one man for another is easy to understand, for their mutual attraction might lie in any taste or inclination common to both. It might be based upon public service or upon private interest, and we find in such recognition no criterion of value or standard of merit. Here and in other countries where democratic ideas prevail, where the King is the people, and merit is recognized by all; here when we meet together to honor one man above his fellows, we try to analyze the grounds of our high appreciation and make plain to ourselves the reason why we do him honor.

We who meet here this evening have given our lives to the science of valuation. As engineers in mining and metallurgy our training and experience and habits of mind have bred in us an instinct of appreciation, for appreciation means simply the just judgment of values. When we examine a mine or a process, we take into account those conditions which give it a value, and we balance one against the other the money value to be paid against the future value to be won. So we must be appreciative of worth in whatever way we find it. We form an instinctive judgment of ethical values which is perhaps of more use to us than a logical process, and as we grow older we are more and more inclined to trust to our instinctive appreciation of what is good, than to our intellectual balance sheets. As we have met here with a common purpose to express our high appreciation of one of our number, we must, as scientific men, ask ourselves what are our reasons for this and what scale we apply to our determination of values.

What is it that brings men together and what are the qualifications we seek in a leader? What makes us distinguish between man and man and point to one as preeminent? It is remarkable that we are drawn together by the possession of certain qualities common to us all and repelled by certain other qualities equally common. "All men are liars," said the Psalmist in his haste, but a liar is in no way attracted to another liar. A company of mean minded men would not be difficult to assemble, and yet their meanness would not insure harmony. There is no continuity in a mob, all unanimous in one evil passion. The deed once done all unity falls into discord, into mutual hatred and recrimination. You cannot bind men together by their vices.

There is in all men a certain agreement, a sense of what is best in nature and in his fellow men. The musician would not make a universal appeal if harmony were not harmony to all. Instinctively the ear recognizes certain sounds as pleasing and others as disagreeable. Instinctively the eye receives certain combinations of color or form as beautiful and rejects others as ugly. So instinctively we feel certain qualities in man to be right and uplifting while others we recognize as wrong and degrading. The perception of good is axiomatic. It cannot be explained. You can explain to a man all about the light waves—you can give him a very accurate idea of their pitch and amplitude and frequency. So that he may know as much about these as we do, but if he is blind you can never give him the perception of light. So you can explain what is good and analyze all that enters into its scope and relations, but the immediate perception thereof is from within. If you have no children of your own you can never fully understand what the word Father means. No explanation of duties and obligations can give you this perception, and yet it is as simple and satisfying as the perception of light.

It is this recognition of the best in ourselves and our fellow men that draws us together. This feeling lends to the formation of fraternities and societies and parties and makes these independent of their founders. The mob endures for a day or an hour and tomorrow the sheriff cannot find it, for it is based on evil. The society endures for generations, for it is based on a universal perception of what is good.

And yet with this appreciation of what is good is bound up the idea that each member of that organization has entire liberty of belief as to the best means to attain that desired end. The mere fact that we disagree with our leader does not in any way weaken our loyalty to him. Very often what attracts us about a man is that we disagree with him. You and I may argue from the same set of facts and reach entirely different conclusions. We have started in the same place, used the same tools, tunneled through the hill in different directions and come out on opposite aspects, and yet I am much more interested in you than I am in a man who believes as I do, but who cannot set forth the reasons for his belief. You have used your faculties as I have, our habits of mind and our methods of procedure are alike. That he and I agree is a mere accident of position, that you and I differ is a result of action, and in life what counts is action and not position. Life is not static, it is dynamic, and the doing means more to us

*A speech delivered before the Mining and Metallurgical Society of America on the occasion of the presentation of the Society's gold medal to Professor Richards.

than what is done. So in leadership of any kind, in pre-eminence in art or science, or any human activity, the leader is one who possesses a habit of mind common to himself and his followers, who reflects in his life and character those qualities which each feels to be the best in himself and who expresses his life in action.

There is another qualification we must not omit, that of humanity. A generation ago our mental attitude was much more tolerant of restraint than it is today. We confined ourselves more readily within the boundaries of formula and dogma than we do now. We subscribed more easily to the tenets of the majority and sunk our individuality in our party or church or creed. Today we are given more to individualism. We can no longer write ourselves down as Democrat or Republican, as Baptist or Presbyterian, as materialist or idealist. Today we realize that all good cannot be expressed in a single formula, and when our knowledge increases, the old forms in which we expressed our beliefs must be broken and be replaced by larger conceptions of truth.

Many of you here have felt that disturbance of mind which comes from seeing some time honored belief pushed aside by a new discovery. No dogma is sacred from investigation. In science itself where we have felt most secure in our belief, where the ground seemed safe beneath our feet, we remember the shock which was given us by the discovery of radium. Even in such a comparatively limited field as the concentration of ores, our conceptions were entirely revolutionized by the process of flotation. These are small matters compared with the revolution that has taken place in our conceptions of life and our relations to the universe.

In all times of mental stress we turn instinctively to certain men for guidance. We see such men holding fast to all that is best in the past and at the same time reaching forward to all that is best in the future. They are not bound by any limited conceptions. They realize that the birth of a new idea does not mean that the old was false, but simply that it was incomplete and imperfect. Such men act as intermediaries, absorbing the best of each generation and passing on the light. The candle our grandfathers passed to our fathers was exchanged for the lamp they passed to us and we pass the electric filament to our children. The medium changes, but the light is always increasing. In all our mental struggles, each one of us has found some man who taught him to see clearly, who handed him the light.

Why is it that the memory of Joseph LeConte is so revered on the Pacific coast today? Do we not realize how he helped us in that period when all our old beliefs and faiths were overset and we knew not where to turn? It was not so much what he did and said as the kind of man he was that helped us. So in Michigan we revere Angell, not for what he taught us so much as for the impression he made on us, and that impression will endure throughout our lives.

When we come here to honor one of our members we are agreed that in him we recognize those faculties that are best in ourselves, those habits of mind that lead us to use our faculties for the general good and that faith in human nature and the future progress of the race which makes us feel that our lives are worth living and our duty worthy of the doing.

We are each interested in the questioning of nature by direct experiment. We know that she does not reveal her secrets and unlock her treasures unless we have the pass key of patient research. We recognize in our friend that tireless energy in the search after facts, that ingrained habit of investigation which characterizes each seeker after truth. Little by little and one by one we gather the materials of our knowledge. But facts alone are fragments forming no concrete whole. We must group them in order, classify and arrange them so that they fall into sequence and form the basis of argument, and the man whom we honor has that happy faculty of arrangement and that sense of order which makes experiment, science and not empiricism. He has shown us how the sequence of fact leads to the discovery of law, and what we call a law is simply our expression of the reasonableness of nature.

But we are all practical men, interested not only in laws of nature, but in their practical application. As soon as we discover how nature does things we wish to apply that knowledge for our material advancement. I need not remind you that our friend has profoundly influenced our mining and our milling practice. This is evident to all. We realize that it is one of his great claims to our high appreciation. While I assent to this as we all assent, I do not think this is his greatest claim.

Man's progress is not altogether material. Those of you whose specialty is organization will understand that men are not machines, each to be speeded up to their individual limit. You know that in planning any mine or mill or smelter, we have to consider each part in relation to the whole—each with a liberal factor of safety, each to be balanced against the other in unity of action. In any organization, what counts is the recognition of the human factor, remembering man's weakness as well as his strength. Success in all things depends upon sympathetic knowledge of human nature.

So if you ask me to define wherein lies that pre-eminence which we meet tonight to honor, I give you my opinion. Untiring zeal in experimentally questioning the facts of nature, ability to marshall those facts in an orderly and logical sequence, imagination and idealism which looks behind the facts and discovers the laws of nature, practical insight into the requirements of industry and application to the industry of those laws in such a way as to further our material progress, and lastly an elemental simplicity and kindness in his relation to his fellow men.

The greatest thing in life is personality. The greatest men are those whose fingers find the chords of life and at whose touch we thrill in sympathy. It is that personal appeal that some men make to our better selves that makes them leaders, and so I place above all other attainments the personality of the man we honor tonight, Robert H. Richards, our mentor and our friend.

DISCUSSION

Readers of the MINING PRESS *are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.*

The Design of Belt Elevators

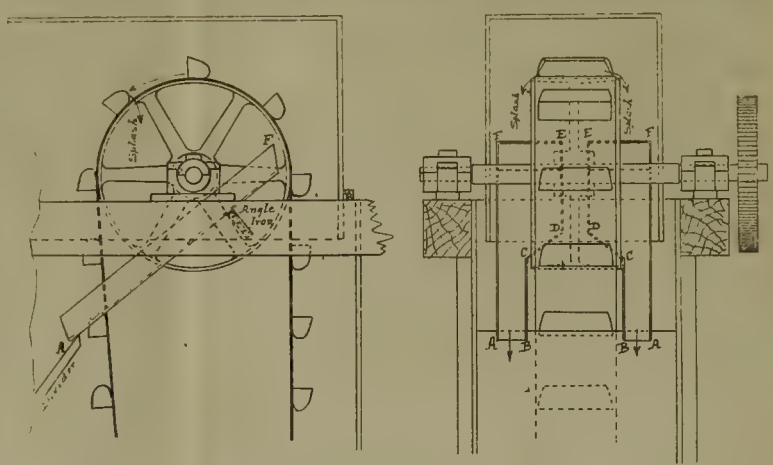
The Editor:

Sir—I have been much interested in the discussion of belt elevators in your issues of October 31 and November 28, by Messrs. Caetani and Lewis. In the mill for which I am responsible there are half a dozen elevators ranging from 8 to 22 in., handling wet and dry material of different sizes. In the course of years the usual troubles have been experienced, and the following is a description of the remedies that have been applied to improve the efficiency of the elevators and to reduce repairs.

Head pulley.—With moderate size elevators of 14-in. belt or less, I never had any trouble with the head pulley getting loose on its shaft, although ordinary solid hub pulleys with one key are used. However, this difficulty was repeatedly experienced with a 22-in. elevator, lifting about ½ ton of pulp per minute to a height of 45 ft. The manufacturers had provided an ordinary 52 by 23-in. pulley, fitted with only one small key on a 4 1/16-in. shaft. After many unsuccessful trials to make the pulley stick to the shaft, the trouble was finally remedied by taking another shaft of 5⅝ in. and fixing the pulley on this shaft with two keys of ¾-in. height by 1½-in. width, only slightly tapered. The keys are so long that they come out at the other side of the hub and are secured by two set-screws with locknuts. This arrangement has proved entirely sufficient. On large size elevators it is better not to use collars fixed by set-screws on the upper shaft, because they often become loose on account of the constant jarring; it is preferable to have shoulders turned on both ends of the shaft.

Contrary to Mr. Lewis' opinion, I have found it a great benefit to line the head pulley with belting. If the rubber covering of the belt at the back is somewhat worn, the heads of the bolts that hold the buckets stick out on the surface of the belt, and this causes constant slipping of the belt on the bare surface of the head pulley. I believe that either balata or old rubber belting that has lost its cover should be used, because it offers more friction than a smooth rubber surface. It seems an advantage to have the pulley heavily crowned as Mr. Caetani suggests, and I wonder why manufacturers do not make them that way. The shaft may be ever so carefully leveled when the elevator is started, but the bearings do not wear equally, and it may get out of level at any time, causing belt and buckets to run to one side and possibly damage the housing. It is certainly easier and safer to use crowned pulleys than to check the level of one's elevator shaft every few days.

In order to prevent unnecessary spilling, the head pulley should be of small diameter. If the buckets run fairly full and are forced to pass over a large head pulley, the tilting is done so gradually that much pulp is emptied over the sides of the pulley instead of in the receiver. The ideal, though practically impossible, is an abrupt tilting of the buckets. But, although a small head pulley gives higher efficiency, it does not offer enough friction to the belt, and when constructing an elevator one must compromise so as to obtain a serviceable appliance. It is strange that manufacturers of mining machinery often build elevators that are destined to be failures. For instance, I remember a 20-in. elevator, built by a well known firm in the United States, that was supposed to lift pulp to 30-ft. height and had been constructed with a 30-in. head pulley and 2 1/16-in. shaft. It had a special sheet-iron boot which was so narrow that there was barely two inches of play between the rim of the pulley and the sides of the boot. The whole affair had more the appearance of a toy than of an elevator, and it had to be entirely rebuilt before it could be used.



DESIGN OF ELEVATOR.

Gears.—Mr. Caetani prefers direct drive to gears. In this I cannot agree with him, because direct drive means

a slowly running driving belt, and such belts are a nuisance in a mill. If slow-running belts are to give reliable service they must be of considerable width, even if the power they have to transmit is small. Further, the wear on slow-running belts is much heavier than on fast running ones, and therefore more is spent on new belting than is saved by not using a gear. But, even if gear is used, there is always a belt required to drive the countershaft from a motor or line shaft, so there is no rigid connection as Mr. Caetani observes. All the trouble that has been caused here by gears on elevators during several years was confined to one broken pinion which was replaced at a cost of $12. The noise made by gears is trifling, and it certainly cannot be heard at all in a mill where 30 stamps are dropping.

Feeding.—A trial has been made here applying both methods of feeding to the same elevator, namely delivering by a spout in front of the bucket-line, or feeding from the side or back into the boot. The latter way proved to wear out the rims of the buckets twice as fast, on account of the scraping of the buckets over the sand in the bottom of the boot. The pulp did not contain any coarse particles, all the sand being finer than 1 mm. The feed spout should be so placed that there are always two buckets in vertical position beneath it to receive the pulp stream. This insures minimum splash and thereby reduces the scraping up of sand by the buckets from the bottom, which has proved so detrimental.

Buckets.—For elevating pulp I prefer malleable-iron buckets with extra heavy rim. The life of the steel plate bucket is much shorter, and it frequently starts leaking at the joints after having been used for a short time only. It is, of course, quite possible that for other conditions the steel bucket is cheaper, but where every ton of machinery is subjected to a freight charge of about $80, those buckets that have the longer life are the cheapest, even if the initial cost is considerably higher. I never found that on account of the increased weight of the buckets the elevator needed more power, or that the belt wore faster. Where the rim of the bucket touches the belt it should be rounded so as not to cut the belt or pad when tilting. I prefer a solid rubber strip behind the buckets to the washers mentioned by Mr. Caetani; it happens that the washers tear and are lost and then the bucket will become loose. Old vanner belting is a good material to put behind the buckets. On elevators that handle wet material I have all the buckets shifted to another place on the belt every four months or so, and all the necessary holes for the places which the buckets will afterwards occupy are punched before the belt is put on, thereby reducing the time of changing buckets to a minimum.

Belts.—After having tried several different kinds, I use at present only 6 or 8-ply rubber belting with a heavy rubber coating on the side that runs on the pulleys. The other side does not need an extra rubber protection, because when the strips I referred to before are used between belt and buckets, there is very little wear on that side of the belt. It is very important not to damage the rubber covering on the back, because sand will get in through cuts and cracks and become lodged between the canvas and the rubber, forming elevations which have the appearance of blisters, and once these are formed the rubber comes off very easily. Ordinary elevator bolts generally have rather small heads, and are therefore, when being tightened, drawn into the rubber covering of the belt and tear it. To prevent this, I have used a 2 by 2-in. square washer of $\frac{1}{16}$-in. sheet iron between the head of the bolt and the belt, so far with good results. Rubber washers did not prove a success for this purpose; they wear and fall off, and then the bolt gets loose. I have also tried bolts with special washers, as are used with Jackson's belt lacing, but they are expensive and not better than the ordinary bolts with home-made washers.

Lower bearings.—There is no reason why the pulp should overflow the bottom bearings when the elevator is stopped, as Mr. Caetani says; if the elevator sump is provided with an overflow at a lower level than the bearings the pulp may be run into a special tank, or into the draining launder of the mill floor. However, when the elevator boot is placed at a low level in the mill, this may be difficult, and then it is advisable to use closed bearings as described by Mr. Lewis. Even in this case, a stoppage of the elevator need not cause the bearings to be flooded, if the boot is built in a tank which does not fill in the time that is needed to stop the feed. I use closed bearings with stuffing-boxes on an elevator which unfortunately has its bearings frequently flooded, and it proved entirely sufficient to keep the grit out. Bearings of this type, if kept well packed and greased never allow any sand to get inside; I have used them on drag classifiers where they work all the time in thick sandy pulp, and they never caused any trouble. It is better to use grease for lubricating than oil, because the pressure from the grease cup helps in preventing dirt from entering the bearing at the gland.

In every instance the bearings should be provided with a take-up device which allows the belt to stretch at least 18 in. before it needs to be shortened.

Foot pulley.—It is a common mistake of elevator manufacturers to fix the lower pulley on its shaft with set-screws only; on account of the lower shaft being out of sight, one does not notice it when the set-screws get loose and the pulley starts to revolve on its shaft. It is only found out when the harm has been done, and then there is no other remedy but to put a bushing into the hub of the pulley and to get a new shaft. It is not safe to rely upon the set-screws, the trembling of the elevator will loosen them, and a key should always be used.

Perpendicular or inclined elevators.—For handling wet material I could never find any advantage with inclined elevators. They are supposed to discharge better, but the same effect is obtained by using a small boot pulley. An inconvenience is that they need idler rollers to support the ascending belt, which means extra cost of maintenance. For dry material the inclined construction is much better, because it is much cleaner, not spill-

ing material at the feed spout. For this work I prefer square buckets of thin sheet steel, placed so close together that the feed never falls directly against the belt.

Casing.—A well constructed casing is more essential for successful operation than generally is supposed. Common errors are to make the case too narrow, to have the boards placed horizontally, or to have them placed outside the frame. The boxing must be so wide that the splash hits it as little as possible, and the belt never scrapes against it even when not running in the center of the pulleys. When the planks are placed vertically the wear to which they are subjected by the splash of the pulp is very little, and if the framework is protected by the planks it does not wear at all. The boot must be always slightly longer and wider than the housing, so as to collect any drippings that run down along the casing, and the hood must be narrower and shorter for the same reason, and also to prevent pulp falling on the supporting beams of the upper bearings and getting into those. Most splash of pulp is where the belt descends, and it is advisable to lag that side of the casing with discarded belting. To protect the lower bearings from splash, conical shields of sheet iron can be fixed on the ends of the bottom shaft, which also prevents any splattering of pulp through the slots in the boot through which the shaft passes. The distance of the upper bearings should not be less than from 2½ to 3 times the width of the belt, and if the above described design of casing and boot is followed, the bottom bearings are still a little farther apart. It is obvious that this construction requires heavier shafting than when the bearings are close together, that the elevator occupies more room in the mill, that more lumber is needed for its construction, and that consequently the cost must be higher than when following the usual narrow design. On the other hand, the advantages that no pulp drips through the housing on the mill floor, that the bearings are kept free from grit, and that the woodwork scarcely needs any repairs, more than offset the higher cost of installation.

Boot.—A square wooden tank of 2-in boards makes a practical boot for pulp elevators. The corners will of course fill with sand, but if it is fine enough, it does not pack so tightly as not to give way somewhat if a bucket or something else falls into the boot, whereas with a round iron boot that closely follows the outline of the buckets generally some harm is done. It should be so deep that from 8 to 10 in. of clearance is left between the bottom and the bucket in its lowest position, supposing the take-up bearing to be entirely screwed down.

Receiver.—For an elevator working under normal conditions the receiver as described by Mr. Caetani is quite sufficient, but if it is heavily loaded a slight modification is necessary. The buckets then run nearly full and more pulp is spilled over the sides of the head pulley during tilting. Further, where much work is required of an elevator the buckets may be spaced closer on the belt than usual, but this again causes spilling on account of the buckets emptying part of their contents against the bottom of the preceding ones. To catch all the spillage and direct it into the receiver, special trays should be built on both sides of the pulley, made either of boards or sheet iron and held in place by angle irons fixed to the supporting beams of the upper bearings. Their lower end rests on the dividing board of the receiver. In the accompanying sketch their outline is indicated by the letters ABCDEF. The width of these trays depends upon the size of the elevator and the amount of splash, and they must be provided with rims on all sides to prevent the pulp from running or spattering over. The pulp they collect is discharged at AB into the receiver. It is, of course, better to have an elevator of ample capacity, but, through changes in the mill, the amount of pulp that an elevator has to handle may be increased, and then the expedient to place more buckets on the belt and arrange the receiver as described will greatly add to the capacity.

M. G. F. SÖHNLEIN.

Ingenio de Machacamarca, Bolivia, January 11.

Banding of Ore Deposits

The Editor:

Sir—Referring to the editorial in the issue of January 9, 'Banding of Ore Deposits,' I note that you do not seem to recognize the theory of mining geologists in the field upon that subject, to-wit: That after a fissure was first made, and filled with one, or, two, or more bands, it, for a long time thereafter, constituted a plane of weakness in the earth's crust such that subsequent dynamic action in that region was very likely at any time to reopen the fissure, when it would be filled with more 'bands' of a different period and different composition; and this process could naturally occur an indefinite number of times, causing an indefinite number of bands produced at different periods, and naturally of different composition. Conversely, at any time before the fissure was completely filled with vein matter, the opening may have been forcibly closed ('slammed shut') by like subterranean forces, and deposition stopped for a period, until it was reopened again. If this theory of successive reopening of the fissure and deposition at different periods is admitted, it accounts for all the essential phenomena of 'banding of ore deposits.'

CHESTER T. KENNAN.

Colorado Springs, Colorado, January 21.

[Our correspondent seems to be confusing two sets of phenomena. Reopening of a fissure is not uncommon, and the resulting vein structure is easily recognized. But in such veins as those referred to in the editorial there is no evidence of any dynamic action, which is one of the reasons why they are so puzzling. It is quite possible that when sufficient evidence has been accumulated they will be found to be quite easily explicable.—EDITOR.]

LABOR EMPLOYED on the Panama Canal zone on January 20 totaled 20,926 persons.

CONCENTRATES

Readers of the MINING PRESS *are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.*

MOSQUITOES AND MALARIA in the Philippine Islands are to be investigated by the Bureau of Science at Manila.

CARAT is a term to denote quality of gold and not weight. It is only used as a weight in connection with precious stones, 1 carat being equal to 3.166 grains, troy.

WE DO NOT KNOW of any amendment in the law relating to annual labor which prevents trails, roads, or buildings necessary for the development of the mining claim from being counted as assessment work. The only questions involved are as to the value of the work and whether it tends to develop the claim as a mining property.

AMALGAMATED COPPER PLATES may be scaled of their gold film by the use of sal-ammoniac and sulphur. A powdered mixture of these is spread evenly over the copper plate so that the whole surface is covered with the mixture to the depth of an eighth of an inch or so. The entire surface of the plate is then carefully and gradually heated from below until combustion of the sulphur is completed. The gold scale is removed in the form of large laminae after cooling.

MINE HAULAGE PROBLEMS are usually separated into three divisions: (1) underground haulage, that is, from the working face of the mine to the bottom of the shaft, or to the surface in the event that the mine is opened by tunnel or adit; (2) surface haulage, which delivers the ore or coal from the mouth of the shaft to the ore-bins at smelters, or coal tipples at railway yards; and (3) hoisting, that is, handling the ore or coal from the mine through either vertical or inclined shafts to the surface, according to A. H. Fay, of the U. S. Bureau of Mines, in a paper to the Electric Vehicle Association.

EVOLUTION of mine haulage may be summarized as follows: human carriers; two-wheel carts and wheelbarrows; wooden cars on wooden tracks, these tracks in 1803 covered with strap iron, and the motive power largely women and children until 1842; ponies in 1846 in English mines; iron tracks with strong wooden cars, and sheet iron cars of one-ton capacity with men and ponies as power; larger cars with mules and horses; wire-rope tramways; gravity planes; belt conveyors; dogs were used up to 1909 in a coal mine in Illinois, while in the Far North (Alaska and Klondike) they are indispensable; steam locomotives since the early fifties; wire-rope haulage introduced about 65 years ago; compressed-air locomotives in 1885; electric locomotives in 1887; auto-trucks; and the latest, the gasoline locomotive. There might also be classed under the head of mine haulage the steam, air, and electric hoisting systems for raising ore and waste from mines, after it has been conveyed to the bottom of a shaft by one of the haulage systems mentioned.

SECTION 690 of the California Code of Civil Procedure provides: "The following property is exempt from execution or attachment, except as herein otherwise specially provided: (5) The cabin or dwelling of a miner, not exceeding in value the sum of $500; also his sluices, pipes, hose, windlass, derrick, cars, pumps, tools, implements, and appliances necessary for carrying on any mining operation, not exceeding in value the aggregate sum of $500; and two horses, mules, or oxen with their harness, and food for such horses, mules, or oxen for one month, when necessary to be used on any whim, windlass, derrick, car, pump, or hoisting gear; and also his mining claim, actually worked by him, not exceeding in value the sum of one thousand dollars. No article, however, or species of property mentioned in this section is exempt from execution issued upon a judgment recovered for its price, or upon a judgment of foreclosure of a mortgage or other lien thereon."

HAULAGE SYSTEMS which are indispensable to the mining industry do not serve their purpose without a great harvest of death and injury among those who by the nature of the work are compelled to perform a certain amount of labor connected therewith. The total number of men killed in the hauling and hoisting accidents in coal mines during 1913 was 584, or a total of 21% of all fatalities. In the metal mines, the total number of men killed in haulage and hoisting accidents was 168 or 24% of all mine fatalities. The number of men injured by haulage or hoisting accidents in metal mines in 1913 was 5432. There were employed in the metal mines 193,000 men during the year, so that the haulage and hoisting injuries represent 28 out of every 1000 men employed. The total number of fatalities in coal and metal mine haulage and hoisting systems was 752 in 1913. There were employed in the coal and metal mines during this period 940,732 men, thus making the fatality from these two causes about 8 per 10,000 men employed. Accidents in the haulage systems occur in many ways, among which may be enumerated breakage of cables, falling down unprotected shafts, struck by objects falling down shafts, run over by mine cars or locomotives, accidents due to coupling of cars, accidents due to cars jumping the track, and caught between cars and side of entry or drift.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

SACRAMENTO, CALIFORNIA

LEGISLATION AFFECTING THE MINING INDUSTRY, THE OLD ARGUMENT, 8 HOURS AT THE FACE, OR FROM COLLAR TO COLLAR.

Mine operators gathered in force at Sacramento, Thursday evening of last week, for a public hearing on various bills relating to mining now before the mines and mining committees of the California General Assembly. The bill which attracted most attention, and opposition, was one introduced by Mr. Harris of Kern county at the request of the miners' union and with the approval of the Federation of Labor. It proposes that in underground work the eight-hour day established by law in California shall be interpreted to mean from the time a man enters the mine until he leaves it; that is, 'from collar to collar.' When the eight-hour law was enacted a few years ago, there was a difference of opinion on this point. The men contended for the interpretation now proposed; the operators held that the proper view was that the law was intended to prevent men being required to work more than eight hours underground, and that accordingly eight hours 'at the face' might be properly required. There would seem to be ground for this contention, since even the proponents of the present bill do not ask that lunch time shall be paid for; in other words, there is no contention that it is dangerous for men to stay underground more than eight hours—merely that they should not work long hours there. The matter was settled at the time it arose by compromise, and at most California mines the men go in on company time and come out on their own. This plan has seemed to work very well, and operators employing more than 5000 men testified before the committee that they had had no complaints. At certain of the mines even direct inquiry had failed to discover any dissatisfaction. Mr. Harris and Mr. Paul Scharenberg, the latter the secretary of the State Federation of Labor, stated nonetheless that there was dissatisfaction, though they refused to commit themselves as to how extensive or even as to how many union miners there are in the state. They urged the bill on the broad grounds that it was a proper interpretation of the law; that if the men were to go in and out on company time their entrance and exit would be facilitated, whereas now, it was alleged, they had to walk and climb long distances unnecessarily; and finally that the proposed interpretation was already accepted in Arizona, Nevada, and other Western states where mining flourished, and so could not be held to constitute any fatal burden on the industry. The operators held that the situation was similar to where men work in an office in a high building. No one thinks of asking that they be allowed pay for time riding up to their office, why then should they be paid for time riding down to a stope? It was also shown that at most of the mines where considerable time was involved, as at the North Star, Empire, and others, where long slopes afford entrance, the men ride to the various levels in cars and that the time could not be shortened except by running at dangerously high speed. In other mines where entrance is through adits, it is not always possible to introduce a trolley system without also introducing danger. At the Melones and Mammoth, where unusually large adits had been driven, this was possible, and electric haulage was in fact furnished. It was the general testimony of the managers that under the proposed act the loss of time to the companies involved would range from 15 minutes to one hour per day, with a general average of 30 to 40 minutes. This would be a small matter to the men individually, but might well be the 'last straw' in the case of numerous mines now being kept open by assessments on stockholders. Mr. F. J. Martin pointed out that the Utica, which is virtually the support of a whole community, had not made a profit for years and was only kept in operation on the hope that better ore might still be found. Another mine was cited which had been operated six years and had distributed $600,000 in wages and $9000 in dividends. It is an open secret that many mines are run at an actual loss in hope of finding good ore. Manifestly, each additional increase in cost decreases the probability that stockholders will take this chance, and it will not do to brush this aside, as Mr. Scharenberg was disposed to do, as being merely a repetition of old statements that an industry is about to be ruined whenever a new burden is laid on it. Mr. Charles Knox stated that at the Black Oak mine

the actual effective working time was now only about 6½ hours, and other operators gave 7 to 7½ hours as the time spent at the face. As W. J. Loring pointed out, the 'rules of the game' had been materially altered in the four years since he began to study the Plymouth with a view to reopening it, and if further and continual changes of this sort were to be made, it was bound to enter into the calculations of those who might otherwise attempt reopening of the old mines. There was much further testimony to the same effect, namely, that the proposed change was an uncalled for and unwise additional burden on an industry that was in bad condition already. The same arguments were advanced against the various bills proposing to require the use of water drills in the mines and establishing a mine inspectorship. It was shown that water drills were not always necessary, and that it is difficult in many situations to force the men to use them or even to use respirators. The bills were also shown to have been carelessly drawn, and the situation is already covered by the safety rules now being framed by the Industrial Accident Commission. As this body has now

full authority in the matter and is proceeding actively and intelligently to formulate and put into force an adequate mine safety code, there was strong protest against the proposed legislation. No action was taken on any of the bills, but they were made special order for the committee March 26, at which time Mr. Harris and Mr. Scharenberg promised to have miners there to present at first hand the miners' arguments. Among those attending the hearing were G. W. Metcalfe, John Mocene, F. J. Martin, C. E. Uren, William Hague, G. W. Starr, Paul S. Cole, Webb Smith, W. J. Loring, J. E. Davis, Charles Janin, H. Foster Bain, and others.

NEW YORK

Position of the Alaska Issues on 'Change.—Jumbo Extension.—Dome, Hollinger, and Crown Reserve.—Mineral Development Co.—Miami and Chile Copper.

Alaska Gold Mines has been something of a star as a market leader for the past week. That is, it led, though there was little or no market worth mentioning to follow. There are those who predict that precious metal issues are to occupy the centre of the stage for a time. However, gold-producing properties are so dissimilar in character and are severally governed by such a varied set of conditions that it seems meaningless to attempt to group them. Coppers can be brought to some sort of standardization, but a gold mine is a gold mine, and ordinarily does not lend itself to classification. Perhaps the Rand is the exception that proves the rule. In the United States the Homestake's great success with low-grade milling ores has produced no real rivals. It is possible to find, almost any time, somewhere in the financial district in New York, a man owning ground containing the Homestake veins and who is looking for big capital for development purposes. As far as can be determined, he never finds it, but his persistence shows the attraction that lies in the large orebody. Once nothing attracted attention but high-grade ores; now the public, with the example of copper in mind, evidently looks on Alaska Gold as pregnant with possibilities. This somewhat changed, or broadened, attitude of the public is creating some opportunities in unexpected quarters. Heretofore, the interests controlling the Alaska Juneau have been quite emphatic in their stand that the property was to be operated as a close corporation. On more than one occasion, some strong interests have asked permission to participate in the development of the Alaska Juneau, only to be informed that assistance was not needed. Now it is stated, apparently on good authority, that the Alaska Juneau is to be made the market leader of the group. As a matter of correct classification, this group should include the older properties on Douglas island, the market for which is in England, and which cannot, therefore, be made a part of a market movement based on the development of this entire region. There has been as yet no announcement of the organization details, nor any intimation as to the basis upon which the invitation is to be extended to the people at large, but in the light of the experience of Alaska Gold, the offering should beget no little enthusiasm. In the meantime, things have not gone so well with the Ebner, which adjoins the Juneau, and which has been under examination and systematic exploration by the United States Smelting, Refining & Mining Co. The financial situation is too complicated to unravel in limited space, but briefly the Company wants the Alaska Ebner to return the money which has been spent in exploration, some $400,000.

The Jumbo Extension litigation is now getting a full share of attention from Eastern shareholders. Willard P. Ward and Isaac Untermeyer of New York, and W. H. Dickson of Salt Lake City are trying to get the stockholders to unite in opposing the apex litigation. In the meanwhile, market operations in the stock are based on the buyers' or sellers' view of the apex doctrine.

As has been many times remarked in this correspondence, in mining matters one should learn to look for the unexpected. Porcupine has broken out into activity after a prolonged period of hibernation. The 'Big Dome' is to expend something like $500,000 for additional stamps to crush its low-grade ores. As a preliminary to some new financing, which is expected to be done through the sale of stock, the shares have been advanced from around $6 to $11 per share. A probable dividend is being discussed by market operators; it is hardly to be thought that the gentlemen making up the Dome's board of directors would drift so far away from business principles as to pay dividends and issue additional treasury stock at the same time. Many so-called mining companies have been guilty of the like, but they have not been guided by men of such calibre as those who administer the financial affairs of the Dome.——Hollinger has also come to life, and the doings in the two Porcupine leaders, in conjunction with the recent strike and consequent market interest in Temiskaming of Cobalt, have combined to make more activity in Canadians than has been seen for a long time.——The Crown Reserve management has taken an option on the Bonanza mine, in the Pis Pis district in Nicaragua, which was for some time under consideration by the Camp Bird company, but which was dropped about the time of the outbreak of hostilities, presumably because of the impossibility of financing anything in London. Sam Cohen, of the Crown Reserve, is now on his way to Nicaragua to assist in making the examinations. It is stated, but it could not be confirmed, that the General Development Co. has an interest in the option.

H. Vincent Wallace, who is in charge of the operations of the Mineral Development Co. at Guanajuato, Mexico, writes that two or three small ore-shoots have been found in the long cross-cut which is being driven to reach the extension of the orebody of the Valenciana, and that in his opinion the cross-cut is now into the foot-wall of the Veta Madre. The Mineral Development has been a long-drawn-out operation.

Miami is receiving an increased share of attention market-wise. It has advanced sharply and been considerably more active than usual on the strength of possible resumption of dividends.——Chile Copper is to begin production in about five weeks. The power transmission line has been completed and connected; the railway line between the mine and the mill, and the lines carrying the steam-shovels to the excavation benches, have all been put in readiness. The 40 miles of 12-in. water-pipe line has been placed in commission and the water turned on. It will take a considerable time to 'tune up' the whole plant to its present estimated capacity of 10,000,000 lb. per month. The developed ore of the Chuquicamata, as proved by the churn-drills, is now estimated at more than 300,000,000 tons of 2.1% ore.

LONDON

Résumé of the Cornish Tin Situation, Including Returns, the Dolcoath and Carn Brea Properties.

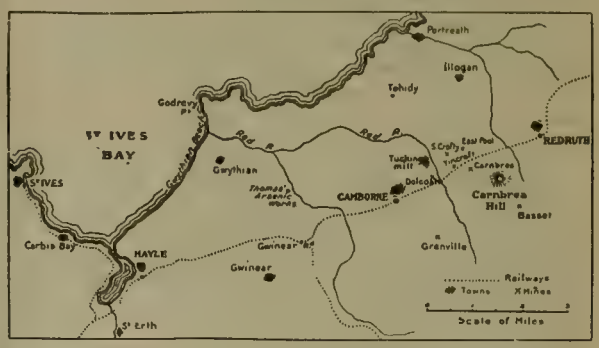
As mentioned in a letter a few months ago, the Cornish tin mines were severely hit by the dislocation of the tin market following the outbreak of war. At the time, Cornishmen were feeling terribly down-in-the-mouth. With the London Metal Exchange closed and no official quotation for tin, the fortnightly sales, or ticketings, at Redruth could not be held. Consequently black tin accumulated, and many of the mines finding themselves without income had an anxious time of it. Fortunately they were able to borrow money on their concentrate. The present is a suitable time to study the Cornish position in order to see the actual effects of the war. The general impression gained by such a survey is that things are not anywhere near so bad as they might have been. Cornish

mines have recently reached another era of impoverishment in depth and under such circumstances it might be imagined that the war crisis would give them their final quietus. It speaks volumes for the pluck and endurance of the managers and directors that so few of the mines have gone under.

Naturally we take Dolcoath first. The concurrent fall in the yield per ton, and the price of the metal during the first half of 1914, nearly extinguished the profit. During the second half of the year the further fall in the prices of tin made it advisable to mine a smaller tonnage and draw on the richer reserves. Thus it is found that 57,254 tons yielded 728 tons of tin concentrate during the first half-year, and that 48,058 tons yielded 710 tons during the second half, the yield per ton advancing from 28½ to 33 lb. At the same time the average price of concentrate decreased from £92 14s. to £83 18s., and the total income from the sales from £67,544 to £59,672. Expenses were only just met. As regards the future of this mine, the present indications are extremely discouraging. For years, even the most hardened mining geologists hesitated to think of Dolcoath as anything other than immortal. They would as soon, as Sydney Smith used to say, speak disrespectfully of the Equator. The announcement made two years ago by *The Mining Magazine* to the effect that developments at depth were well-nigh hopeless, came therefore like the proverbial bolt from the blue. Six months ago Malcolm Maclaren was commissioned to make a geological examination. His report has not been published, but R. Arthur Thomas, the manager of the mine, states that Mr. Maclaren's opinion is against sinking below the present deepest level at 3300 ft. Mr. Thomas does not share this opinion, and intends to sink another 300 ft. and explore from this lower level. While writing of the question of persistence of ore in depth in Cornish mines it may be mentioned that an eminent Cornish engineer, when speaking of Dolcoath, said that this mine had paid dividends a century ago and was paying dividends now; no doubt when he retired in due course to the realms above he would be able to look down a century hence and see dividends still being distributed. To this a flippant shareholder remarked that if our friend proceeded eventually to the nether instead of the upper regions, he might be able to be of greater practical service to Dolcoath. To revert once more to serious vein, the sinking of the Williams circular vertical shaft to cut the lode at depth, has unfortunately not proved to have been a good investment. When it was started the condition of the mine in depth was excellent, and the scheme, as a speculation, was fully warranted. It just happens, however, that serious impoverishment started at about the point of intersection of the shaft and the lode, and consequently the ore hoisted through the new shaft has been relatively small. The shaft and its equipment have cost over £100,000. Indirectly the shaft has served the useful purpose of improving ventilation. Indeed it is doubtful whether the mine could have been efficiently worked during the last year or two without the advantages in this direction provided by the shaft.

Carn Brea & Tincroft has managed to pull through the half-year in a much better fashion than was expected. This Company, owning a group of mines on the other side of Red river to Dolcoath, has had a rough time of it ever since it was reconstructed under limited liability in 1900. It never had enough capital to reorganize the underground system and the surface plant. As it is, the mines consist of an agglomeration of independent workings, and the pumping, hoisting, and milling plants were allowed to remain with the casual connection between each other as before the amalgamation. The ore has for many years been of low grade, the yield per ton averaging only about 25 lb. of black tin. Sixty years ago the average content must have been 80 to 100 lb. per ton, and the dumps remaining from those days contain as much tin as the ore now being worked. Four years ago the directors decided to get a successful outside engineer to take the management, and they appointed E. S. King to the post. Mr. King had done well in Western Australia and is a man of ideas, and he introduced as many reforms as he could without capital. But he was unable to find higher-grade ore, and he could not prevent the fall in the price of tin, so his efforts have all been in vain, and he resigned last summer. It has been found necessary to close the Carn Brea section and to devote sole attention to North Tincroft, and instead of making serious losses, as was the rule a year ago, the monthly balances are now on the right side, though the margin is perilously narrow. The report for the second half of 1914 shows that the financial position was saved by the Bolitho family, who advanced money on the security of the concentrate produced. Owing to the closing of the Carn Brea, the tonnage mined was only 29,372 as compared with 45,537 when both mines were fully worked a year before, and the yield of black tin was 304 tons, against 391 tons. The extraction per ton of ore rose from 19 to 23 lb. The half-year ended with the small loss of £283, which under the circumstances was a good result, and compared favorably with the loss of £12,899 a year before. The Company will keep going, for it is strongly backed by the owner of the mineral rights, Lord Clifden, who has lent money at low interest for the erection of modern dressing-plant.

The South Crofty, also at Camborne, deserves special men-



PART OF CORNWALL, ENGLAND

tion, as it constitutes the best example of the thorough overhauling of underground methods and concentration systems on modern lines that can be shown in Cornwall. The mine had been worked for many years on the cost-book plan, but had drifted into inefficiency, owing to the leading shareholdings being in the hands of trustees who could not by law allow the estates of the deceased shareholders to provide additional working capital. In 1906, the Allen-Meyerstein group in London presented a scheme for reconstruction under limited liability that was acceptable to the old shareholders, and moreover had the excellent advantage of providing a large amount of working capital. By this means it was possible to sink a new shaft and erect entirely new plant. The ore is complex, containing tin, wolfram, and arsenic, and it is far from being rich. Treatment is necessarily complex, and a full description of the plant, with discussions of the experimentation and the reasons for adopting certain methods, was given in the issue of *The Mining Magazine* for June 1913. It is generally said that the manager, Josiah Paull, combines the practical and scientific elements that go to make a successful manager, to a greater degree than any of his confreres in Cornwall, and this without disparaging in any way the business ability and long experience of other managers. During the past two years development at this mine has not disclosed any ore of high grade, and not too liberal a supply of ore of medium grade. In spite of this, however, excellent dividends were paid for 1912 and 1913. The serious drop in the price of tin hit the Company hard during 1914. Nevertheless it was possible to pay a small dividend. The report shows that 69,842

tons of ore was mined and milled, yielding 644 tons of black tin, 113 tons of wolfram concentrate, and 706 tons of arsenic. These results were much the same as those for the previous year, but owing to the fall in the price of tin, the income from the sale of products was only £79,654 as compared with £100,085, the yield per ton being worth 22s.9d. ($5.46), compared with 28s.10d. ($6.92). It has been possible to reduce working costs, which were 20s.7d. ($4.94) per ton, against 22s.2d. ($5.32). The net profit for the year was £2653 ($12,500), and adding this to the balance brought forward from the previous year made a disposable balance of £4608 ($22,000). Out of this, £4375 ($21,000) has been distributed as dividends, being at the rate of 8¾%. It is interesting to note that there has been no difficulty in selling the wolfram concentrate in England. Hitherto all this product of the Cornish mines has gone to Germany. During the past few months the High-Speed Tool-Steel Co., which has erected a works in Lancashire, is taking all the wolfram offered.

The East Pool & Agar is another old Cornish property that has had the pleasant experience of the acquisition of additional capital for development. From 1834 to 1913 the mines were worked on the 'cost-book' plan, and in later years, in spite of this old-fashioned system of finance, large sums of money were devoted to improvements in milling and concentration. Unfortunately underground development did not keep pace with requirements, and three years ago a run of bad luck as regards the content of the ore milled brought the Company to a serious position. Bewick, Moreing & Co. came to the rescue by introducing £30,000 capital. The Company was reorganized under limited liability, and this firm was made general managers. The development done under their guidance has been attended by excellent results. Not only have the known lodes been developed to advantage, but an entirely new orebody has been discovered north of the present workings that promises to be of unusual importance. The lode has been cut through for 30 ft. without the foot-wall being found, the driving of the cross-cut being suspended temporarily owing to the heavy flow of water encountered. Drifts east and west on this lode average, for the distance driven, over 70 lb. of black tin per ton, for a width of 5 ft. exposed. When it is remembered that the average yield of the ore milled at this mine for the year ended December 31 last was only 17.6 lb. black tin per ton, and that the total working cost, including all development, was 17s.9d. ($4.26) per ton, it will be seen how important an effect this discovery, if maintained, will have on the future of the Company. The report for 1914, accompanied by a plan showing the developments for the past year, is presented in a form that might well be copied with advantage by some of the other leading Cornish companies. The quantity of ore milled was 81,593 tons, which shows an average duty of 26.5 tons per day for each Holman pneumatic stamp. The yield was 644 tons of black tin, 108 tons of wolfram concentrate, 456 tons of crude arsenic, and 20 tons of copper concentrate, the monetary value of the whole being 17s.2d. ($4.12) per ton milled. The average chemical assay of the ore was 15.8 lb. metallic tin per ton, and the tailing averaged 4.68 lb. metallic tin per ton. The theoretical extraction was 70.3%, and the actual 70.9%. The managers have had cause to complain of the irregularity of the work of the miners. The lost shifts during the year amounted to as much as 62 per day, on a basis of 308 full working days during the year. The income and expenditure during 1914 just about balanced.

Some time ago I recorded that the directors of the Levant mine near Land's End were contemplating the abandonment of operations at the expiration of the present lease during 1915. The chairman, Francis Oats, of De Beers fame, had lately put large sums of money into the mine. Little profit has been made recently, and the terms on which the leases were to be renewed by the mineral 'lords' were too onerous for contemplation. Under the present circumstances following the collapse of the tin market on the outbreak of the war, the lords have extended the present lease for a year. In the meantime something may happen to change the attitude of the lords.

The Sniff group of companies operating various old tin mines in Cornwall and producing radium from the pitchblende ore at the Trenwith mine near St. Ives has gone into bankruptcy, and receivers have been appointed to protect the interests of the various classes of shares, debentures, and bonds. It is unnecessary on this occasion to recapitulate the story of irresponsible optimism, which prompted financial operations on a large scale and the construction of extensive surface plants, without any systematic effort to ascertain the existence of ore. Of all the properties, the West Kitty at St. Agnes and the Glew at St. Ives, are the only two that have anything like fair prospects, but in either case it is doubtful whether any returns could be made on money invested unless present capitals were reduced by 90 per cent.

HOUGHTON, MICHIGAN

STRIKE INVESTIGATION.—AHMEEK AND NEW ARCADIAN.—FIRST-AID CONTESTS.

No report will be made by the Congressional committee which investigated the Western Federation strike in the Michigan copper district. This committee was sent from Washington through the efforts of C. H. Moyer and his group of paid agitators and politicians. The men on this committee listened to the stories told by strikers and agitators for several weeks, and then, wearied with the farce, granted the mining companies one week for a statement of their case. The committee served but one purpose, and that was to advertise the Western Federation of Miners, and to aid the agitators in misleading the unfortunate workingmen of the district.

Thomas L. Chadbourne, a director of the Ahmeek Mining Co., has proposed to the stockholders that the capital of the Company be increased from the present 50,000 to 200,000 shares.

F. R. Weekes has reported on a detailed examination of the New Arcadian property. Mr. Weekes thinks that the lode is of commercial width and value, and considers the property a good prospect. New Arcadian has several tons of 'rock' on the stockpile, and a test will be made as soon as the Franklin mill is ready for operation.

Six first-aid teams from the mines of the Cleveland-Cliffs Iron Co., on the Marquette range, competed in a contest last week at the general office at Ishpeming. First prize was awarded to the team representing the Negaunee mine, the Stephenson second, and the Gwinn third. These teams were organized about a year ago, and this was their first exhibition.

CALUMET & HECLA TAILING DREDGE AT TORCH LAKE.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press.

ALASKA

Circle

Practically all of the machinery for the Berry dredge on Mammoth creek has been landed, and the boat should start during the coming season.

Cordova

Recent shipments from the Mother Lode copper mine were as follows: January, 137 tons averaging 14.45 oz. silver and 48.32% copper; and February, 209 tons of 11.45 oz. and 42.64%; the whole netting $28,674 from the smelter. From March 4, 1914, to February 8, 1915, the output was 956 tons producing 934,170 lb. copper and 14,016 oz. silver, the settlement being $91,191.

Juneau

On March 9 the new electric haulage system was started at the Alaska Juneau mine. So far the line runs through three tunnels aggregating 3395 ft., and the total length of the system will be about 2½ miles. There are 160 men employed, according to the superintendent, John Richards.

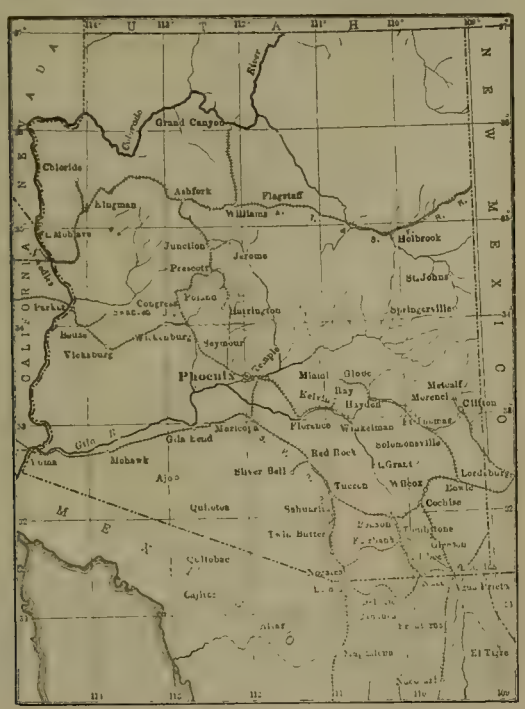
Nome

The post-office at Fairbanks is crowded with second-class mail for Nome, and there is no means of forwarding it.

ARIZONA

Cochise County

From Douglas comes the following news: General Calles has received an order from Carranza to remove the embargo on food supplies consigned to Sonora through Agua Prieta.



ARIZONA AND PART OF MEXICO.

This will relieve distress in the Moctezuma and Arispe districts. As the Villistas and Carranzistas require rolling stock, it is difficult to see how supplies are to be sent to El Tigre and Nacozari, which are almost run out. The mines at these places may have to close, the Moctezuma having little storage room left for concentrate. The Lucky Tigre Combination Gold & Silver Mining Co. held its meeting at Douglas on March 15. Later on a number of shareholders and all of the officials called on General Calles at Agua Prieta, in response to a personal invitation from him.

Some $60 ore was opened in the Juniper Flats Gold Mining Co.'s ground last week. This district is being quietly prospected.

A brief review of the report of the Calumet & Arizona company for 1914 shows that ore reserves were increased by 556,427 tons. Ore sent to the smelter totaled 608,126 tons, yielding copper, silver, and gold valued at $8,504,015. Out of the net profit of $3,085,536, $1,851,089 was paid in dividends. The property was worked at 50% capacity during five months, and costs increased only 0.54c. per pound.

Pinal County

It is expected in Tucson that the Phelps-Dodge Co. or Southwestern railroad, will buy the Southern Arizona railway connecting Red Rock and Silverbell. The road is in the hands of a receiver and is to be sold on March 27. It is said that the reason for the Southwestern buying the property is because when the Gila Bend to Ajo line is constructed by the Southwestern and Calumet & Arizona company, the material on the Southern Arizona line would be used in the new one.

CALIFORNIA

Eldorado County

The Plymouth Consolidated company, of Amador county, has started unwatering the old Montezuma mine near Plymouth. When drained it will be examined for future development.

After three years' development, the Rising drift-gravel mine, two miles east of Placerville, has proved to be a valuable property, and a mill of 7-ton capacity per hour has been constructed at the local foundry. G. W. Englehardt and Charles M. Henson are manager and superintendent respectively.

Shasta County

The Mountain Copper Co.'s new concentrating plant at Minnesota station, between Keswick and the Iron Mountain mine, started last week with 30 men.——The new zinc-sorting plant at the Mammoth mine is working two 8-hour shifts, employing 20 men. A good deal of fine material is produced during crushing and screening, too poor to send to the smelters in Oklahoma, so a jigging plant is to be installed to make a richer product.

A 5-stamp mill is to be moved from the old Spanish mine and re-erected on the Black Cloud and Red Top claims in the Quartz Hill district. Over 5000 ft. of work has been done in the property.——The Yosemite Investment Co., of San Francisco, is repairing the old suction dredge on Middle creek and intends moving it to some new ground.

Sierra County

The 20-stamp mill at the Plumbago mine was destroyed by fire on March 17. The outbreak was caused by a short cir-

cuit in a rotary converter at the plant. The Croesus company owns the property, Walter B. Pearson being in charge. ——Repairs are nearly complete on the flume of the Sierra Buttes mine, and the mill will resume in the spring.

The Croesus Mining Co., owner of the Plumbago mine, has authorized its manager, W. B. Pearson, to have a new 20-stamp mill erected as soon as possible.

Siskiyou County

Los Angeles people have acquired the old McKeen mine at the head of Scott valley, near Callahan, and will erect a 20-stamp mill. A large tonnage of ore has been opened in the mine. James Doyle is manager.

COLORADO

Clear Creek County

The Capital mill completed last week the treatment of 150 tons of ore from the Onondaga mine. The concentrate assayed $70 gold per ton. In the mine the rise is up 155 ft. above the Capital tunnel, and is improving.——In the Silver Plume district J. B. Ballantine has leased the Illinois level, including the Bismarck lode on the Seven-Thirty. This ground is considered the best available.——The Bard Creek mill should be completed early in April. Nelson Bros. have been in charge of construction.——The Primos Chemical Co., of Philadelphia, is shipping two wagon-loads of molybdenum ore daily to the Empire station, where it is loaded on cars and shipped to the Company's plant in the East. It is reported that this Company expects to employ 100 men next summer.——Numbers of other operators in the districts are busy.

Dolores County

Shellhammer and Batchellor, lessees in the Jumbo No. 2, in the Pro Patria tunnel of the Rico Mining Co. at Rico, have opened very rich ore.

Lake County (Leadville)

The Western Oxide Co.'s smelter is being overhauled, and operations will commence in a few days.——The Big Five Operating Co. has received the insurance on account of the fire in its plant some weeks ago, and operations at the Big Four mine have been resumed.——The shoot in the Jennie June is yielding 1 to 5-oz. gold ore.——Preparations are being made for installing the pumps in the Penrose shaft. The pumps will be suspended by ropes, and winches will regulate their position as the water is lowered.

San Juan County

The electrostatic plant at the Sunnyside mine at Silverton is working full time on zinc ore.——The Champion mine is being examined for E. W. Waybright by Louis Shafer.——When the weather moderates, the Ben Butler mine is to be reopened.——The Hercules property was sold by the sheriff to J. R. Smith, of Denver.——The Ledge mill at Chattanooga is to resume soon. The North Star mine and mill has been sold.

Summit County

It is said that the Tonopah Placers Co., a subsidiary of the Tonopah Mining Co. of Nevada, will construct a large hydro-electric power plant near Breckenridge during this summer for its dredges.

Teller County (Cripple Creek)

In January Stratton's Independence produced 5129 tons of $7.08 ore. Low-grade mine and dump ore treated amounted to 10,100 tons. The total profit was $6934.——The Golden Cycle mill, at Colorado City, will have to be operated to its full capacity of 33,000 tons per month as soon as possible. Net earnings of the Company last year totaled $750,000.——Lessees on the Ingham vein of the Doctor-Jack Pot property have perhaps the best lease in the district, it paying from $20,000 to $30,000 per month in dividends.

IDAHO

Idaho County

A controlling interest in the Florence Hydraulic & Dredging Co., involving title to about 1800 acres of placer deposits in the old Florence district, and water rights which serve practically the entire district, has been sold by J. Hanson Hussey to W. C. Hoag, of Spokane. Development work already completed on the property is valued at about $75,000. Mr. Hoag will enter the district on April 1 with a small force of men from Spokane for the completion of the water system and installation of a hydraulic plant, and with the opening of summer a crew of 20 to 30 men will be put to work in the operation of the system. Work yet to be finished in order to bring the necessary water supply to the property will cost about $5000. Over 22 miles of ditches and flumes are owned by the Company.

Shipments from the Coeur d'Alene group of gold quartz claims situated 1½ miles east of Golden, in the Stites district, are expected to be started soon. The property is being operated under bond by Peter Proulx, of Golden. Ore has been blocked out in this group valued at approximately $1,200,000

Shoshone County

The Federal Mining Co. is being sued by Kennedy J. Hanley to quiet his title to the one-eighth interest in the Skookum lode, and a share of the proceeds of ore extracted since 1906, when he won a previous case.——Good progress is being made in enlarging the Interstate-Callahan mill.—Faulting has cut off the ore in the Caledonia mine, but as there are a number of such occurrences in that property, no doubt is felt as to the shoot being found again.

MISSOURI

The biennial report of the state geologist, H. A. Buehler, at Rolla, has been published. It covers 62 pages and is illustrated with several maps, and deals with the work of the Bureau of Geology and Mines during 1913 and 1914. The mineral production of Missouri in 1913 was valued at $47,760,584, to which lead contributed $11,444,935; zinc, $9,664,423; coal, $7,468,308; clay products, $6,598,664; cement, $4,556,822; limestone, $2,486,020; mineral paints, $2,359,592; and sand and gravel, $1,109,233.

Jasper County

The arrival of spring weather will be accompanied by a large increase in prospecting in the Missouri-Kansas-Oklahoma zinc-lead district, on account of the high price of spelter.——The sanitary conditions in the zinc-lead mines of the Joplin district, and their relation to pulmonary diseases among the miners, was the subject of a recent report by A. J. Lanza of the U. S. Public Health Service and Edwin S. Higgins of the U. S. Bureau of Mines. The causes of the complaints and recommendations for their abatement are discussed fully.

A large number of lessees are busy producing ore from the Lone Elm Mining & Development Co.'s property, northwest Joplin.——The H. L. & S. Mining Co. has cut ore in disseminated ground at 170 ft. by drilling.——The Cactus Hills company is moving its 150-ton mill on to a lease of the Lone Elm company, where it will receive custom ore.

MONTANA

Broadwater County

It is now proposed to connect Radersburg with the Northern Pacific line by way of Toston, work to start by June 15. This road will be constructed by the Keating Gold Mining Co., and will consist of a 42-in. gage line 14 miles long. With the Baldwin gasoline locomotives and other equipment it will cost $150,000. At the junction with the Northern Pacific, ore-bins will be built later on. In January the mine

produced 3340 tons of ore which was forwarded by teams to the Washoe smelter at Anaconda. There are 137 men employed, and the output will be 250 tons per day when the line is ready. Large ore reserves are blocked out in the mine.

Rich ore is reported to have been opened at 1090 ft. in the Keating mine. Shipments to the Washoe plant are about 65 tons per day. The directors are considering erection of a concentrator for low-grade ore.

Fergus County

(Special Correspondence.)—The Fergus County Oil & Gas Co. has recently been organized to prospect for oil and gas in this county. It is capitalized at $250,000, and already 4000 shares of par value of $10 each have been sold. Mr. Boerema, late of Calgary, Alberta, is president and promoter of the Company, which plans to purchase its own drilling outfit, and to bore under the direction of the most competent petroleum geologist that can be secured. The strata outcropping between the various mountain uplifts are chiefly of Cretaceous age, and are often folded into quite regular anticlines. The structure, character, and age of the rocks seem to be favorable for collection of oil and gas in profitable quantities, a number of seepages and other surface indications of oil having been found. Natural gas is reported to have been recently found in a well south of the Big Snowy mountains.

Revenue from bullion of the Barnes-King Development Co. from its mine at Kendall in the North Moccasin mountains for 1914 was $422,962, practically all from oxide gold ore treated by the cyanide process. Sulphide ore, estimated at over 7000 tons, has recently been found below the 600-ft. level, and a small roasting furnace will be installed to treat this ore before cyanidation. The exact costs of production for 1914 are not available until the annual meeting held early in March, but it seems probable that the net profits will be close to $200,000 for the year. Naturally this has revived talk of a substantial dividend, which could easily be paid.

Prospecting by churn-drilling is being done by Guy Norman and others two miles south of Kendall. There are no surface indications of ore, but the dome structure appeared to be favorable for the formation of the irregular replacement deposits in limestone, in which the gold of the North Moccasin occurs. Last summer a number of drill-holes were completed, one of which passed through 13 ft. of yellow oxide rock containing gold, commencing at a depth of 285 ft. This hole was continued to 400 ft., where more ore was discovered. A new drilling rig has been purchased, and if further drilling proves favorable, a shaft will be sunk.

Gem topaz has been found in the West Kendall mine, which has been cut into stones resembling diamonds.

Lewiston, February 22.

In February the Barnes-King company produced $41,705 from 4287 tons of ore, equal to $9.73 per ton.

Lewis and Clark County

A report dealing with the Cruse estate properties in the Scratch Gravel and Marysville district states the following: In the former area, the Franklin mine made a profit of $29,597 from December 20, 1914, to March 15, 1915; and at Marysville the Cruse mine made a loss of $8027.

Silverbow County

The U. S. Bureau of Mines rescue-car No. 5, in charge of J. L. Boardman, arrived at Butte on February 18, and will remain until about April 1. During that time the government officials in charge of the car are giving free instruction in the first-aid treatment of injured men to all who may apply for it.

The Gagnon mine accident, whereby four men were killed in the incline shaft on February 6, is described in the Anaconda company's safety-first publication, *The Anode*, for March.——As soon as the East Butte company's smelter resumes, the Butte-Alex Scott mine will again produce ore. The shaft is down 2100 ft., and is to be sunk 100 ft. farther.

The Butte-Duluth company has gone into the hands of a receiver, as it is unable to meet the amount of $50,000 due.

The Anaconda company has reopened the suit with the Pilot-Butte company over the Emily vein near the Badger State mine. The plaintiff alleges that the defendant has disobeyed the restraining order of October 8, 1913. With the reopening of the Pennsylvania mine of the Anaconda, the Company is now operating 15 of its 22 shafts, and employing about 6533 men.

NEVADA

Clark County

According to J. B. Jenson, in *The Deseret Evening News* of Salt Lake City, the Good Springs district is livelier at present than in many years, half a dozen mines shipping, mills operating, and various properties actively developing. The occasion for the stir is the rise in the price of zinc and a recent discovery of platinum-bearing ore in the Boss mine. ——After a shut-down of three months, the Yellow Pine mine has resumed and will increase its normal production of 300 to 400 tons per month, to 800 to 900 tons. This product is zinc and lead. The mine is developed to the 600 and 700-ft. levels, where a large body of zinc is now being opened. In one place it has been developed 70 ft. wide and 100 ft. along the strike, the ore sampling 38 to 40% zinc.——The Mobile property has changed hands. Givver and Hutchens, of Boston, have taken over the property from Sam E. Yunt on a $30,000 bond and lease. It has a 2800-ft. tramway, the longest in the district.——The Potosi is operating three large ore-hauling trucks and will put on two more.——Joe Dedericks, a prominent millman, formerly of Salt Lake City, is operating the Columbia property. He is shipping two to three carloads of copper ore per month.——The Mountain Top is shipping 200 to 300 tons.

At the new town of Plantina a large hotel has been erected to take care of the increased traffic, particularly to and from the Boss copper and platinum mine. The railroad station is Jean, where at every train the platform is crowded with passengers. All teams are busy hauling ore and material, and many new auto-trucks are coming in. It is said that 30 to 40 new automobiles have been purchased in the past 60 days.

Esmeralda County

The eighth annual report of the Goldfield Consolidated Mines Co. states that in 1914 the mill treated 338,192 tons of ore, yielding $3,926,349 net. Of this, $1,835,224 was profit, and one dividend, 30c. per share, amounted to $1,067,744.

In consequence of the uncertainty that has arisen through the apex suit recently instituted by the Reorganized Booth company against the Jumbo Extension and Goldfield Merger, the management of the Lone Star Consolidated, according to the secretary, Joseph S. Henderson, has suspended operations in shaft No. 2, on the extreme southwestern section of the vast property, until satisfactory side-line agreements can be made with companies owning adjoining properties.

The incline rise above the north drift along the latite-shale contact at 1750 ft. in the Atlanta has opened 30 ft. of ore, all of which is suitable for shipment.

Humboldt County

Eight miles southeast from Rochester, on the east slope of Buffalo peak, a mild boom has set in, and all the ground around the new discovery has been staked. Attention is divided between quartz and placer deposits.

Lincoln County

At the Nevada-Utah properties, at Pioche, stoping is under way at 1200, 1300, and 1400 ft. About 5000 tons of ore has been hoisted and 20,000 tons is blocked out between 1200 and 1400 ft. At the present price of spelter the ore is worth $30 per ton at the mine. The output in February was 551 tons.

Mineral County

Work has been resumed at the Giroux claims, 14 miles north of Luning. They are controlled by the Arizona Copper Syndicate.——From the Neversweat, in New York cañon, several cars of copper ore have been shipped.——Two miles northeast of Luning is the Esmeralda Copper Co.'s claim, and a compressor has been ordered, also extensive development.——Luning people are interesting themselves in the Moho district, six miles from Belleville. Some ore is being shipped.

In the report of the Goldfield Consolidated for 1914 reference is made to its subsidiary, the Aurora Consolidated. About 60,000 tons of ore was treated since acquiring the property. This should have yielded a profit of $90,000, but left none, and about $200,000 has been spent in alterations at the mine and mill.

Nye County

The directors of the White Caps Mining Co., of Manhattan, are proposing to shareholders that the incorporation be changed from South Dakota to Nevada, the capital stock be made assessable, and increase the capital to 2,000,000 shares when necessary. The new arrangements generally should broaden the scope of the Company.——The Big Pine company's tube-mill plant is showing a daily capacity of 150 tons, and the recovery is above 90%.——The spring is responsible for many placer properties resuming sluicing.

Tonopah mines produced 10,940 tons of ore, worth $222,880, in the third week of March. Some February returns were as follows: Belmont, 14,397 tons, 2800 oz. gold, 257,369 oz. silver, and $91,453 profit; Jim Butler, 4255 tons, and $22,444 profit; and Tonopah Mining, 10,200 tons, 181,150 oz. bullion, with $47,800 profit.——Promising developments are recorded at 600 and 980 ft. in the Extension and Merger, respectively.

Storey County

According to the superintendent of the Consolidated Virginia Mining Co., T. F. McCormick, the principal work performed in 1914 was on the 2500-ft. level. From certain development there was extracted 1550 tons of $10.15 ore.——It is probable that the Yellow Jacket, Crown Point, and Belcher mines may be consolidated, and the old south end of the Comstock lode reopened. The output of these properties in 1914 was as follows: Yellow Jacket, 23,763 tons, $17,792 net; Crown Point, 10,776 tons, $42,000 gross; and Belcher, 8801 tons, $42,700 gross.

NEW MEXICO

Dona Ana County

The Organ Mountain copper claims have been acquired by the American Smelting & Refining Company.

Socorro County

A new treatment plant worth $150,000 was destroyed by fire at the Calumet in the Black Range district last week.

UTAH

Carbon County

The Ketchum Coal Co.'s mines at Castle Gate were sold to L. R. Eccles, of Ogden, last week, for $200,000. Development has opened about 1,250,000 tons of coal.

Juab County

At 1800 ft. in the Chief Consolidated a good shoot of ore has been developed. Prospecting is still being done by diamond drill.——Mules have been lowered into the Gemini mine to facilitate tramming underground.——Low-grade dumps at the Bullion Beck have been leased to D. R. Goodwin, V. Watkins, and W. L. Anderson, who will erect a plant of four jigs to treat the material.

Summit County

With a 35-ton Holt-Dern roasting furnace installed, the Park City Mills plant is to start on American Flag ore. Theodore P. Holt thinks that 50 tons may be reached with 90% recovery, 85% being guaranteed.

CANADA

Alberta

At 2774 ft. the Alberta Petroleum Consolidated Co. has found oil of high grade. There was 1000 ft. of oil in the well last week.

British Columbia

Early on March 22 a snowslide carried away about half of the buildings at the Britannia copper mine, north of Vancouver. About 100 miners were asleep in a bunk-house, and about 55 of these were killed, and their bodies cannot be recovered until the snow melts.

JEWEL-DENERO MINE AND MILL NEAR GREENWOOD, BRITISH COLUMBIA.

The Union Hydraulic Gold Mining Co. has completed its camp buildings near Vernon, and is installing the sluicing plant. Russell H. Hanauer is in charge.——Production of the Granby properties in January was as follows: Anyox, 1,304,353 lb. copper, 19,053 oz. silver, and 506 oz. gold; and Grand Forks, 775,786 lb., 12,223 oz., and 2019 oz. The net earnings approximated $100,000.

Ontario

Nickel ore shipments from the Alexo mine to the Mond Nickel Co.'s plant at Coniston amounted to 839 tons in February.——The North Thompson mine at Porcupine has been closed temporarily, and the plant has been leased to the Porcupine Gold Mines, whose mine is developing well. A Hardinge ball-mill is being installed in the mill.

The Canadian Copper Co., according to the president, A. D. Miles, will spend $500,000 on a new shaft-house, rock-house, eight workmen's homes, and equipment.

PERSONAL

R. A. F. Penrose, Jr., is at Denver.

A. F. Main, of El Oro, is in New York.

Thomas H. Leggett is at Los Angeles.

Franklin Guiterman is visiting Denver.

T. A. Rickard arrived in San Francisco today.

A. Chester Beatty sails for London on March 27.

Allen H. Rogers is going from New York to Burma.

H. C. P. Woolmer has arrived in London from Russia.

R. M. Atwater is inspecting copper mines in Arizona.

E. G. Spilsbury is returning to New York from Montana.

S. F. Peters, of La Libertad, Nicaragua, is in San Francisco.

H. Foster Bain will leave San Francisco tonight on his way to London.

Charles S. Haley has been at Ludwig, Nevada, on professional work.

John M. Nicol, mining engineer, recently of Mexico City, is in San Francisco.

William Newbrough is now at 229 Monterey avenue, Highland Park, Michigan.

James W. Malcolmson was in San Francisco last week and has returned to Kansas City.

Herbert C. Enos was married to Miss Caroline Nolan on February 16 at Salt Lake City.

P. D. Burt has returned from an examination trip to the Hassayampa district, Arizona.

E. L. Wolcott, assistant secretary of the American Mining Congress, was at Salt Lake City recently.

Utley Wedge has been elected president of the Tennessee Copper Co. to succeed James Phillips, Jr.

S. H. Brockunier, who has been in the East for several months on business, has returned to Nevada City.

Charles A. Banks, of the Jewel-Denora mine, Greenwood, B. C., is in Manitoba examining mining property.

William T. McDonald, formerly superintendent of the Chino mill, is now with the Ray Consolidated at Hayden.

F. S. Janney and D. C. Jackling are making a trip of inspection to Juneau to look over the Alaska Gold operations.

W. H. Bassett has resigned his position as foreman at the Engels Copper Co. at Keddie, California, and has returned to Oakland, California.

R. P. Rogers, of the Coniagas of Cobalt, has accepted the appointment of adjutant of the 37th Battalion, Canadian Overseas Expeditionary Forces.

Roswell H. Johnson, of the firm of geologists of Johnson & Huntley of Pittsburgh, was in Washington this week in connection with the Osage hearing.

A. A. Hassan is examining manganese deposits of Tennessee, West Virginia, and Virginia. Mr. Hassan's temporary address is care of Tennessee Copper Co., Copperhill, Tennessee.

William Campbell has been promoted from associate to professor of metallurgy in Columbia University. E. K. Judd has been similarly promoted to be assistant professor of mining.

E. S. Sheffield, formerly division superintendent of the General Petroleum Co. at Taft, is at present at Chungfu in Shensi, North China, drilling well No. 2 for the Standard Oil Company.

Israel C. White and W. L. Saunders have been appointed members of the Federal Trade Committee of the Chamber of Commerce of the United States, which is to co-operate with the Federal Trade Commission.

E. S. Sheffield, formerly at Taft and McKittrick, California, is now in charge of a crew of California drillers and tool-dressers that is engaged in putting down the first well on the Standard Oil Co.'s concession in the Yen-Chang oilfield, China.

E. E. Hampton, superintendent of the Bunker Hill mine, Amador City, is visiting the southern part of the state for his health. Bayliss C. Clark has taken his place temporarily. This mine has just paid its 105th consecutive monthly dividend.

The following nominations for officers for the year 1916 have been made by the Council of the Geological Society of America: for president, John M. Clarke; for first vice-president, J. P. Iddings; for second vice-president, H. F. Reid; for third vice-president, Rudolph Ruedemann; for secretary, Edmund Otis Hovey; for treasurer, William Bullock Clark; for editor, Joseph Stanley-Brown; for librarian, Frank R. Van Horn; for councilors (1916-1918), F. B. Taylor and C. P. Berkey.

OBITUARY

Peter Peck, one of the best known employees of the Calumet & Hecla Mining Co., died at Calumet, March 9. He was employed by the Calumet & Hecla in various positions for the past 45 years.

Emmanuel Stephens, a well known pioneer resident of the Michigan copper district, died at Osceola March 8. The late Captain Stephens was born in Cornwall, England, 80 years ago. He came to the Lake Superior region in 1857, settling first at the Cliff mine. He worked at various other mines in the copper district and for some years had had charge of mining operations near Ironwood.

Jacob Wilson, one of the pioneer Finnish mining men of Michigan, died at Hancock, March 2. He came to the Michigan copper district from Finland in 1874 and was widely known as a mining authority. For several years he was in charge of operations at the Orijarvi mines of the Finnish-American Mining Co., near Helsingfors, Finland, and returning from Finland only a few years ago, became connected with the Quincy Mining Company.

David W. Culp died February 24 at Rathdrum, Idaho, aged 84 years. He was one of the early pioneers of Deer Lodge county, Montana, going to California in 1853, and was in Idaho during the days of 1863. At the time of the vigilance committee of Montana he went down to Valparaiso, Peru, and arrested the murderers of Magruder; he was one of the guards during their imprisonment and execution at Lewiston, Idaho. He leaves a widow, three sons, and two daughters, and many friends.

Schools and Societies

On March 24, Horace M. Swetland gave the fourth of his lectures on industrial journalism at the New York University.

Affairs at the University of Utah are decidedly unfortunate. On March 18 fourteen professors resigned as the result of the attitude expressed by the board of regents (ten Mormons and two Gentiles) in a public statement regarding the recent dismissal of four professors, and the demotion of the head of the English department. Robert S. Lewis, mining and milling, and W. C. Ebaugh, chemistry, were among those who resigned. The alumni association is preparing a suit for the forfeiture of the charter of the University. The complaint, it is said, will allege that the institution has failed to fulfill the requirements of the act and has become a sectarian institution, dominated by the Mormon church. The Wall scholarship has been withdrawn from the institution.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, March 25.

Antimony	25 —25¾
Electrolytic copper	15½ 15¾
Pig lead	4.40— 5.35
Quicksilver (flask)	$80.00
Spelter	10¾—11
Tin	40 —41½
Zinc-dust, 100-kg. zinc-lined cases	15

EASTERN METAL MARKET

Owing to some delay in transmission our regular telegram of metal prices did not come to hand in time for insertion in this issue.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.		Average week ending	
Mch. 18	50.12	Feb. 10	48.20
" 19	50.50	" 17	48.42
" 20	50.25	" 24	48.70
" 21 Sunday		Mch. 3	49.02
" 22	50.37	" 10	49.81
" 23	50.37	" 17	51.18
" 24	50.37	" 24	50.33

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	....
Feb.	57.53	48.45	Aug.	54.35	....
Mch.	58.01	....	Sept.	53.75	....
Apr.	58.52	....	Oct.	51.12	....
May	58.21	....	Nov.	49.12	....
June	56.43	....	Dec.	49.27	....

The silver market has been featureless during the past week. On March 20 about 230,000 oz. left San Francisco for the Orient. Up to March 4 about 13,000,000 had been shipped to India from London, against 10,000,000 oz. in the same period of 1914. According to Samuel Montagu & Co. of London, quotations neared 23d. several times this year, but as a considerable amount of metal is held back for prices about that limit, quotations receded. Owing to the $10 per $1000 insurance rate to England from Canada, the Nipissing is storing its product at present.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Feb. 24	62.50	Mch. 10	80.00
Mch. 3	70.00	" 17	80.00
		" 24	80.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60.00	Aug.	80.00	....
Mar.	39.00	....	Sept.	76.25	....
Apr.	38.90	....	Oct.	53.00	....
May	39.00	....	Nov.	55.00	....
June	38.60	....	Dec.	53.10	....

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	....
Feb.	39.76	37 23	Aug.	50.20	....
Mch.	38.10	....	Sept.	33.10	....
Apr.	36.10	....	Oct.	30.40	....
May	33.29	....	Nov.	33.51	....
June	30.72	....	Dec.	33.60	....

Tin is easier at 45 to 50c. In London quotations are £168 10s. per ton for spot metal. It is reported that the British government has issued an order forbidding the exportation of pig tin, chloride of tin, and tin ore except under special licenses; also that these permits would only be granted if the shipments were consigned to British consuls at ports of destination. Prices broke considerably on this news being published.

COPPER

Prices of electrolytic in New York, in cents per pound

Date.		Average week ending	
Mch. 11	14.50	Feb. 3	14.50
" 12	14.50	" 10	14.29
" 13	14 63	" 17	14.30
" 14 Sunday		" 24	14.42
" 15	14.63	Mch. 3	14.38
" 16	14.63	" 10	14.50
" 17	14.63	" 17	14.59

Monthly averages.

	1914.	1915.		1914	1915.
Jan.	14.21	13.60	July	13.26	.. .
Feb.	14.46	14 38	Aug.	12.34	.. .
Mch.	14.11	....	Sept.	12.02	....
Apr.	14.19	....	Oct.	11.10	....
May	13.97	....	Nov.	11.75	....
June	13.60	....	Dec.	12.75	....

The Rio Tinto Copper Co. of Spain has declared a dividend of $8.40 per share to cover the whole of 1914.——The Osceola will pay $2 per share on April 30.

Regarding the copper situation the National Conduit & Cable Co. says: "The general tone of the copper market lately was one of underlying strength, and demand from both domestic and foreign sources enabled holders to keep the situation well under steady control. International requirements were of sufficient volume to absorb free deliveries of the metal. The increase in domestic manufacturing operations is in particular evidence, and the home melting of large tonnages monthly is proving an effective factor in sustaining prices around the range recently established of 14¾ to 15c. for electrolytic. The curtailment of the output of copper instituted several months ago strengthened the argument for better market conditions. And on the basis of recent production it has been possible to lift the market to the plane on which it rests at present. It is hardly probable, however, that conditions are favorable enough for an early resumption of output at full capacity. There is more life and activity in business and industry, compared with the state of trade last fall, but more definite indications are necessary to demonstrate the permanency of these encouraging conditions."

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Mch. 11	3.95	Feb. 3	3.80
" 12	3.95	" 10	3.80
" 13	3.95	" 17	3.85
" 14 Sunday		" 24	3.85
" 15	4.00	Mch. 3	3.87
" 16	4.10	" 10	3.95
" 17	4.10	" 17	4 01

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	....
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	....	Sept.	3.82	....
Apr.	3.86	....	Oct.	3.60	....
May	3.90	....	Nov.	3.68	....
June	3.90	....	Dec.	3.80	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
Mch. 11	7.50	Feb. 3	7.58
" 12	8.00	" 10	7.75
" 13	8.00	" 17	8.24
" 14 Sunday		" 24	8.25
" 15	8.00	Mch. 3	9.05
" 16	8.00	" 10	8.00
" 17	8.00	" 17	7.92

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	5.22	9.05	Aug.	4.45	....
Mch.	5.12	....	Sept.	5.16	....
Apr.	4.98	....	Oct.	4.75	....
May	4.91	....	Nov.	5.01	....
June	4.84	....	Dec.	5.40	....

During the week ended March 13, the Missouri-Kansas-Oklahoma output of ore was 5200 tons, but shipments amounted to 2800 tons, consequently a large surplus is accumulating. In the following week a wide range of price was recorded between high and medium-grade zinc orders, due to the relatively strong demand for the former. Prices were from $65 down to $55 per ton.

COMPANY REPORTS

HOMESTAKE MINING COMPANY

With its great mines, 1020 stamps, sand leaching and filter-pressing plants, and other extensive accessories, this well known South Dakota company in 1914 produced gold worth $6,160,161 from 1,587,774 tons of ore. Of this, $2,210,208 was paid in dividends. In September the Company lost through death its president, James B. Haggin, and superintendent, Thomas J. Grier.

The new superintendent, Richard Blackstone, reported as follows: "Operations of the Company for the year 1914 have been normal, there being no interruption of any kind to continuous operation. The property is in an excellent condition. Ventilation of all workings and safety of employees are closely looked after. The average number of employees was 2350. The principal betterments for the year consist of: A completely equipped central boiler plant of six 600-hp. boilers, an electric generating station having a maximum capacity of 4000 kva., consisting of two units of steam turbines, condensing, direct connected to generators; a compound condensing steam hoist, designed to handle two 6-ton skips from a maximum depth of 4000 ft., skips dumping direct into two No. 8 Gates crushers; and a compound condensing air-compressor, with a capacity of 3000 cu. ft. of free air; the Recreation building, containing a theatre with a seating capacity of 1000, a library, swimming pool, gymnasium, bowling alleys, billiard and amusement rooms, was opened to the public August 31, 1914. The B. & M. shaft was sunk from the 1550 to the 1700-ft. level, and the Golden Star shaft from the 1250 to the 1400-ft. level, while 17,809 ft. of driving was done during the year. Ore reserves in the mine are large and represent many years' supply for the present crushing capacity, and we are now saving 94% of the gold.

SOCIOLOGICAL CONDITIONS AT LEAD, SOUTH DAKOTA; HOW THE HOMESTAKE MINING CO. LOOKS AFTER THE WELFARE OF ITS 2350 EMPLOYEES. RECREATION HALL, BUILT BY THE COMPANY AT A COST OF OVER $250,000.

Assets and liabilities are as follows:

ASSETS

Mines and equipment, etc	$25,116,000
Balance in banks	1,086,530
With superintendent	18,660
Bullion in transit	280,870
Total	$26,502,060

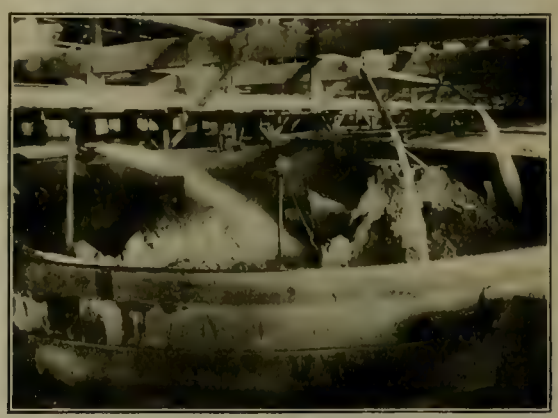
LIABILITIES

Capital stock, 251,160 shares at $100	$25,116,000
Outstanding drafts	$ 181,136
Unclaimed dividends	28
Profit and loss, balance account	87,296
Total	$26,502,060

An analysis of the financial statement would indicate that the full amount of dividends had not been earned, and this might be shown as follows:

Bullion, balance from 1913, and sundry income	$7,776,970
Balance from 1913	1,428,247
Revenue in 1914	$6,308,723
Operating expenses and dividends	6,839,374
Steam power-plant, recreation hall, property purchase, etc.	350,650
Expenditure fairly chargeable to operation	$6,488,724

The new revenue, $6,308,723, compared with the expenditure, $6,488,724, shows that the Company apparently went behind $180,001, although there may be other items of expenditure included in the operating cost which might be fairly chargeable to what is ordinarily carried as capital account.



SLUICING OUT TREATED SAND AT THE HOMESTAKE. THESE VATS HOLD FROM 600 TO 1250 TONS, AND ARE EMPTIED IN ABOUT THREE HOURS.

The year started with a balance of $1,428,248, and ended with one amounting to $897,596.

Costs may be stated as follows, being calculated from the total charges of the various departments:

	Total charge.	Cost per ton.
Aid fund, benefices, recreation hall, hospital, house, etc.	$ 185,466	$0.116
Assay office	30,627	0.019
Shafts	416,518	0.262
Deadwork, débris	51,364	0.032
Foundry, machine shop, smithy, etc.	98,836	0.062
Mine, principal items:	Per ton.	
Labor $1,641,807	$1.033	
Powder 198,321	0.125	
Timber 103,934	0.065	
Total mining charges	2,228,245	1.403
Mills (six)	378,406	0.238
Regrinding	24,289	0.015
Leaching sand	152,664	0.096
Filter-pressing slime	136,878	0.086
Central steam electric power plant (construction)	198,627	0.125
Freight on bullion	9,362	0.006
General expense	95,876	0.060
Legal	8,386	0.005

	Total charge.	Cost per ton.
Lime kiln	5,005	0.003
Office	17,121	0.011
Dividends	2,210,208	1.392
Property purchase	30,896	0.019
Salaries	28,291	0.017
Silver plating	3,768	0.002
Survey	32,579	0.020
Stable	24,857	0.015
Timber lands	83,498	0.053
Timber	9,412	0.006
Tramway	26,962	0.017
Water	66,878	0.042
Taxes	258,962	0.163

The 1,587,774 tons of ore treated averaged $3.879 per ton. Special note should be made of the heavy taxes, 16.3c. per ton.

At the Panama-Pacific Exposition the Company has arranged an exhibit showing a section of the mine, and has a large number of photographs illustrating its many activities.

Book Reviews

CARRANZA AND MEXICO. By Carlo de Fornaro. P. 242. Ill. Mitchell Kennerley, New York. For sale by the *Mining Press*. Price $1.25.

To the student of sociological problems, Mexico is possibly the most interesting spot in the universe. Her problem is so complicated that very few people claim to know what all the trouble is about, and of those opinions voiced as authoritative we are extremely skeptical. An effort, however, which holds up the mirror to even one facet of this extremely complex problem is worthy of note, and it is with this attitude of mind that the present work by Sr. Carlo de Fornaro should be approached. Don Venustiano Carranza, while well known to the Mexican public for many years, was an obscure character to the American people until two years ago when he espoused the cause of Madero and took up arms against the Huerta administration. Since that time his name has been continuously linked with the upheaval which Mexico has experienced, and bids well to continue for some time to come. Carranza, as the governor of the state of Coahuila, from which state the weak successor of Porfirio Diaz came, was the logical leader of the anti-Huerta forces. Although his military genius and peerless leadership were most in evidence at banquet boards in the wake of Francisco Villa's victorious army, he was accepted as the leader of the Constitutionalist cause. While the present work has the atmosphere of a Carranza subsidiary, it presents many interesting facts which are pertinent to the present crisis, and as such will interest the casual student of Mexican affairs. As a history of the present embroglio the work has its chief importance, and its references to Constitutionalist leaders other than those in sympathy with Carranza, and Francisco Villa in particular, are extremely biased. While the opinions of the author are those of the champions of Carranza, those who have followed the career of this first leader of the Constitutionalist cause will find many reasons to differ from Sr. Fornaro, and will note that those qualities and actions which have been so largely accountable for Carranza's decline in power and popularity have been totally neglected.

PETROLEUM INDUSTRY OF CALIFORNIA. Map Folio accompanying *Bulletin* No. 69. By R. P. McLaughlin and C. A. Waring. 17 plates. Issued by the California State Mining Bureau, San Francisco, March 15, 1915. The *Bulletin* is still in the press, and when published, a review of the whole of this valuable investigation will be given. Editorial comment on the Folio appears in this issue.

RECENT PATENTS

1,121,268.—ALUMINUM ALLOY. William A. McAdams, Bay Shore, New York. An aluminum alloy composed of aluminum, silver, zinc, and copper combined substantially in the proportion by weight of 100 parts aluminum, 20 parts silver, 10 parts zinc, and 5 parts copper.

1,121,226.—DRY TREATMENT OF ORES. Wilhelm Buddeus, Charlottenburg, Germany. The treatment of zinc-blende, ore containing blende, and similar metallurgical products, consisting in mixing the finely divided or disintegrated material with a binding agent such as calcium silicate, forming it into briquettes, and roasting the briquettes with fuel in the presence of an air current, and finally directing a burning gas current against the briquettes.

1,120,175.—PROCESS FOR RECOVERING PRECIOUS METALS. Frederick A. Wiswell, Oakland, California. The process consists in subjecting finely divided material containing precious metals in fine particles to the action of an aqueous solution of mercuric chloride, in the presence of a metal which is more readily acted upon by the mercuric chloride than the fine particles of the precious metal, while subjecting the mass to the action of an electric current having its polarity periodically reversed.

1,122,664.—ELECTRIC ZINC FURNACE WITH INTEGRAL CONDENSER. —Charles Victor Thierry and Michel Thierry, Paris, France. In an electric zinc furnace a longitudinally extending bed of carbon resister, a charging pocket or pockets disposed along one of the vertical sides of said resister, a plurality of transversely disposed tubes, filled with carbon which are arranged along the other vertical side of said resister and a space or chamber with which the said tubes communicate.

1,121,002.—MINING-MACHINE. Charles E. Davis, Chicago, Illinois, assignor to Goodman Manufacturing Co., Chicago, Illinois. A mining machine comprising a stationary frame and a movable frame, a motor associated therewith, a mechanism associated with the frames for removing them relatively, a propelling mechanism forming part of the machine for moving the entire machine from place to place, said propelling mechanism normally disconnected from the motor, and means for connecting said propelling mechanism with the motor under predetermined conditions.

1,114,372.—PROCESS OF ROASTING ORES. Frederick Laist, Anaconda, Montana. In the treatment of ores and other material, the process of subjecting a charge of the ore while traversing a treatment chamber to the action of hot reaction-supporting gases, introducing said gases in a direction conforming to the general direction of movement of the ore in said chamber to prevent overheating of the charge, removing the resulting hot calcines from the influence of the said gases, completing the treatment of the calcines thus removed, without further application of heat and conducting the gases from the final treatment to the charge traversing the treatment chamber aforesaid.

1,121,985.—PLACER-MINING MACHINE. Arthur E. Custer, Salt Lake City, Utah. In a placer-mining machine the combination of an inclined sluice-box; a plurality of pyramidically shaped tanks forming a bottom in said sluice-box; a screen in said sluice-box forming a foraminous covering for said tanks; a valve-controlled pipe in the bottom of each of said tanks; a riffle sluice suspended below and inclined in the same direction with said sluice-box; and a nose piece on the lower end of each of said pipes and spaced along said sluice-box, and adapted to deliver progressively finer grades of material at successive spaced parts of said riffle sluice from its head to its discharge end.

RECENT PUBLICATIONS

ABRIDGED TABLES OF HYPERBOLIC FUNCTIONS. By F. E. Pernot. University of California publications in mathematics. P. 7. Berkeley, 1915.

ECONOMIC MINERALS AND MINING INDUSTRIES OF CANADA. Special edition prepared for the Panama-Pacific Exposition. P. 78. Map. Ottawa, 1914.

COAL MINING PRACTICE IN DISTRICT III. By S. O. Andros. *Bulletin* 9. Illinois Coal Mining Investigations. P. 30. Illustrated. University of Illinois. Urbana, 1915.

WATER SUPPLIES IN THE PHILIPPINES. By Alvin J. Cox, George W. Heise, and V. Q. Gana. P. 138. Ill., 5 plates. Paper in *The Philippine Journal of Science*. Manila, July 1914.

REPORT of the Purdue University Agricultural Experiment Station. *Circular* No. 46. P. 355. Maps. La Fayette, Indiana. November 1914. A study of stallions and jacks in the state.

THIRTEENTH BIENNIAL REPORT of the Bureau of Mines of Colorado for 1913 and 1914. By T. R. Henahen, commissioner. P. 228. Ill., index. Denver, 1914. An abstract of this report appeared in the *Press* of March 6.

MECHANICAL COMPOSITION OF CLASTIC SEDIMENTS. By Johan August Udden. Reprint from the Bulletin of the Geological Society of America. P. 89. A discussion of three classes of sediments, namely, glacial till, water, and wind deposits.

TRANSACTIONS of the Canadian Mining Institute in 1914. Vol. XVII. Edited by the secretary, H. Mortimer Lamb. P. 507. Ill., maps, charts, index. Montreal, Quebec, 1915. Numerous abstracts have already been made in the *Press* from the pamphlets containing the papers included in this volume.

MINERAL PRODUCTION OF BRITISH COLUMBIA, 1914. Preliminary review and estimate. By Wm. Fleet Robertson. *Bulletin* No. 1, 1915. P. 42. British Columbia Bureau of Mines, Victoria. The output was $4,107,378 less than in 1913. Abstracts of the report appeared in the *Press* of February 27 and March 6.

THE ECONOMIC VALUE OF PACIFIC COAST KELPS. By John S. Burd. *Bulletin* 248. College of Agriculture Experiment Station, University of California. P. 33. Illustrated. Berkeley, 1915. The giant kelps contain large quantities of potassium salts, also iodine, and nitrogen, which will possibly justify commercial recovery.

FIFTH BIENNIAL REPORT of the State Forester of California, G. Morris Homans. P. 202. Ill., table. Sacramento, 1914. This is an interesting compilation of an important subject. It includes forest legislation, state forest organization and fire protection, federal and state control of forests, cut-over land study, railroad rights-of-way investigation, fires, and prosecutions.

COMPARATIVE STATISTICS of Lead, Copper, Spelter, Tin, Aluminum, Nickel, Quicksilver, and Silver. Twentieth annual issue. 1904-1913. Metallbank und Metallurgische Gesellschaft. Frankfort on the Main, July 1914. P. 109. American Metal Co., 61 Broadway, New York. As a résumé of the world's production and consumption of metals, this compilation is very valuable.

University of California publications, Berkeley, 1915:

REMAINS OF LAND MAMMALS FROM MARINE TERTIARY BEDS IN THE TEJON HILLS, CALIFORNIA. By John C. Merriam. P. 6. Illustrated.

AN OCCURRENCE OF MAMMALIAN REMAINS IN A PLEISTOCENE LAKE DEPOSIT AT ASTOR PASS, NEAR PYRAMID LAKE, NEVADA. By John C. Merriam. P. 8. Illustrated.

PROCEEDINGS of the Sydney (New South Wales) University Engineering Society, 1912. P. 71. Illustrated. The papers are as follows: 'Transferring the Surface Meridian to Deep Underground Surveys,' by R. A. Cambage; 'On the Loss of Heat Due to Bends in Pipes,' by T. P. Strickland; 'System of Assay Plans in Use at the Hercules Mine, Tasmania,' by G. B. Boydell; and 'Notes on Flotation—Summary,' by F. A. Eastaugh.

Bulletins of the Cement-Gun Co., 30 Church street, New York:

EXPERIMENTAL LEVEES WITH CONCRETE PAVING AND SHEET-PILE CUT-OFF, MISSISSIPPI RIVER. By C. O. Sherrill. No. 60. P. 4. Illustrated.

CEMENT-GUN CONSTRUCTION AT THE HOSPITAL FOR THE INSANE, WHITBY, ONTARIO. By H. B. Magowan. No. 90. P. 3. Illustrated.

Mississippi State Geological Survey publications, Jackson, 1911:

THIRD BIENNIAL REPORT. June 30, 1909, to June 30, 1911. P. 14.

SOILS OF MISSISSIPPI. A preliminary study. By E. N. Lowe. *Bulletin* No. 8. P. 220. Illustrated.

STRUCTURAL MATERIALS OF MISSISSIPPI. A preliminary report and supplement. *Bulletin* No. 9. P. 85. Illustrated.

HAND FIRING SOFT COAL UNDER POWER-PLANT BOILERS. By Henry Kreisinger. *Technical Paper* 80. P. 83. Ill., index. U. S. Bureau of Mines, Washington, D. C., 1915. This paper should be secured by mine and power-plant operators. The Bureau is making tests to determine how fuels can be used most efficiently for different purposes, and this report contains descriptions of methods of firing soft coal with that end in view. The notes are given in a thoroughly practical manner.

DETAILED REPORT ON LOGAN AND MINGO COUNTIES, WEST VIRGINIA. By Ray V. Hennen, David B. Reger, and W. Armstrong Price; I. C. White, state geologist. P. 776. Ill., index, and case containing two large maps. West Virginia Geological Survey, Morgantown, 1915. Price, $2 postpaid. A thoroughly prepared work. In addition to the detailed description and revision of all the rich coal beds and other geologic formations exposed in these counties, the geologic map gives the structure contours and outcrops of the celebrated No. 2 gas coal, as also that of several other valuable coal beds, along with many new sections.

U. S. Bureau of Mines publications, Washington, D. C., 1915:

METALLURGICAL SMOKE. By Charles H. Fulton. *Bulletin* 84. P. 84. Ill., charts, index. This is a valuable compilation of an investigation into the fume problem of the country at smelting and ore-roasting plants, and will be dealt with at length in the *Press*.

WHAT A MINER CAN DO TO PREVENT EXPLOSIONS OF GAS AND OF COAL DUST. By George S. Rice. *Miner's Circular* 21. P. 24. This is another contribution to the literature on coal-mine explosions.

THE MINE under the Palace of Mines and Metallurgy at the Panama-Pacific Exposition. P. 12. Illustrated. A description of the mine and Bureau exhibits.

MINING DECISIONS

Possession of Minerals—Presumption

A possession under general warranty deed of a tract of land is possession of the surface and the minerals below the surface, unless the minerals have previously been separated from the ownership of the surface by prior conveyance.

Big Sandy Co. *v.* Ramey (Kentucky), 172 Southwestern, 508. January 20, 1915.

Coal Lease—Guaranteed Tonnage Clause Construed

A coal lease contained a provision for the payment of a flat rental for a stipulated number of tons of coal to be mined each year, and for making up deficiencies in such annual tonnage within six years after they should occur. Held, that the stipulated number of tons must be mined in a given year before any part of the tonnage mined in that year could be applied on the deficiency for preceding years, so as to stop the running of interest on the royalties due on such deficit.

Hodgdon *v.* Lehigh and Wilkes-Barre Coal Co. (Pennsylvania), 92 Atlantic, 752. October 5, 1914.

Oil Lease—Contract Vitiated by Fraud

Assignees of an oil lease who have induced third parties to enter into a contract for a part interest in the lease upon representations that the royalty under the lease was 20%, whereas a matter of fact said assignees were under obligation to pay the original lessees from whom they had taken their assignment an additional 10%, making 30% in all, have not acted in good faith toward such third parties, and the contract may be rescinded upon suit of the latter.

Glass *v.* Templeton (Missouri), 170 Southwestern, 665. November 27, 1914.

Trespass on Vein Owned by Another—Damages

In case of an innocent trespass in a mine where the trespasser sells the finished product of metalliferous ores, the measure of damages is the gross value of the ores in the mine before removal, and this may be ascertained by deducting from the gross proceeds or value of the finished product the cost of making the product at the time of conversion. Where the trespass is wilful, however, the measure of damages is the gross proceeds of the ore without any deduction for mining or milling.

Liberty Bell Gold Mining Co. *v.* Moorhead Mining & Milling Co. (Colorado), 145 Pacific, 686, January 4, 1915.

Alaska Coal Lands—Opening and Improving Mine

The discovery of an outcrop of coal on a tract of land does not constitute the opening and improving of a mine thereon within the meaning of Section 1 of the Act of April 28, 1909, providing "that any person or association of persons qualified to make entry under the coal land laws of the United States, who shall have opened or improved a coal mine or coal mines on any of the unsurveyed public lands of the United States in the district of Alaska, may locate the lands upon which such mine or mines are situated." No right of location and entry under said act is acquired by merely discovering an outcrop of coal, staking the claim, recording the notice of location, and applying for patent.

John L. Long (Land Department), 43 Land Decisions, 305. May 27, 1914.

Clay Deposits—Not Subject to Mineral Patent

In a placer patent application, where the land described was in conflict with a prior railroad grant, the only showing of mineral value was based on deposits of shale shown to contain varying percentages of silica, alumina, iron oxide, calcium carbonate, and limestone, whose only suggested use was for the manufacture of portland cement. Held, that on account of the wide distribution of this clay, the small proportion its value bears to the cost of manufacturing cement, and its dependence for being used on various artificial conditions, it is not a mineral deposit such as would warrant the withholding of a tract on which it occurs from disposition under a railroad grant or patenting it under the mineral laws.

Victor Portland Cement Co. *v.* Southern Pacific Railway Co. (Land Department), 43 Land Decisions, 325. June 6, 1914.

Extralateral Right Not Sustained

In a suit involving the ownership of certain orebodies lying within the vertical boundaries of a patented claim, the Ontario, the plaintiff attempted to prove an extralateral right therein covering said orebodies, basing its claim to such an extralateral on an alleged contact between the secondary vein in the adjacent Stewart Fraction claim and a well defined fault, causing the said secondary vein, which entered the Stewart Fraction through a side-line, to turn and pass out through an end-line. The court found, however, that the vein was cut off by this fault and did not turn and pass out through the end-line as alleged. Held, that this finding precluded complainant from basing any extralateral right on the secondary vein; in other words, a secondary vein, entering the claim through one side-line and terminating within the claim does not entitle its owners to an extralateral right on its dip. Hence, the orebodies lying within the vertical boundaries of the Ontario presumptively belonged to the owner of that claim.

Stewart Mining Co. *v.* Bourne (Idaho), 218 Federal, 327. November 2, 1914.

Placer Patents—Exception of Known Lodes

Where a placer patent was applied for on mineral ground near Butte, Montana, in 1879, and at the time when the application was made the only evidence of a 'known lode' within the boundaries of the claim was indications of a possible lode of possible mineral value in the form of prospect holes and float quartz and disintegrated outcrop, this evidence was insufficient to justify a decree excepting a lode subsequently discovered to be of value from operation of the placer patent. The general exception in a placer patent of "any lode known or claimed to exist when the patent was applied for," even though it be not defined is without warrant of law. The burden is always on the lode claimant seeking to locate subsequently to the grant of the placer patent to prove that his lode was known to exist at the time the placer patent was applied for. Such proof must show that at said time the lode was clearly ascertained and defined, and of such known extent and content that, in view of all circumstances and conditions affecting its worth, such as the importance locally attached to like lodes under similar conditions, ease or difficulty of development, facilities for ore treating, cost of mining and reducing ores, reasonable probabilities of development, and the like, it would then have justified location, development, and exploitation, and because of which it and the area attaching to or excluded with it were valuable, and more valuable than for placer mining purposes.

Clark Montana Realty Co. *v.* Ferguson (Montana), 218 Federal, 959. December 31, 1914.

Note.—This case goes further than most decisions in upholding the title of a placer patentee to lodes within his ground, and is difficult to reconcile with the theory that known lodes are altogether excepted from a placer patent and are subject to subsequent disposition by the Land Department under the lode law.

New Machines and Devices

Severe Tests for an Auto-Truck

Unusual demonstrations of load carrying and traction power have been given recently to dealers and visitors at the factory of the Thomas B. Jeffery Co., Kenosha, Wisconsin, where the new Jeffery 'Quad' or four-wheel drive truck is being manufactured. Some of these tests are very unusual, one of which is that of climbing a pile of lumber in which the heavy planks are arranged to provide steps respectively 4, 8, and 12 in. high. The angle of the slope is 49%, which represents an angle of 44.1°. The total weight of the truck, load, and operator used in this test is 8950 lb. The hay with which the truck is loaded weighs 3250 lb. Another severe test is given in which the truck has to pull itself out of a deep ditch.

Mine-Rescue Parties Telephone to the Surface

Devising ways and means for protecting human life in mines is probably the most prominent question before both mining operators and the government. The laws of practically every mining state now include statutes calling for regular inspections of all mines, and contain many safety regulations, which are being rigidly enforced. Not the least among these requirements is a law in a great many of the states compelling the use of telephones underground. The need of mine telephones is so obvious as not to require comment, and every important property in the world could not be operated conveniently without them.

During the past few years the Western Electric Co. has furnished several thousands of its No. 1336 mine telephones for use underground. Through this association with the U. S. Bureau of Mines and the prominent mining companies, attention has been directed to the urgent need for some means of communication between the advance or rescue party equipped with oxygen apparatus, and the rear party outside the mine. Careful consideration will convince anyone familiar with rescue work that a simple reliable equipment providing instant and continuous communication between the rescue party and the rear will be of great value. In the past many losses of life have occurred to members of rescue parties, which unquestionably could have been prevented if there had been some means of communicating with the rear, advising the need of aid, which easily could have been given. Another feature of importance is that such an intimate and constant communication with another human being on the outside encourages the rescuer far underground and prevents those sudden waves of overpowering fear that everyone more or less is subject to in times of great danger, particularly when in darkness and alone. Realizing the need of an equipment as above mentioned, the Western Electric Co. has, in spite of many difficulties, succeeded in producing a light, serviceable, and extremely simple telephoning equipment for use in rescue work. In developing this apparatus, the Bureau of Mines has been frequently consulted, and mine-rescue equipment can now be supplied which will fulfill every requirement of this specially severe service. As the man equipped with an oxygen helmet, which covers his mouth, cannot use the ordinary type of telephone transmitter, a special transmitter, known as the throat transmitter, has been developed, which is the only type of instrument that will satisfactorily meet the special requirements of rescue service. This transmitter is light and compact, and is provided with a soft rubber cup designed to be held firmly against the throat. A light pigskin harness is used to hold the receiver and transmitter firmly in position and in such a manner as not to interfere with any type of oxygen apparatus now on the market. The throat transmitter has been found by actual test to be entirely satisfactory, and to transmit speech practically as well as the standard Bell instrument.

The telephone equipment used by the man on the outside or at the rear, is a Western Electric standard switchboard operator's set, which consists of a chest-type transmitter and head-band receiver. The method of keeping the advance party connected up with the rear is accomplished through a small wire cable consisting of two copper conductors insulated with Western Electric black elastic enamel and two servings of silk, all covered over with a stout linen braid impregnated

MINE-RESCUE 'PHONE SET IN ACTUAL USE.

with a moisture-resisting compound. This wire is furnished in 500-ft. coils and is carried in a leather case fastened to the helmet-man's belt, and pays out as he advances. One end of this coil is equipped with an aluminum-encased plug and is connected with the head telephone equipment by means of an aluminum-encased jack. The other end of the coil is equipped with a similar jack, which connects with a plug and cord running to a battery and apparatus box. As the wire coils are of light weight (2 lb. 7 oz. each), several of them can be carried along by the rescue party, and as soon as one is run out, another can be connected in by means of the plugs and jacks, and the party proceed another 500 ft., and so on. Due to the special winding of these coils, it is not feasible for the mining company to rewind the wire once paid out, but as they are of comparatively low cost, a stock of them should be kept on hand by the rescue crew. The total weight of the equipment carried by the rescuer, including the head telephone apparatus, belt, leather coil, and one coil of wire, is only 5 lb. 4 oz. The battery and apparatus box is always a necessary part of the equipment and must be placed at the point where the person who is directing the rescue work from the rear, by means of the telephone, is stationed. It contains eight dry batteries mounted in a Patterson (screw type) battery holder, and a No. 466 key,

two jacks, and a battery gage mounted in a separate compartment fitted with handles and easily lifted out.

In many cases it will be found desirable to use cable for carrying the circuit down a shaft or into a slope mine up to the edge of the danger zone. For this purpose the large box and cable reel is furnished. It consists of a heavily reinforced, metal-bound, mortise-cornered box made of ash and containing an aluminum reel on which is 1300 ft. of special, stranded twisted paired, rubber covered and braided cable. The cable is flexible and strong. The rubber insulation is composed of 30% pure Para rubber.

The accompanying illustration shows the complete outfit, which is now a part of the U. S. Bureau of Mines exhibit in the Palace of Mines and Metallurgy at the Panama-Pacific Exposition. This particular one is the most advanced of others being tested.

In the 'mine' in the Mines Building, the Western Electric Co. has standard telephone equipments, and desk instrument in the superintendent's office. In the Varied Industries Building the Company has its main display, consisting of a complete lay-out of railway telephones and dispatcher's desk for trains, sectional-unit switchboards, bells and enunciators, riot bells, fire alarms, mechanical signaling sets, by which certain signals are given for each superintendent on a mine or mill wherever he may be, loud-speaking 'phones or announcers, and a variety of other apparatus, installed by A. G. Kingman, of the New York office, who was in charge from the end of December to March 8. Two prominent features of the exhibit are an immense telephone several feet high, and reels of armored cable.

Commercial Paragraphs

The Excavating Engineer for March contains varied information on the work of Bucyrus steam-shovels, such as basement excavation, construction of a reinforced concrete dam in Ontario, eight shovels at the Nevada Consolidated Copper Co.'s mine, and a lot of field notes.

W. C. Green, well known to the western mining trade for the past 25 years, and during the past six years representative of the mechanical goods department of the DIAMOND RUBBER CO., died February 13, from an attack of pneumonia. Mr. Green's work for the Company will be carried on by C. A. Tracy.

The HOLT MANUFACTURING CO., of Stockton, California, in its publication, *The Caterpillar Times*, for February, describes the firm's exhibit at the Exposition. In a future issue of the *Press* the display will be fully discussed. *Bulletin* H58 covers the Holt harvesters, specifications and cost of operation in the field.

T. A. Bennett, who for the past five years has had charge of the conveyor and elevator belt sales of the B. F. GOODRICH CO., Akron, Ohio, severed his connection with the Company March 1, to become the assistant to the general sales manager of the New Jersey Zinc Co., with offices in New York. Mr. Bennett will be succeeded by J. D. Mooney, formerly special mining representative for the Goodrich company.

The CALIFORNIA ORE TESTING CO., of San Francisco, has added a 2 by 6-ft. tube-mill to operate in combination with a battery of three 350-lb. stamps for all-sliming tests, or in combination with the five 1050-lb. stamps, or dry-crushing plant, for part regrinding. This unit has proved itself efficient in corroborating exact large-scale operations, and also in reducing tungsten ores on a fairly large scale.

The MARION STEAM SHOVEL CO., of Marion, Ohio, which manufactures railroad and revolving steam-shovels, electric and traction shovels, dipper, elevator and hydraulic dredges, scraper-bucket, clam-shell and orange-peel excavators, ballast and other unloaders, has published a 29-page booklet on 'Digging and Mixing Clay,' one operation. The work is well illustrated, and three blueprints give tables of specifications of standard models which are drawn to scale on these pages.

The WOOD DRILL WORKS, Paterson, New Jersey, has sent us several leaflets briefly describing its products. The new model No. 5 rock-drill is an improvement on the 3⅝-in. machine for large engineering undertakings, and has a capacity of 50 ft., finishing with a 4-in. hole, instead of 35 ft. and 3⅝ in. The machine has been thoroughly tested, being used in the hardest trap-rock for the past three years with great success. Some notes are given on hose couplings and menders.

In *Bulletin* E-35, superseding E-30, the CHICAGO PNEUMATIC TOOL CO. describes its 'Universal' electric drills operating on direct or alternating current. These were patented February 18, 1913. This feature of being able to use varied power is of great value to contractors and others, who may find it necessary to do work in districts which may be supplied with either current. Seven sizes of drills are made, adapted for drilling holes in metal from ⅞ to 1¼-in. diameter. No. 3 S S will drill up to 2¼-in. holes in wood. They weigh from 4¾ to 54 lb.—— The No. 11 Boyer riveting hammer is described on *Form* No. 212. This hammer is useful for expanding superheater flues and for other work. It will drive up to 1½-in. rivets.

Tests made on one of its 500-hp. Diesel-type engines are tabulated in a communication from the MCINTOSH & SEYMOUR CORPORATION, maker of Diesel-type oil-engines and steam-engines, at Auburn, New York. The oil used, from the Indian Refining Co., was of 33°B. gravity, having a heat value of 19,266 B.t.u. per pound. Five tests were made on January 11, showing the following results:

	No. 1.	No. 5.
Time of test, hour	0.5	0.5
Load, per cent	113.4	25.2
Speed, revolutions per minute	171	170
Brake horse-power	567	126
Oil consumption per hour, pounds	230	82.2
Oil consumption per b-hp.-hour, pounds	0.495	0.652

The LINK-BELT CO., of Chicago, in *Bulletin* 207 discusses its 'Link-Belt' electric hoist. This machine may be used where a slow hand-chain block, on a crank or elsewhere, only could be employed. The cut steel gears run in oil; a dynamic braking system is used, the descending load drives the hoist motor as a generator and uses it as a brake; a powerful solenoid brake automatically holds the load when current is interrupted, the hoisting cable can be replaced in 10 minutes; and the hoist is claimed to be quite safe. The whole is enclosed in a neat case. The one illustrated has a 4-ton capacity.—— In *Bulletin* 212 this Company describes its 'Wendell' centrifugal coal drier. Actual results at an Alabama coal mine show that 30 to 40% moisture in coal is reduced to 8% for the ovens.

The CAMBRIA STEEL CO., of Johnstown, Pennsylvania, has issued a 41-page bulletin on the 'Slick' mine ties. These were patented January 19, 1915, being the result of experiments to produce a metal cross-tie for mine and industrial railroads, as a substitute for wooden ties which are not conveniently available in quantity and at reasonable prices. The 'Slick' tie is of rolled steel section, light and strong, the necessary rail fastenings are always in place and cannot be lost. Track laying is quickly and cheaply done. A complete 36-in. gage medium-weight tie weighs about 10 lb. In dry places these ties should last 10 years, wet places not so long, but they may be coated for protection against water or sulphur. More head room in mine drifts is given than with wooden ties. They are convenient for extending tracks, and they are popular with miners in Pennsylvania. Twenty pages of the publication deals with weights and dimensions of ties and rails. At the Panama-Pacific Exposition the Cambria Steel Co. has an excellent exhibit of its steel products on view, including samples of the 'Slick' mine ties.

LIFORNIA
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MINING PRESS

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LEAVING CAMP

THE passing of the dog-sled and the coming of the railway means much to the great interior mining regions of Alaska. This railroad, to be built by the Government, will leave the coast at Seward and traverse the Susitna valley, across the Broad pass, to Nenana on the Tanana river, with a branch to Nulato on the Yukon. The subject is discussed in this issue.

ON THE VALDEZ TRAIL IN WINTER

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SAN FRANCISCO, APRIL 3, 1915

Buyers Directory—Page 28
Advertisers Index—Last Page

TABLE OF CONTENTS

EDITORIAL Page.

Notes 505
Alaska Railroads 506
The Passing of the Pioneer 507

ARTICLES

WHAT MINE SUPPLIES SHOULD COST.

By B. J. Silbert, with preface by the Editor....508-542

A comprehensive effort by the purchasing agent of the Tigre Mining Co., S. A., Esqueda, Sonora, to set forth the kind, amounts, and cost of the mine supplies purchased by that Company, as a preliminary step toward greater economy of effort by purchasers and sellers.

MINING NITRATES IN CHILE.

By John G. Beck..... 510

Methods pursued in Chile for the mining of *caliche* and the recovery of nitrates from it are in many instances crude. Notable improvements have been effected by the use of modern equipment at the property owned by the du Pont Nitrate Company.

ORIGIN OF OOLITES AND OOLITIC TEXTURE IN ROCKS..... 514

A summary of the investigations made by Thomas C. Brown on these interesting and important deposits.

SOME PROBLEMS IN COPPER LEACHING.

By L. D. Ricketts..... 515

Various methods have been studied, and Mr. Ricketts concludes that dilute sulphuric acid will give a high extraction from material less than 6 mm. cube. Precipitation can be done with iron at a profit, but electrolysis is preferable and practicable. The best method appears to be the use of SO_2 in electrolysis, without control of the iron content of the solution. Cost estimates are given.

SOME USES OF TRAVERSE TABLES.

By James Underhill..... 519

Traverse tables can be applied for a variety of purposes other than those for which they are ordinarily employed. A prominent authority on mineral-land surveying gives some examples of such uses.

AUSTRALIAN GOLD PRODUCTION IN 1914..... 520

MINING AT SANTA BARBARA.

By F. J. DeWilde..... 521

Shrinkage stoping is used in those veins of this part of the Parral district that are wide enough. In narrow portions of the veins underhand stoping is employed.

SWEDISH IRON ORE AND STEEL AT THE EXPOSITION..... 522

Sweden is an important mineral-producing country and has properly made an important exhibit at the Panama-Pacific International Exposition, in which the iron deposits, electric smelting industries, and the manufacture of steel products are well displayed.

Page.

FLOTATION: ITS SPHERE OF USEFULNESS IN GOLD METALLURGY.

By W. B. Blyth..... 523

Flotation has already become an important method in the metallurgy of the precious metals. Some of the considerations governing its use are here set forth.

PROFITABLE USE FOR OLD HAMMER DRILL..... 523

An ingenious way of making otherwise useless equipment serve a useful purpose.

CENTRIFUGAL *v.* RECIPROCATING PUMPS..... 524

A concise summary of the reasons why centrifugal pumps were chosen for the pumping plant at the Durban Roodepoort Deep mine instead of reciprocating pumps.

COSTS AT THE WASP NO. 2 MINE..... 524

Detailed figures as to operating costs at a new mine in the Black Hills, South Dakota, which has made an excellent record.

DEPARTMENTS

DISCUSSION:

Who Will Engineer the Engineers?
By Clyde M. Becker..... 525

A protest from a married engineer against opinions expressed by earlier correspondents.

Practical Points on Sampling.
By Wilson W. Hughes..... 525

A valuable suggestion as to how the cutting of a standard volume in sampling may be easily performed.

The Copper Beds of Coeur d'Alene.
By George Huston..... 525

A reply to criticism, including an attack on 'highbrow' geologists.

Electric Smelting at Tyssedal.
By Robert M. Keeney..... 527

A concise statement of the results attained in this interesting Norwegian plant.

CONCENTRATES 528

REVIEW OF MINING: Special correspondence from Deadwood South Dakota; Helena, Montana; Porcupine, Ontario; London; New York; Vancouver, British Columbia 529

THE MINING SUMMARY 533

PERSONAL 537

SCHOOLS AND SOCIETIES 537

THE MARKET PLACE:

Metal Prices 538
New York Metal Review 539
Current Prices of Ores, Minerals, Chemicals, Oil, and Candles 540

NEW MACHINES AND DEVICES:

Caterpillars at the Exposition 541
Pulleys at the Exposition 541
Commercial Paragraphs 541

EDITORIAL

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OUR London correspondent apologizes for mentioning the matter of a dinner in war-time; that only applies to those not at the front.

OFFICIAL announcement has been made by the Bureau of Mines that the cost of production of the 300 milligrams of radium bromide it has so far made was at the rate of $60,000 per gram, a marked reduction from the prices formerly prevailing in the open market.

AMONG the casualties of the war, we have to record the death of Leon Chester Thresher, a passenger on the steamship *Fabala*, which was sunk by a German submarine on March 29. Mr. Thresher was an American engineer on his way to the Broomassie mine, in West Africa; born in Massachusetts, he was well known on the Pacific coast, where he was educated.

FORCED loans are being assessed by the Villa government. Among companies recently mulcted may be mentioned, with the amounts, Amparo Mining Company, ₱150,000; Cinco Minas, ₱100,000; El Favor, ₱20,000; Mololoa, ₱10,000; Espado, ₱2000; Casados, ₱5000; Chapala Electric Company, ₱250,000; Bank of Londres & Mexico, ₱150,000; Bank of Jalisco, ₱100,000. While this is only an incomplete list from one locality, it will serve to indicate conditions fairly common in Mexico at present.

SNOW-SLIDES are an ever-present menace to mining operations in regions of heavy precipitation. This is recognized by operators, who take care usually to place their buildings and mine openings in situations where the topography of the surface renders slides improbable. The great danger lies in the circumstance that under unusual conditions slides sometimes take place at points where they have never previously been known to occur. The great slide which occurred at the Britannia mine, in British Columbia, a short time ago, causing the loss of many lives, was of this nature. More details of the catastrophe are given on another page.

RUMOR says that Carranza is to evacuate Mexico City and that Obregon is to re-occupy it. Apparently the contents of the treasury have ceased to be interesting and pickings are better outside the capital. Carranza and Villa are fighting over Matamoros, to the imminent danger of peaceful spectators across the international border at Brownsville. The military operations are on an insignificant scale, but it is possible that the immediate result may exert a wide political influence. It looks as if Mexican affairs would have to become worse before they can be better.

AN unusual phase of the present period of prosperity in the Joplin district is the circulation by the Lyon Investment Company, a local concern, of a letter cautioning investors against a repetition of the wild-cat speculation and over-capitalization period that followed the high prices of 1899. Anyone who was familiar with the district in the years succeeding that orgy of high prices will hope that the warning will be heeded. There is much money to be made out of zinc mining. It is a most excellent business when approached in a business-like manner, but the small uncertain mines from which much of the money made at Joplin has come, are not suited to stock ownership, and periods of exceptional prices, such as the present, are inevitably followed by others of depression.

STATE-MANAGED liability insurance has been a success in California, according to a report which the State Insurance Fund has just made public. The operating expenses of the Fund, other than claims, amounted to 8 per cent of the total premiums during 1914, the lowest record ever made in state-managed insurance, and 15 per cent of the premiums collected is being returned to all policy-holders, except those who paid the minimum premium. During the year the Fund wrote net premiums amounting to $547,000, and now has an unapportioned surplus of 28 per cent, that will be returned to the policy-holders when the excess of legal reserves over actual losses has been determined and withdrawn. The officers of the Fund deserve great credit for the capable way in which they have managed its business.

ALASKA RAILROAD

At the time of writing, no official announcement has been made regarding the proposed route for the Government railroad linking the Yukon basin with the Pacific coast, or 'the outside,' as the 'sourdoughs' call it. The interest of the subject, however, warrants us in making a forecast based on unofficial surmises. It appears likely that Seward will be the terminus on the coast and that the line will run across the Kenai peninsula to Knik, on the estuary of that name, thence along the Susitna val-

ley, across the coast range at the Broad pass, down the Nenana river to its confluence with the Tanana, at the settlement of Nenana, situated a short distance below Fairbanks, the chief distributing point for the Tanana watershed. A branch railroad will be extended from Knik to the Matanuska coalfield and a longer extension will be made from Mile 187 through the Kuskokwim mining district to Nulato, the old trading-post on the Yukon itself. This will involve the purchase by the Government of the Alaska Northern Railroad, from Seward to Knik, about 70 miles, the price stated being $1,150,000. On the other hand, it would appear that the Copper River & Northwestern Railroad, owned by the Morgan-Guggenheim interests, is not to be acquired. The latter railroad has been the subject of a lurid chapter in Alaskan history and a cause of contention from its very inception. Apparently the engineering commission advising the Government has found the line unsuitable, on account of the long stretch of threatening glaciers along which it makes a precarious way into the coast range. Our own knowledge of the region indicates that the route selected by the Government commission is the proper one. We hope that the selection presages an immediate construction of the railway itself, which will serve several important mining districts, producing coal, copper, and gold, and will become the main artery of commerce to a vast mineral region in the North.

The ordinary man does not realize the bigness of this region because he sees it on small-scale maps, usually that of North America. Alaska covers an area of 590,000 square miles. From Skagway to Nome, by the Yukon, is 2275 miles. So far, only the rim of this territory has been tapped by two or three little railways, the bulk of the traffic going by water along devious routes. As a mineral region it is of growing importance, having long ago made ridiculous the price of $7,200,000 paid for it in 1867 by the United States to Russia. The annual output of gold alone exceeds twice the original price.

COPPER

The predominant feature of the copper metal-market during the past two years has been the excellent control of the producers. To this there has now been added the complete control of the export trade by the British Government. The exporters of copper have been exceedingly busy men, not only during the months preceding the war, when demand was at a high level, but since hostilities began, when it became necessary for them to enter the field of international diplomacy. The right of search, which Great Britain has always claimed to hold, sprang into immediate importance when it became a part of Britain's campaign to keep copper from finding its way into Germany. Today practically every shipment of copper is approved by representatives of the English government before it leaves our ports. In consequence, England and the neutral nations of Europe are taking all of our export copper. Theoretically, Germany can import copper on the same terms, whenever it can secure such control of the sea as will make it possible for shipments to get through to that country. The striking thing about the recent arrangements as to copper shipments is the fact that the State Department was apparently unable or unwilling to help the shippers out of their dilemma and, as an alternative, consented to the shippers taking the matter up directly with the English representatives. All of which goes to prove the statements that have been made as to the versatility of the men who handle the producers' end of the copper metal-market. Exports are now moving smoothly and without a hitch. In the meantime domestic deliveries have moved up to record figures, though it is impracticable to get at them with the same exactness that was possible when the Producers Association gave out its compilations. Wire-mills are said to have come into the market in the past two weeks, while the demand for brass, for war munitions of one kind and another, grows larger as plants are getting into operation. Many of the factories in the Connecticut valley are just beginning to turn out work under new contracts, and the whole of the lower part of New England is busy making war supplies. It is said, although it cannot be confirmed, that sales of Lake copper were made last week at 17 cents; electrolytic was quoted at 15¼ cents, with a tendency toward further advance.

THE PASSING OF THE PIONEER

In 1914 the mining profession lost by death five men who had been peculiarly influential in the great development of mining in the Western States that has marked the period since the close of the Civil War. They stood as the representatives of two great currents of capital that were at once the cause and the effect of the large-scale gold-silver mining which has characterized the period and region. Associated with them were others, most of whom had gone before, and a few hale and hearty veterans who seem to have found the secret of perpetual youth. Of the five who died in 1914, three were native-born Americans and two were immigrants, one from Prussia and one from Canada. All were staunch in their Americanism, but cosmopolitan, as befits a miner, in their technology. James B. Haggin was a country lawyer who became a great mine-owner. Louis Janin was the trained engineer on whose judgment the capitalist took or refused properties. Thomas J. Grier was a telegraph operator who became a great mine-manager working for the Haggin-Hearst group. Samuel B. Christy was an instructor in chemistry who became the head of a great mining school, largely supported with money from mines approved by Janin, managed by Grier, and owned by the widow of Haggin's business partner. These men were bound together by personal and professional ties, and they represented a typical American group; the shrewd trader who foresees and stimulates the development of natural resources but confirms his judgment with the best the profession affords, the practical operator who builds

up a great enterprise, and the scholar who passes on to the succeeding generation the best of the technology developed in connection with this work. The Haggin-Hearst combination was one that made its money out of the ground. The men at the head were primarily miners of ore, not manipulators of stocks. They took the legitimate chances of mining boldly for themselves, sharing risks and profits honestly with a few friends; they scored many successes and had their share of failures. All over the West the scout of today finds the marks on the trail made by these pioneers. It is interesting to note that, in the difficult market-days of last August, shares in the Homestake Gold Mining Company were among the few that scored a rise, and that, with the same dividend rate, the shares have recently sold above United States Steel preferred. These pioneers not only hunted out the best opportunities, but they built well on what they found.

The second group represented among the men who died in 1914 was the Exploration Company of London, of which Henry Bratnober was long a field-agent. Associated with him were Alfred Wartenweiler, who died in 1912, and, less closely, Mr. Henry Callahan, who fortunately is still among us with judgment keen as ever and spirit untouched by age. At the head of this group was first Hamilton Smith and later Mr. R. T. Bayliss, who still, in London, maintains an honorable and influential tradition in mining. Of the many others affiliated with these men, there is not here space to speak. It was a notable group, changing from time to time as such groups do, but through long years Bayliss stood at the head and Bratnober scouted the field. In contrast with the Haggin-Hearst combination, the Exploration company worked with public capital and depended on the market. It, however, put money into mining, developed successful mines, and made large and legitimate profits. In the United States it was the pioneer in bringing foreign capital to mining which previously had been considered too speculative.

We have already printed brief sketches of Wartenweiler, Bratnober, Haggin, and Grier, and editorial references to Janin and Christy. The group as a whole was a notable one, and any complete account of their careers would resolve itself into a history of mining through the last half-century. It would be difficult to say which among the men listed played the most influential part. Bratnober, as superintendent at the Drumlummon, gave English investors faith in the stability of American mines, and his memorable tramp alone from Dawson City to bring news of the Klondike is part of the history of the Far North. Louis Janin, perhaps the most distinguished of the distinguished brotherhood of Janins, brought sound learning from Freiberg to the Comstock, and to various other districts in western North America. He was the engineer on whose report Haggin and Hearst bought the Homestake mine, and he scored other great successes as well. One of the gay Bohemian crowd of the old San Francisco, he valued life more than money, and while always hardworking and sound in his technology, never was drawn into the scramble for dollars. Haggin amassed a large fortune and to the day of his death was an active factor in many widely scattered enterprises. Grier worked long years faithfully, and he built unobtrusively but well. It was our great pleasure shortly before his death to record the singularly strong commendation passed upon his work by the Commission that has been investigating industrial conditions throughout the United States. This was all the more welcome, since bitter partisan criticism had been heaped upon him; the not unnatural result of the fight that he waged, without troops, without riots, and almost without accidents, against the Western Federation of Labor and which resulted in the marked defeat of the Federation.

Christy stood somewhat aside from the active field in which these other men worked. With the rare exception of the few times when he advised regarding metallurgical matters in law cases, he devoted his long career exclusively to the College of Mines of which he was the head. From the time that he graduated in 1874 to the day of his death he was connected with the College. He was placed in charge in 1879, and it was his good fortune to have the planning and furnishing of the Hearst mining building, the granite structure that commemorates the pioneer miner whose name it bears. Christy was devoted to teaching, but found time for investigation of the genesis and treatment of quicksilver ores, for studies of chlorination, and for original work in cyanidation. Most of his time, however, was devoted to his students, and no one can read the long roll of names of men who have made good in mining around the world without feeling that his influence was deep and far-reaching. Mr. Charles Butters, who was in the first class graduated under Christy's instruction, has said: "If I were asked to name the most prominent quality in his character, I should say it was his deadly earnestness." He has also related, as illustrating his helpfulness to former students, how Christy made an all-night journey to Kennett to take Butters from laying a pipe in a ditch in the midst of rain and mud, and sent him off to Africa and the brilliant career that we all now know.

The pioneers are passing. Hard-headed, rough-handed, practical men who became great leaders of industry; scouts, capitalists, engineers, and teachers; they are going one by one. Soon the early days of mining—and Mr. Hennen Jennings has made it clear that mining as we now know it is essentially modern—will be known to us only by tradition and through writings. Already the young men are becoming old men, and the radicals of yesterday are the conservatives of today. But mining itself is always young. Always there are veins to be explored, orebodies to be found, and mines to be opened; always problems to be solved and processes to be developed. Our predecessors did their part. It is left to each generation in turn to pioneer for the next.

What Mine Supplies Should Cost

By B. J. SILBERT

[In order that the full significance of the data that Mr. Silbert has compiled with great care shall not fail of appreciation, it will be well to point out in some detail the reasons why such a compilation as this is of great value to both the seller and the buyer. Each of them is apt to fail to appreciate how closely his own interest is linked with the interest of the other. Every man knows that a special job is exceedingly expensive, and that whenever an article becomes standardized its cost is greatly decreased, but the full ramifications of this idea are not generally appreciated. The great variety of materials which a mining company purchases is well brought out in the cost sheets given farther on, and may be indicated by the fact that purchases were made from 361 firms, including such diverse industries as makers of billiard tables, tent manufacturers, book publishers, optical instrument makers, and paint manufacturers. Many of these purchases only involve comparatively small sums and may not therefore be regarded as of importance. Nothing could be farther from the truth, for the aggregate of these purchases amounts to a large sum and is of importance. Every purchaser is anxious to save $500 on a single $5000 order; it is just as profitable to save $500 on a multitude of orders aggregating $5000. The reply will at once be made that the amount of attention and correspondence required to save a dollar on a small order is not worth while, but the point is overlooked that with a proper co-ordination of buyer and seller the necessity for most of this trouble on the part of the purchaser would not exist. With any company this situation is constantly arising: "We need a few dollars worth of this or that, where can we get it?" Nobody knows, but after some effort a firm is found that can supply the needed article, and the purchase is made. In many cases a slightly different article, at perhaps half the cost, would have met the need just as well; or it might have been bought of some nearby firm, instead of a distant one, at a corresponding saving in transportation cost. The lost motion arises from the fact that each purchasing agent breaks a fresh trail for himself in the making of minor purchases. If the buyer and seller can be brought together in such a way that the necessity for this useless work does not exist, both will be the gainers thereby.

Sellers of goods are also subject to lost motion. They endeavor to get in touch with possible purchasers through the medium of salesmen, direct correspondence, and advertising. Where there is a reasonable possibility of securing a large order a salesman can be employed, on a small order his traveling and other expenses consume all the profit on the sale, and it is only in so far as his visit leads to later unsolicited orders that it is profitable. Correspondence is also expensive, unless well directed; in the average office a personal letter costs about 10c. to send, if all cost factors are included. Advertising is a means of reaching a wide public at a low cost per individual, but with it also the effect must be permanent to be profitable. A cigar-maker does not advertise his brand of cigars in the hope that everyone who sees his advertisement will at once buy a box. He advertises continuously and judiciously with the expectation of impressing his name on the memory of the public as a maker of goods of the quality he represents them to be, in the hope that from time to time those who have received this impression will purchase his product, that will thereafter sell itself to that buyer. The lost motion arises because the seller does not know exactly where all his buyers are to be found, and therefore he usually concentrates his efforts on one or more fields that he arbitrarily assumes will yield the best returns, and totally neglects the fields which will yield some, though less returns. In certain lines of products the mining industry has highly specialized needs, such as are now being covered by the advertisements appearing elsewhere in this journal. But, as shown by the cost sheets given by Mr. Silbert, rock-drills, dynamite, mine-cars, and metallurgical equipment do not circumscribe the whole field of a mining company's activity. If this list were to be extended to cover the whole mining community an even greater diversity would be found. As to many of these products the needs of the mining community are to some degree special, and the seller does not know how they differ from the ordinary, nor does the buyer know to what degree the seller can meet his needs. Mining companies build many houses, usually in regions where careful attention to heating requirements is necessary, but no maker of heating equipment seems to be aware of the fact, and the superintendent who is charged with building houses for his men is at a loss to know what kind to choose or whether it will prove satisfactory. The mining company needs typewriters, filing cases, card indexes, and so on; where shall it buy the most satisfactory article at the best price? The mining community needs automobiles, insurance, life, fire, and accident, phonographs, player pianos, books, gasoline, kerosene or gas stoves, household electric equipment, and other things too numerous to mention. Where shall it buy them to the best advantage and get what will give the best service. Here is where the lost motion now exists. The following article is the first attempt to make the needs of the purchaser clear. If the seller can obtain a clearer and more accurate idea of what the purchaser wants, and the purchaser of what manufacturers have to sell, both will profit by it. It will be our endeavor to devise a means by which this may be brought about.—EDITOR.]

The accompanying forms and data are offered as a contribution to the rather negligible portion of the literature hitherto devoted to a somewhat important branch of the industry—that relating to the purchases of sup-

plies. It has long seemed to me that but little of concrete interest to the many concerned with this phase of mining, has found its way into the pages of the mining journals. That which has been written has been of an extremely cursory nature.

Naturally, from the inception of operations, every operator must purchase supplies. Generally, until a producing stage has been reached, attempts by small operators at maintaining a well organized and dependable system of records for the guidance of those who make the purchases, are somewhat abortive. The invoices, as they accumulate, are plastered in invoice books or stuck away in files. Not until card systems are installed is there a well ordered method of quickly arriving at comparative costs.

Except in going concerns—where the services of a purchasing agent are available—the person who buys has rather vague ideas of what the first cost of supplies should be upon which he has not received quotations beforehand, and the like of which he has not theretofore purchased, since the vacillating tendencies of supply house-discounts, governed by the size of the order and the standing of the purchaser, preclude the possibilities of any accurate knowledge of costs being obtained from the catalogues. It is for the particular interest of these small operators that these forms are offered. Those in Mexico will find of especial service the columns devoted to Mexican duties. Those in the Southwest may see in the first costs at the large supply centres of Denver and El Paso information of some value to them. To engineers in these localities, planning construction work, and to operators figuring on additional installations, some helpful figures may be seen in these data.

The costs herewith shown are compiled from the purchase cards of the Tigre Mining Co., an operator, the extent of whose purchases may be learned from the list below:

Cyanide (100%)	700,000	lb.
Flint pebbles	1,000,000	lb.
Zinc dust	120,000	lb.
Muriatic acid	160,000	lb.
Litharge	20,000	lb.
Borax glass	20,000	lb.
Bone ash	6,000	lb.
Bi-carbonate of soda	6,000	lb.
Fluorspar	4,000	lb.
Silica	16,000	lb.
Soda ash	16,000	lb.
Crucibles	500	
Gas oil	25,000	gal.
Mixed oil and greases	2	carloads
Carbide	100,000	lb.
Carbide lamps	1,500	
12-lb. T-rail	150,000	lb.
Black pipe	60,000	lb.
Iron and steel	2	carloads
Cement	200,000	lb.
Blacksmith coal	200,000	lb.
Blasting powder	150,000	lb.
Fuse	1,000,000	ft.
Caps	300,000	

To L. R. Budrow, general manager for the Tigre Mining Co., I gratefully acknowledge my obligations for permission to publish this material.

The first costs on most of the articles enumerated are generally as low as careful buying and keen competitive bids can make them. In the delivered costs, no handling charges are included; the figures stand for the original cost, freight to mines, expenses of crossing at border, and the duties. For the guidance of operators in Mexico, who seek a basis of comparison in these figures, it might be well to mention that beyond the border (Douglas, Arizona) aside from duties and commissions, the following costs are accrued:

	Per 100 lb.
*Railroad freight to Esqueda	₱0.50
Wagon freight to mines	1.20
Total	₱1.70

*Carload rate is about ₱0.25 (Mex.) per 100 pounds.

Those operating farther in the interior, whose freight cost from the border is, say ₱5 (Mex.) per 100 lb., need but to add ₱3.30 per 100 lb. in order to arrive at the comparative figure.

There is no attempt in mind in these pages to direct attention to particular supply houses or manufacturers, as indicating those from whom the best prices may be obtained. Several other firms in the locality may have supplied the article at an equally low cost at various times. Nor is it the intention that any information given herewith be construed as pointing out the most desirable supplies from the consumers' standpoint. For instance, many brands of rubber belting are listed. Some have been found more satisfactory than others by the Company. Some brands have been entirely dropped, while others are favored. It must not be assumed that the prices shown are those available at the present time, for the reason that a period of three years is embraced in this compilation. Furthermore, fluctuations and constantly changing market conditions during that time have probably altered the present complexion of some of the figures beyond recognition. Also, an error may be found here and there. In the main, however, the data are dependable, and it is hoped the publication of same may serve the purpose of encouraging those whom it interests in making further contributions to the literature on the subject.

All figures herewith shown are in Mexican currency at an equivalent of ₱2 Mexican money for $1 in U. S. currency. The present rate of exchange is much higher. In the table 'Frac.' refers to the schedule of the Mexican tariff under which the article is quoted. 'K.b.' is an abbreviation for *kilo bruto* or gross kilo; 'k.l.' stands for *kilo legal*, or net kilo.

(Continued on page 542)

GOLD PRODUCTION of the Homestake Mining Co., to December 31, 1914, totaled $134,181,596, of which $33,405,700 was distributed in dividends. These totals include production and dividends of the mining companies which have from time to time been absorbed by the Company.

Mining Nitrates in Chile

By JOHN G. BECK

On the west coast of South America, bounded by the still unexplored Andes on the east, is one of the richest lands of the world. It is also one of the most desolate and barren of regions. It is devoid of all vegetation. Not a plant, a tree, a blade of grass, or anything green is to be found. It is a land where the rain never falls, and is absolutely waterless except for that brought down by pipe-line from the adjacent mountains. It is a land of salty particles that reflect the sun's rays, inflaming the eyes and parching the skin.

Such a land is the great nitrate field of Chile that runs through the desert up the west coast from Taltal at the south to Pisagua at the north. This district, all of which is in the *provincias* of Atacama, Antofagasta, and Tarapaca, extends practically parallel with the Pacific shore-line. Bounded by the Pacific Coast range of hills on the west, which extend inland approximately forty-five miles, and by the foothills of the Andes on the east, which are from 25 to 30 miles farther inland, it consists of a plateau from 2600 to 7500 ft. above sea-level and 600 miles long. To the east, towering above the foothills, can be seen some of the majestic peaks of the Andes, one of which, Llullaillaco, is said to be 22,000 ft. high.

POWDER MILL.

THE RESULT OF A BIG BLAST.

While the mineral deposits in the mountains bordering the district have been a source of wealth for hundreds of years, being rich in gold, silver, copper, and tin, the greatest are the nitrate deposits, that for a generation and more have made Chile richer than any other South American country, and today are paying from 75 to 80% of all the government expenses and in addition are yielding fortunes to those who exploit them. Since 1889 many thousands of workmen have been employed on the *pampa* (nitrate fields) in the extraction of *caliche* or nitrate-bearing rock, from which the nitrate is obtained by the leaching process. During this time the total revenue from nitrate export duties has been over $400,000,000 in gold.

The nitrate beds are found in the desert, known as the *pampa*. The *caliche* is not regularly and evenly distributed, as much of it is found in pockets. Often a *pampa* comprises an area of several square miles, but there are others where the beds of good *caliche* are confined to a few hundred acres and less, and the nitrate content varies greatly. As a general thing the *caliche* is close to the surface. It crops out here and there and seldom extends more than twenty feet below the surface. There are places, however, where the beds carry an overburden of several feet of waste material, consisting of sand and *pauqueque*, which is a hard, dry clay. Such a condition exists on the *pampa* of the du Pont Nitrate Co., at *Oficina* Delaware, which is about 90 miles inland from Taltal, Chile. For a long time past it has been apparent that the present methods were far too costly at the present rates of labor. Though at different times experiments have been made by different producers to extend mechanical treatment to those processses which have always been carried out by hand, the results have not been satisfactory. Little was done to improve upon the primitive hand methods employed when nitrate was first worked until the new Delaware came under the ownership and management of the du Pont Nitrate Co., that with the usual Yankee initiative and vigor is installing costly machinery for an entirely new process.

The *caliche* lies in irregular beds or strata at some distance under the surface; and the method of getting it out is to bore a round hole, about one foot in diameter, from the surface through the sand, *pauqueque*, *costra*, and *caliche* to the *choro* or waste material which underlies the *caliche*. A large pocket is worked out in the *choro* under the *caliche*, and this enables the driller to pack practically all of the powder, used in blasting, at the bottom of the hole. Very often it takes several days to complete one of these holes, as the material is very hard and has to be drilled and blasted. The powder used is made at the *oficina* out of nitrate, charcoal, and sulphur. It is a slow-burning powder, but it has been proved that this low-grade

DRAG-LINE SCRAPERS OPERATING ON A 6 PER CENT GRADE.

powder is much more effective than the faster powders. The explosion breaks up the earth for a radius of 40 ft. around the charge, mixing the *caliche* with the waste material. All of this has to be separated, the waste material thrown to one side and the *caliche* broken up into lumps of such size that they can be loaded by hand into the cars or carts that transport it to the *maquina*, or factory, where the nitrate of soda is extracted as later described. It can easily be seen that this primitive method of getting out the ore is not only slow but costly, as the increased production of the past few years has created a greater demand for labor, with a corresponding increase in wages.

The du Pont company has installed a Bucyrus class 14 drag-line excavator, mounted on a caterpillar tractor, which is being used with great success for stripping the overburden, and it is expected that the machine will later be used for loading the *caliche* into cars. This machine is equipped with the standard 60-ft. boom and carries a 2-yd. scraper bucket, fitted with forged teeth, the points of which are made of tool steel, hardened. In view of the high wages paid, the average being 10 pesos (about $2 gold) per day, and the fact that practically all of the workmen are imported from outside the district, a machine such as the drag-line excavator, which is capable of handling without blasting, 1000 yd. and more per day and of doing the work of a hundred men, will revolutionize *pampa* operations and materially reduce the cost of production. Not only will it reduce the cost of operations, but it will make it possible to work isolated and abandoned places, where the cost of removing the overburden was prohibitive. Very often thin veins of almost pure nitrate of soda, from 50 to 75% pure, are found, but cannot be worked on account of the high cost of removing the overburden.

The material encountered is probably the hardest ever dug with a scraper bucket without blasting. The *pauqueque* is especially hard, consisting of dry clay and conglomerate, cemented into a solid mass with salts; in fact, this *pauqueque* is so hard that it is often mistaken by the inexperienced for *caliche*. The machine makes a cut about 100 ft. wide, removing the overburden to one side in a pile. All of the waste material is removed and the *caliche* left in a clean state ready for the drillers. After the ore has been taken out, the machine is moved back to the place where the cut was started and a new cut

OFICINA DELAWARE, OWNED AND OPERATED BY THE DU PONT NITRATE COMPANY.

taken out. The waste material in this second cut is deposited in the trench, from which the *caliche* has been previously removed. This operation necessitates the rehandling of the first spoil pile, but any number of cuts can be taken thereafter and the waste material deposited in the worked-out area, without rehandling.

As previously stated, the *caliche* beds are scattered over a large area. It is necessary to do a great deal of moving from one part of the *pampa* to another. For this reason the machine was equipped with a caterpillar traction, which enables the machine to be moved over very rolling ground at the rate of about ½ mile per hour, often climbing grades as steep as 10%. The excavator was not put to any very severe tests while I was at the *oficina*, but up to the time I left, it had done enough work to prove that it would meet every expectation of the purchasers, in fact it handled material without blasting that the purchasers had fully expected it would be necessary to blast before the machine could dig it.

The *caliche* as delivered at the *maquina* is in rough lumps and is crushed in an 18 by 20-in. crusher. It is dumped from cars—usually of the Koppel side-dumping design—into a bin that roughly holds 125 carloads of *caliche*. From the bin it passes through doors at one side to the Blake crushers which deliver the crushed *caliche* upon a short belt which discharges into a bucket elevator. The crushers are set to break the ore into pieces about the size of a man's fist, but because of the earthy nature of the material there is a considerable quantity of dust and smaller pieces. The elevator discharges above in the *maquina* into a chute, which in turn discharges into cars of a capacity of approximately one cubic metre or two tons, these cars being on tracks running over the boiling-tanks.

The solution of the nitrate and its extraction from the ore takes place in the boiling-tanks, the system being simply a counter-current solution treatment. In the various *oficinas* the number of boiling-tanks of course differs to a great extent and the minor details of operation may vary, but in the main it may be said that practically every *oficina* uses the same general methods in the treatment of its *caliche*. The *cachuchos* or boiling-tanks are usually about 40 by 7 by 8 ft., fitted with steam coils connecting to a main header running the length of the *maquina*. Each tank is connected with the tanks on each side of it by a valve which allows for the passage of liquor from one tank into the next. On each tank there are also two valves opening into a pipe below the tank, leading to the pumps, by which the liquor in any tank may be pumped into any other tank; also valves by which the *relaves* or wash waters may be drawn off to a storage tank below, and the valve from which the *caldo* or hot saturated solution of nitrate is run. In the bottom of each *cachucho*, 9 in. from the floor, are crinoline plates, perforated with ½-in. holes, beneath which the *borra*, or fine mud, collects. Along one side of the boiling-tanks run canals, through which the liquor, discharging from the pumps when pumping from one *cachucho* into any *cachucho* in the series ahead of it, flows, and through which the wash waters and *aqua vieja*, or mother liquor, are delivered to the proper tanks, these canals opening through plugs into each *cachucho*. Below this boiling-tank floor is the *ripio* floor where the *ripio*, or tailing, is discharged through two or three doors in the bottom of each boiling-tank into the dump cars which are drawn by mules to the dump.

The remainder of the apparatus consists simply of centrifugal solution pumps, a pump for water and *aqua vieja*, *relave* pumps, and various tanks for the storage of *relave* and *aqua vieja* and water. In many *oficinas* the *aqua vieja* and *relave* are preheated by the exhaust steam from the boilers supplying the power. There are also settling-tanks, in which the muddy *caldo* is allowed to clarify, and the crystallizing pans. Of settling-tanks there need be only four, of about 500 cu. ft. capacity each, for an ordinary sized *oficina*, and of crystallizing pans anywhere from 90 to 200, depending on the time which it is desired that the hot crystallizing liquor should stand. These crystallizing pans are usually of a capacity of 450 to 600 cu. ft., and of a size about 17 by 17 ft., having a sloping bottom, being 2 ft. deep at one end and 2½ ft. at the other. By the side of each line of bateas is a *falca* or draining platform, on which the wet nitrate when shoveled from the batea is allowed to drain before it is unloaded into the cars which carry it to the *caucha*, the final drying and sacking floor. The settling-tanks are connected to the *cachuchos*, and the crystallizing pans to the settling-tanks, by canals through which the hot liquor to be crystallized finally finds its way to the batea.

For the sake of conciseness, assume an *oficina* having 18 boiling-tanks in two sections of nine each, and operating on a basis of ten *fondadas* per day, that is to say, filling, treating, and discharging ten tank loads of *caliche* per day. This is a production of roughly 50,000 quintals per month (a quintal is 100 lb.). The object of the operation is, of course, to extract from the ore all the nitrate possible in the time allowed. For different classes of *caliche* different periods of steaming, steam pressure, and washing are found necessary, but the main operations remain practically the same. The *oficina* assumed will therefore make five *fondadas* per day from each section of nine boiling-tanks. Looking at the system at the time, say, when the hot saturated solution is being drawn off of the first tank in the series, we find this: Five tanks will be under steam, the liquid in them boiling or steaming. From the first tank under steam the *caldo* will be flowing through the *caldo* valve to the settling-tanks. The liquor in the tanks back of this *caldo* tank will be passing through the valve into the *caldo* tank, and correspondingly the liquor in each tank back as far as the sixth will be passing into the tank ahead, so that there is a difference of level from the height of the liquid in the sixth tank to the first tank. The sixth tank is filled with *relave*, not under steam, and this tank in turn is kept full, in order to maintain a head and force the liquors in the tanks ahead of it

THE MAQUINA DELAWARE.

through to the *caldo* tank, by pumping *relave* from the *relave* storage tanks. The seventh and eighth tanks will be soaking under fresh water, which, when it has stood for a sufficient length of time, is drawn off to the *relave* storage tanks, since it has taken up nitrate and salts. It is this liquid which is pumped to maintain the sixth tank full. The ninth tank will be empty, charging with *caliche*, or discharging *ripio*.

All densities of liquors are taken by a Twaddell hydrometer. The *caldo* is usually started to run when it has a density over 100°T., and is cut at about 95°. Between these two densities it will run perhaps for two hours. From each tank to the tank behind there is a drop in density of about 10°, since the tank farther back has had more extracting and therefore has less nitrate to pass into solution than the tank ahead of it. Imagine, then, that the *caldo* has dropped to 95°T. and has been cut. By this time tank number nine is charged with *caliche*. The liquid from the last *caldo* tank passes upon the fresh *caliche* in number nine; from which in turn, when the liquid has reached the proper density, the next *caldo* will be run. No. 2 passes into No. 1, No. 3 into No. 2, and so on. The steam on No. 5 is turned off and the steam on the fresh tank-load of *caliche* turned on. No. 5 is then filled with *relave* and now holds the same relation to the rest of the system as No. 6 did when *caldo* was running from No. 1. No. 6 and No. 7, of course, now become fresh-water tanks, and No. 8 is discharged or filled. It is at this time when the pass is being made upon a tank-load of fresh *caliche* that the *aqua vieja* or mother-liquor from the crystallizing pans, liquid rich in nitrate but which will no longer crystallize in the batea, is worked into the system. It will have a density of from 75 to 90°T. and is run into the tank under steam having the nearest density to its own.

It will be seen then that the strongest liquor passes into the least extracted *caliche* and the weakest liquor into the most extracted *caliche*, each tank-load of liquor, as it takes up more nitrate and increases in density, passing on to the tank ahead. The *caldo* drawn off from the boiling-tanks flows through a canal to settling-tanks,

ANOTHER VIEW OF THE REDUCTION PLANT.

where it is allowed to stand for about two hours. The mud and considerable of the salt and impurities here separate, and the settled *caldo* is then run directly to the batea, where, upon cooling, the nitrate is deposited. Of nitrate about 25 lb. per cubic foot of *caldo* is deposited. After cooling to air temperature, which requires from 5 to 10 days, depending upon the season of the year, the mother-liquor is drawn off through a canal to a storage tank, and the nitrate deposited in the batea is ready to be thrown on the *falca* to drain off as much of the *agua vieja* as possible. It is then carried in cars to the drying floor, where after standing for about a month it is sacked and shipped.

To supplement the above the following analysis may be of interest:

Caliche.	Per cent.
Sodium nitrate	15.00 to 30.00
Sodium chloride	2.00 to 15.00
Sodium sulphate	5.00 to 20.00
Magnesium sulphate	0.50 to 5.00
Magnesium chloride	0.00 to 5.00
Calcium sulphate	0.50 to 5.00
Sodium	0.04 to 20.00
Ripio.	
Sodium nitrate	3.00 to 7.00

Origin of Oolites and Oolitic Texture in Rocks

In a paper presented before the Geological Survey of America and recently published in volume 25 of the *Bulletin* of the Society, Thomas C. Brown gives the results of detailed studies upon oolites. The matter has considerable bearing upon the genesis of such widely different materials as the Clinton iron ore of the East and the phosphate beds of Idaho and Utah in the West. The paper is too long for reproduction, but Mr. Brown's general summary is presented below:

"From the observations here recorded it seems evident that the recent oolites now forming in Great Salt Lake and Pyramid lake are like those now forming in hot springs and in the open ocean, composed of calcium carbonate in the mineral form aragonite, and they frequently contain sand grains or nuclei of other foreign material. They probably are due to direct chemical precipitation caused by a reaction of sodium carbonate on the calcium sulphate held in solution by the water. The sodium carbonate in Great Salt Lake may be due to the decay of the dead minute algæ found so closely associated with these oolites below the limit of wave action. The argument in favor of these oolites having been derived from solutions of calcium sulphate is greatly strengthened by the fact that the great deposits of the oolitic sand along the shore of the lake are confined to a stretch near the mouth of the Jordan river, and this river until two or three decades ago carried calcium sulphate in solution in excess of any other salt. This salt is now exceeded in amount by sodium chloride, due to the effects of irrigation along the course of the river, but it is still the most prominent calcium salt.

"The older oolitic beds of Pennsylvania were probably all originally laid down as beds of calcareous oolites composed of the mineral aragonite. This mineral, being unstable under ordinary rock forming conditions, soon began to change. Where the beds were not affected by waters bearing other minerals in solution they simply changed to the more stable mineral calcite, and in doing so they often retained their original fibrous radiated and concentric structure. Sometimes, however, they became more or less completely changed into crystalline calcite, occasionally with twinned lamellæ.

"When the circulating waters contained magnesium salts in solution the oolites became altered to dolomite, and in doing so lost their concentric and fibrous structure. The oolitic structure is then only shown by the faint outlines of the original oolites, sometimes accentuated by a ring of rhombohedral crystals around their margin, developed when the process of alteration first commenced.

"When the circulating waters contained silica in solution the oolites were frequently replaced by silica. If the oolite had an original nucleus consisting of a quartz sand grain, this was frequently secondarily enlarged by the deposition of silica around it and in optical continuity with it. In other oolites the replacement was accomplished either by the deposition of granular quartz or of finely fibrous chalcedony. In any case minute rhombs of calcite are frequently inclosed in the replacing silica, showing clearly that the aragonite had in part changed to calcite before replacement by silica began. With the silica is often deposited minute quantities of iron oxide intimately mixed with the fibrous chalcedony.

"At the Clinton horizon in the Silurian, in Pennsylvania, and in other states along the Appalachian Mountain belt, one or more beds of iron ore occur which are either fossiliferous or oolitic. Oolites are present to some extent in all of these ores. They were evidently formed originally as aragonite oolites and later changed, together with the associated fossils, by ferruginous solutions, into oolites composed of iron oxide and silica intimately mixed, but with the iron oxide greatly in excess.

"It is very probable that the silica replacing the oolites of the Ordovician, and the iron and silica replacing the oolites of the Clinton, came from material already in the beds and at no great distance from where it now occurs. The silica probably came from sponge spicules and diatoms, and the iron (with its associated silica, perhaps) from green sand or glauconite."

RE-TREATMENT of residue at the Lake View Consols mine, Kalgoorlie, Western Australia, was started in May 1908. A vacuum-filter plant was used, and 826,084 tons was treated yielding 94c. per ton, at a cost of 62c. per ton. The December output of 56c. per ton resulted in a loss of 4c. per ton. This old material was a mixture from oxide and sulphide ore treated by a variety of processes in the experimental stage of the district before the best metallurgical methods had been determined.

Some Problems in Copper Leaching

By L. D. RICKETTS

*In recent years the metallurgical field of the copper industry has expanded greatly, the copper ores have become lean and diverse in character, and we are obliged to treat such ores on a very large scale. On the commercial side, the operating and consulting staffs of the great mining companies have been enlarged and organized, and no great capital expenditure is decided upon until it has been investigated and recommended by a highly organized force of specialists as a committee.

I believe that in the scientific field and in the most valuable proceedings of our various societies the old idea of one-man point of view and one-man treatment of principle and detail together has been splendidly developed and should continue, but for the advancement of our art we should deliberately discuss subjects among ourselves in order to do away with the idiosyncrasies of the individual and to gain a composite view representing the best thought of many men.

In the development of new ideas leading to the introduction of new methods, the societies could enlarge their present great field of usefulness if such discussion be had, and in my opinion further great good could be done if a number of men of different qualifications and experience would join in preparing a joint book, each dealing with his particular problem, but consulting the other men. In this way individualism would be preserved and various processes would be described, and if properly reviewed the paper would be palpably capable of analysis, and the student would have at his command the associated efforts of a group of qualified engineers.

I have neither the time nor the qualifications to make an investigation and study in detail of hydro-metallurgical processes, but for some years I have foreseen the development of such processes, and I have a deep interest in the subject and have given it in some of its phases careful consideration from a long-distance viewpoint. I have assisted in directing many experiments and in reviewing the merits of many processes, and am glad to make some introductory remarks with the understanding that other gentlemen present will freely and candidly enter into the discussion and help to fill out the few bare bones that I can uncover. You will see in my remarks that I am controlled very largely by operating demands. No matter how beautiful the process, simplicity and cheapness of operating costs are the main features that appeal to me, and complexity and increased costs only appeal to me if they definitely promise an increased yield that will more than offset the increased expense; for, given the grade, the maximum profit per ton is demanded.

As you all know, there has been a very large development of deposits of lean copper ores in the Southwest in recent years, and this region has rapidly developed until in the aggregate it produces more copper than any like area in the world, and it still has a large increase of output ahead of it. The vast mass of these lean deposits consists of sulphide ore, and until recently these sulphides alone have attracted serious attention. It is well known, however, that there are large deposits of oxidized copper ore associated with the lean porphyries.

A few years ago the Calumet & Arizona Mining Co., upon the recommendation of J. C. Greenway, took an option upon a majority of the stock of the New Cornelia Copper Co., whose mining properties are at Ajo, in southwestern Arizona. Mr. Greenway directed systematic drilling upon this property, followed by the sinking of some 70 shallow shafts for test purposes and the sinking of two deeper shafts, with considerable underground development, for the purpose of testing and checking the grade of the sulphide ore. The stock was purchased.

The matrix of the ore is eruptive granite. There is no overburden. The chalcocite has been oxidized nearly as fast as formed. The zone of transition from oxidized minerals to primary sulphides is narrow. The oxide and sulphide ore is remarkably uniform in grade. Ira B. Joralemon's paper, in the *Transactions*,[1] described this deposit. He shows that there is about 40,000,000 tons of ore containing 1½% copper, and the tonnage is divided into about 12,000,000 tons of 1½% oxidized ore and 24,000,000 tons of sulphide ore, with about 4,000,000 tons of mixed oxide and sulphide between. If the grade be dropped to an average of less than 1½%, these tonnages would rapidly increase.

In parallel with this development, oxidized ore in notable tonnage has been found in the Globe mining district. This ore is more scattered, and, on the whole, is leaner than the Ajo ore, and frequently has a large capping of overburden. In the aggregate, the Inspiration Consolidated Copper Co. alone now has over 15,000,000 tons of oxidized ore running about 1.3%, and a probable tonnage in addition. There are other mines in other districts containing oxidized ore, notably in Utah and Montana, and there are also oxidized ores at other points in Arizona and a vast deposit in Chile. The treatment of such tonnages is of prime importance.

The Ajo ore has a matrix of granite with a large percentage of secondary quartz replacing feldspar. There is little calcium present in soluble form, and the oxidized ore seems to be best adapted to a leaching process. Preliminary laboratory tests showed that the ore crushed with the production of remarkably little slime and that the copper will dissolve in dilute sulphuric acid quite freely when the crushed ore contains fragments no larger than 6-mm. cubes. Tests also showed that a little cuprite is present, which is only partly soluble in sul-

*Excerpt from a discussion at a meeting of the New York Section, A. I. M. E., January 6, 1915.

[1] *Bulletin* A. I. M. E., August 1914, pp. 2011 to 2028.

phuric acid. There are also other soluble salts, notably salts of iron and aluminum. It was decided to investigate a leaching process for the oxidized ore, and since the ore made but little fine and could be leached with comparatively coarse crushing, we decided that we would try to leach in tanks by percolation. The amount of silver in the ore is small. Salt is apparently expensive, and it was decided that, other things being equal, the use of chlorine compounds as solvents was not desirable. I know, of course, that chlorine compounds may have a great future in leaching, but in this particular case, and in the early development of a process, it was considered that sulphuric acid offers fewer difficulties as a solvent.

To me the hydro-metallurgical problem divides itself naturally into two nearly separate divisions—the solution of the copper, and the recovery of the copper from solution. We were obliged, however, to study the problems of solution on the basis of getting the copper into solution in the form most convenient for its ultimate recovery.

At the start we employed Stuart Croasdale to undertake a study of the solution of the copper, and we also delegated to him experimentation upon the precipitation of copper by iron. Mr. Croasdale ably conducted a long series of most valuable experiments and published a paper upon this subject which you will find in the *Transactions* of the Institute.[2] At the same time we were fortunate enough to obtain the advice of Utley Wedge upon the manufacture of sulphuric acid direct from calcining-furnace gases.

Mr. Croasdale demonstrated that the ore crushed to an 8-mm. cube, or smaller, would yield over 80% of its copper when treated with a dilute solution of sulphuric acid. He demonstrated that slime presented no difficulty if the ore was distributed in the tanks uniformly, and that by finer crushing 85% of the copper could be obtained in solution if treated for a sufficient length of time with an acid solution. He demonstrated not only that the ore was permeable uniformly, but that with comparatively small tanks the height was not a matter of great consequence, and he was easily able to use a column 12 ft. in height, and could probably use one much higher. Later on we found upward percolation preferable.

Mr. Wedge showed us that with care in calcining the sulphide fines for reverberatory furnaces at the Calumet & Arizona smelter at Douglas, sulphuric acid of 55 to 60° B. could be manufactured with a low operating cost, and a construction cost of not to exceed $3000 per ton of daily capacity. The point of manufacture is about 300 miles, more or less, according to the route, from the mine. Mr. Wedge also undertook a study of sulphating and chloridizing roasts. His requirements were that the ore be crushed to pass a 1½-mm. screen. He showed that if the sulphide ore could be mined in parallel with the oxidized ore, and in proportion to their respective tonnages, there would be sufficient sulphur for his purposes and that a very high extraction could be obtained. He also showed that sufficient advantage could not be had in using salt to offset its cost and the difficulties that might arise later. Mr. Wedge also showed that a small amount of heavy sulphides from the Bisbee mines crushed and mixed with the oxide ore would give a very high percentage of extraction after the mixture had been subjected to a sulphating roast. He also introduced the idea that a preliminary water leach would give a perfectly pure sulphate solution from which the copper could be recovered electrolytically and that the acid thus regenerated would be sufficient to complete the leach.

Frederick Laist in the meantime was conducting a number of experiments governing processes in a like brilliant way, and among these processes was the development of an oxidizing roast on Anaconda tailings. Like Mr. Wedge, Mr. Laist found that by calcining sulphides or mixed sulphides and oxidized ores a high percentage of the copper could be extracted by leaching. Temperature control was vastly important, as the developments of both Messrs. Wedge and Laist showed. If too high a temperature is used a large amount of the copper becomes insoluble in the strongest acid, but in both cases temperature control was demonstrated to be simple and practicable, and under these circumstances practically no insoluble copper compounds were formed. In Mr. Laist's case, however, the use of salt is essential on account of the silver content of the charge, but he finds that it is not necessary to use this in a chloridizing roast and that a solution of salt with sulphuric acid gives him the desired extraction on the product from the oxidizing roast.

The manufacture of sulphuric acid by the chamber process, while simple, requires a very large investment, and in this case the transportation charges would amount to more than the cost of the acid. The chamber and the contact processes, of course, are the two important manufacturing processes, but even a casual study of wet methods of copper recovery shows that there are other methods of acid manufacture involving a principle similar to the chamber method, that might be used in parallel with the recovery of the copper from solution with less investment for plant and with a saving in energy that is important.

The McKay process includes a sulphating or an oxidizing roast, as is desired, to get sulphide of copper into soluble form, and he adopts the same process for this purpose as followed by Messrs. Wedge and Laist.

The Slater process and the Midland process deserve study. They depend upon the use of a complex series of chlorides and hypochlorous compounds that will dissolve many salts of copper that sulphuric acid will not touch. They will attack, among other things, chalcocite, and they deserve serious consideration in many important but special cases, as they avoid the necessity of a preliminary roasting operation. I regret that I am only slightly familiar with the very important work in the development of a process by E. A. Cappelen Smith for the beneficiating of the Chuquicamata ores.

[2] *Bulletin* No. 92, August 1914, pp. 1881 to 1929.

Recovery of Copper From Solution

At the beginning of our investigation we seriously considered what I called the 'brutal method' of leaching, namely, the manufacture of sulphuric acid, the solution of the copper from the ore with such acid, and the precipitation of the copper by metallic iron, with the resultant complete, or nearly complete, destruction of both acid and iron and the production of an impure cement copper that will have to go through the process of smelting and refining. The results of Mr. Croasdale's tests and Mr. Wedge's cost figures indicate that such a course was commercial, and we concluded that the 1.5% Ajo ore, with no overburden, mined by steam shovel and crushed coarse, would yield a profit on a 12c. copper market if a cheap grade of Alabama pig iron were used.

But it occurred to me, as it had occurred to many engineers, that oxide of iron could be reduced to metallic iron without fusion, and if so we might bring Bisbee sulphides to the mine, calcine them for the manufacture of sulphuric acid and then metallize the available iron in the impure calcine, already containing metals requiring recovery, and use this for a precipitant. I found at the start that metallic iron was being produced by this method with an inferior fuel from high-grade iron ore by an intermittent process; that is, by first heating to the desired temperature by internal combustion of a part of the excess coal in the charge and then allowing the heated charge to stand without the admission of air, but allowing the gases formed to escape freely.

After consulting with friends, we concluded to try the experiment of a multi-hearth furnace, and at first my idea was that possibly calcining could be done on the upper hearths and the hot calcine could then pass to the lower hearths, where it could be further heated and submitted to a reducing action. We erected a small Wedge furnace, but only tried to metallize, and not to calcine in it. Some of the iron oxide was reduced to metallic iron, but on the whole our experiment was a failure because in keeping the charge hot the percentage of carbonic acid gas produced was sufficient to retard and reverse the action of carbon monoxide in reduction. In parallel with this, we also made experiments in revolving cylinders, aiming to reduce the iron to the metallic form with illuminating gas and with fuel oil by a continuous process. These also were failures.

Mr. Laist conducted similar experiments on a continuous process for making sponge iron at Anaconda, and ended with a like failure. He has, however, demonstrated that he can make sponge iron by an intermittent process in a revolving drum. It had become evident to me, even in my limited environment, that the simple use of iron, with the destruction of both iron and acid, to the production of an unfinished product, while apparently commercial, was in our extremely simple case preposterous, and investigation showed the splendid work done on other lines and convinced me that if considered from a commercial viewpoint better methods were bound to develop a process that would fit our requirements, and very much cheaper copper would result.

At the start we decided to investigate the electrolytic deposition of copper from solution, but a little later on we took up the subject of the direct precipitation of the copper by sulphurous acid gas. I prefer to discuss the latter subject first for the purposes of this paper.

In the precipitation of copper by sulphurous acid gas, temperature and consequent pressure must be considered. If the copper is precipitated in metallic form this temperature and pressure are very high, but if a subchloride of copper would satisfy us, the temperature and pressure may be moderate. In both of these processes the reactions we are familiar with in the formation of sulphurous acid by treating copper turnings with concentrated sulphuric acid are reversed by heat. For the production of metallic copper the action depends upon getting sulphurous acid dissolved in the sulphate solution in sufficient amount to precipitate the copper and then heating the mixture under proper control to about 150°C. The question of the use of an abnormally rich gas is involved. Under proper regulation pure copper is produced, which only needs melting for the market, and a large excess of sulphuric acid is formed. Mr. Van Arsdale has done valuable original work on this process, followed by the work of Weidlein and others in its commercial development. Laist has studied precipitating subchloride of copper. A soluble chloride is added to the sulphate solution of copper and the proper amount of sulphurous acid is added. Moderate heat under pressure—90°C. of heat—precipitated almost all the copper as subchloride. The subsequent process of obtaining the copper without volatilization and the recovery of the chlorine offered difficulties. Messrs. Van Arsdale and Bacon have valuable experience on this subject.

This process needs further development and is most interesting. It is with no disparagement of the process that we have abandoned it in our case. I simply feel that the method would be a complicated and an expensive one, and I fear working with heat and pressure where fuel is dear and a corrosive solution is used. To me and my friends the electrolytic method seemed best adapted to our condition and the simplest and most certain of commercial application.

Of course, the first difficulty was the solution of other oxides than copper and the danger of some loss of acid thereby, and, what was more important, the susceptibility of some of these dissolved neutral salts to oxidation by nascent oxygen to the production of acid salts, which in turn will dissolve copper from the cathode. It seems that such salts are most valuable as depolarizers, but must be held under control.

After investigating the subject I advised Mr. Greenway on behalf of his company, and we employed F. L. Antisell to make and direct a series of tests and experiments covering the precipitation of copper in the presence of iron and aluminum sulphates. For some time previous I had been familiar with experiments tried by Messrs. Pope and Hahn, and these gentlemen were employed to investigate in parallel the practicability of removing enough of the iron and alumina from the solu-

tions as they foul, to keep them below the danger point in electrolytic work. Both Mr. Antisell and Messrs. Pope and Hahn began their experiments upon a laboratory scale at the Raritan Copper Works. Messrs. Pope and Hahn found the leaching could be so conducted that the rate of increase of iron and alumina was slow. They therefore decided to leach in a certain way and to treat a certain high iron and aluminum neutral solution with copper oxides by agitating, heating, and injecting air. This is a rejuvenation of the old Hoffman process applied to a new purpose. The iron and aluminum sulphates in such foul solution, together with arsenic and other impurities, are precipitated as insoluble oxides and the acid previously combined with these salts is taken over by the copper oxide and forms sulphate of copper. The clarified solution, with these impurities removed, is then mixed with the remainder of the solution, thus keeping an iron content of, say, less than ¾ per cent.

Mr. Antisell began his experiments by using a patent anode. This anode was a narrow, rectangular wooden or lead frame with thin wooden sheets as diaphragms, forming a long and deep but very narrow box. It was packed with clean coke in lumps crushed to pass a 1-in. ring, and contact was given by carbon rods imbedded in the coke. A solution of sulphate of iron and aluminum in great excess was made up and sulphuric acid added. This was used as a solvent for the copper. After the solution came from the ore it was at first passed to an absorption tower, where sulphurous acid gas was absorbed, and then it passed to the electrolytic tank. I go into no detail in describing Mr. Antisell's flow-sheet and his process, as he himself is present. After promising results had been secured in the laboratory tests at Raritan showing the possibility of high extraction and low power costs, Mr. Antisell sent Mr. Jamieson to Douglas, where tests were made with full-sized anodes. Excellent results were obtained here, but difficulty was had with the complete absorption of sulphurous acid. Also, the anode was cumbersome and not adapted to operating conditions, but, notwithstanding, excellent results were obtained experimentally and he ran for a long time with a recovery of nearly 2 lb. of copper per kilowatt-hour, an extraction of 80% of the copper content of the ore, and the production of nearly the theoretical amount of sulphuric acid from the SO_2 gas.

Messrs. Pope and Hahn later went to Douglas and began experiments, and also later conducted a most valuable set of experiments on the manufacture of acid-proof coatings for concrete that will neither crack nor soften under the high temperatures of the Arizona desert, and which will adhere closely to the sides of the tank. This work is very important and needs mention.

Mr. Greenway discovered that if a certain copper solution containing salts of triad elements is treated in a simple way, the iron or aluminum triad salts may be removed. Dyad salts are not affected. He was led to the belief that such oxides thus precipitated were in large part insoluble in dilute acid and that therefore he had a very simple method of removing iron and aluminum from solution. Against my prediction, laboratory tests seemed to show his contention was correct. Having used up about 300 or 400 tons of Ajo ore at Douglas for the Croasdale, Antisell, and Pope and Hahn experiments, and having promising results, the engineers moved to the mine of Ajo. Mr. Greenway erected a small plant of his own, and a Pope and Hahn plant was built and the use of sulphurous acid was temporarily discontinued. As for the Greenway process, I am not yet at liberty to discuss it further. But I may say over 100 charges were run with this process. The iron content in the solution was kept down to less than 1%, and we obtained an average of slightly over 1 lb. of copper per kilowatt-hour, but the extraction was low. We then extended the time of the leach and obtained a higher extraction, and finally we began to crush the ore finer, which at that time had been crushed only to ½-in. ring, and found that if crushed to pass ¼-in. mesh percolation was not retarded and an extraction of over 80% was practicable. The iron has reached as high as 1.2%, but we are still getting a pound of copper per kilowatt-hour from the electrolytic tanks.

These experiments have been so successful that we are proceeding with the erection of a 40-ton plant, where tanks will be used that will hold 60 tons, if necessary, and will be abundantly large to permit of a study of the comparatively even distribution of crushed ore, and we shall proceed with these most interesting experiments, using first, as we have in the smaller tanks, the Greenway process. In the meantime, the 1-ton plant will be liberated and we will immediately proceed with the continuance of a modified form of the Antisell system of leaching. He finds that with the construction of better absorption towers we can absorb the necessary amount of SO_2 gas, and he has demonstrated that with the use of SO_2 gas, using dyad iron as a depolarizer and triad iron as an oxidizer, he can manufacture sulphuric acid. We can, if successful, obtain 1½ lb., and possibly more, of copper per kilowatt-hour, and at the same time manufacture sufficient acid to replace wastage. The electrolytic copper in all cases has been fully up to the trade standards.

Conclusions

My deductions from a study of the work of the able engineers engaged in these extensive operations are as follows:

1. Dilute sulphuric acid will give a very high extraction on oxidized ores of the Ajo type. Time is a more important element in extraction than strength of acid. A maximum size of 6-mm. cube is required. Such ore crushed to the maximum size permits percolation and the production of a clear solution because the slime content in the ore so crushed is very small.

2. Where such ore is mined at a cost of between 25 and 50c. per ton, it is commercial on a 12c. market, even if leached with sulphuric acid and the copper precipitated with pig iron to the waste of the acid and iron and the production of an impure cement copper that requires further treatment. Metallized iron from calcine

can be made and will prove a little cheaper than pig iron if it is marginal.

3. An electrolytic method for the recovery of pure copper from sulphate solutions is far preferable and will produce cheap copper. In all cases a low current density is required. Hard-lead anodes or composite anodes of hard lead and coke of uniform thickness will be used.

4. Such electrolytic method, with control of the amount of iron and aluminum in the electrolyte, and without the use of sulphurous acid gas, is practicable. An acid loss of about 1.5 lb. per pound of copper will be sustained. Chamber acid will be required.

5. I believe there is a decided probability that the cheapest and best method will be the electrolytic deposition from sulphate solutions without iron control, and the use of the requisite quantity of sulphurous acid. The sulphurous acid will be absorbed without the tank house and in quantity that will not cause annoyance. Iron and aluminum will act both as depolarizers and catalytes. This process promises a high yield of cathode copper per unit of power and the manufacture of sufficient sulphuric acid to replace the waste.

6. While these remarks apply to the Ajo oxidized ore and ores physically and chemically similar, they need not apply to ores of a different composition. Mixed oxide and sulphide ores, be the sulphide chalcocite or chalcopyrite and bornite; ores containing great quantities of clay, or presenting other difficulties, have to be considered separately, and there is beyond question a great field for other processes and for other methods, both for obtaining the copper in solution and obtaining the copper from the solution. And now I end my theme as I began. Notwithstanding the importance of this subject, it covers but a corner in the metallurgy of one metal. There are many other subjects which if discussed in committee and with an open mind will lead to the advance of ourselves and of our institutions.

Some Uses of Traverse Tables

By JAMES UNDERHILL

Traverse tables may be used in many ways not ordinarily taken up in books on the subject. Besides being used to determine quickly the sides of right triangles, they may be used with a little trouble for oblique triangles, as a table for stadia reductions, and also in place of a slide rule for many calculations.

Traverse Tables for Right Triangles.—The chief use of the traverse table in surveying is to calculate the horizontal distance quickly in the field, where a transit and long steel tape are used. For this purpose a traverse table to 15 min. is accurate enough. Example:

Vertical angle.	Distance.		Horizontal distance.
16°	275.9 = 270	=	259.5
	5.9	=	5.6
	275.9		265.1

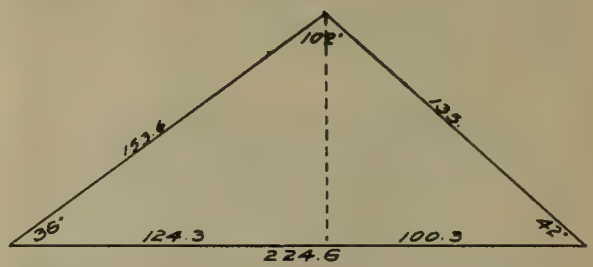
Under the angle 16° first find distance 27, and then 59. Point off properly as above. The horizontal distance is found to be 265.1.

To find the slope distance, the horizontal being given, reverse the above. To lay off 264.4 with an angle of 18°:

Vertical angle.	Slope distance.		Horizontal distance.
18°	270	=	256.8
	8	=	7.6
	278		264.4

Find under 18° the nearest horizontal distance to 264.4. This is 256.8 and gives a slope distance of 270. This leaves 7.6 horizontal (264.4 − 256.8 = 7.6), which equals 8.0 slope. Total distance, 278.0. Vertical distances or departures may be handled in the same way.

Oblique Triangles.—Given three angles and one side. Divide into two right triangles.



Angle.	Vertical.	Horizontal.	Hypothenuse.
42°	130.0	96.6	87.0
	5.0	3.7	3.3
	135.0	100.3	90.3

from this

Angle.	Vertical.	Horizontal.	Hypothenuse.
36°	88.2	121.4	150.0
	2.1	2.9	3.6
	90.3	124.3	153.6
		100.3	
		224.6	

Traverse Table for Stadia Reductions.—There are several methods of reducing stadia measurements. As the horizontal distance equals 100 multiplied by the rod reading multiplied by the cosine squared of the angle read, if we wish the horizontal distance we simply make the calculation twice. For example, 2.4 feet is read on the rod and angle is 14°:

14°	240 ft. = 232.9	230 = 223.2	
		2.9 = 2.8	
		Horizontal distance required	226.0

From an ordinary stadia table the distance would have been 225.96.

For vertical distances, double the angle, and then take half the result.

For 14° and 2.4 feet take angle 28°, 240 = 112.7 by $^1/_2$ = 56.3, which is exactly what the stadia table gives. When both horizontal and vertical are required at once, proceed as follows:

14°	240.0	232.9	
		Horizontal.	Vertical.
14°	230.0	223.2	55.6
	2.9	2.8	0.7
		226.0	56.3

This is much quicker than the multiplication necessary with a stadia table. An even quicker way where many stadia calculations are to be made is to place the angle for stadia readings over the proper column in the traverse table. For example, the results obtained above may for horizontal measurements be found directly in the column under 19° 45′, as the cos. of 19° 45′ is the square of the cos. 14°:

19°45′	240	225.9

This is a little out because 14° 02′ really equals 19° 45′, but the results are accurate enough for ordinary work. In the same way we place the figures representing the stadia angles measured over the proper vertical or departure columns in the traverse table.

Stadia Angles to Traverse Table VERTICAL

St An	Tr To	St An	Tr To	St An	Tr To	St An	Tr To
15′	15′	8°5′	8°	14°26′	15°45′	26°26′	23°30′
30′	30′	20′	15′	14°44′	16°	50′	45′
45′	45′	36′	30′	17°01′	15′	27°12′	24°
1°	1°	51′	45′	18′	30′	36′	15′
15′	15′	9°7′	9°	36′	45′	28°02′	30′
30′	30′	22′	15′	54′	17°	26′	45′
45′	45′	38′	30′	15°11′	15′	50′	25°
2°	2°	54′	45′	29′	30′	29°16′	15′
15′	15′	10°10′	10°	47′	45′	42′	30′
30′	30′	25′	15′	19°5′	18°	30°10′	45′
45′	45′	41′	30′	24′	15′	38′	26°
3°	3°	57′	45′	42′	30′		
15′	15′	11°13′	11°	20°0′	45′		
30′	30′	29′	15′	19′	19°		
45′	45′	45′	30′	38′	15′		
4°	4°	12°01′	45′	56′	30′		
16′	15′	17′	12°	21°15′	45′		
31′	30′	33′	15′	35′	20°		
46′	45′	49′	30′	54′	15′		
5°2′	5°	13°06′	45′	22°14′	30′		
16′	15′	22′	13°	34′	45′		
32′	30′	38′	15′	54′	21°		
47′	45′	55′	30′	23°14′	15′		
6°2′	6°	14°12′	45′	34′	30′		
17′	15′	28′	14°	55′	45′		
32′	30′	45′	15′	24°16′	22°		
48′	45′	15°02′	30′	36′	15′		
7°4′	7°	18′	45′	58′	30′		
18′	15′	35′	15°	25°20′	45′		
34′	30′	52′	15′	42′	23°		
50′	45′	16°9′	30′	26°04′	15′		

Angle over column in Traverse Table for stadia angle read

Tables of Comparison.—A number of calculations ordinarily made with the slide rule or graphically, may be made more accurately with a traverse table, or table

Stadia Angles to Traverse Table HORIZONTAL

St An	Tr To	St An	Tr To	St An	Tr To	St An	Tr To	St An	Tr To	St An	Tr To
12′	15′	5°40′	8°	11°10′	15°45′	16°44′	23°30′	22°24′	31°15′	28°10′	39°
20′	30′	5°50′	15′	11°20′	16°	16°56′	45′	22°34′	30′	28°22′	15′
36′	45′	6°2′	30′	11°32′	15′	17°6′	24°	22°46′	45′	28°32′	30′
44′	1°	6°12′	45′	11°42′	30′	17°16′	15′	22°56′	32°	28°44′	45′
54′	15′	6°22′	9°	11°52′	45′	17°28′	30′	23°8′	15′	28°56′	40°
58′	30′	6°34′	15′	12°4′	17°	17°38′	45′	23°18′	30′	29°8′	15′
1°16′	45′	6°44′	30′	12°16′	15′	17°50′	25°	23°30′	45′	29°18′	30′
1°24′	2°	6°54′	45′	12°26′	30′	18°00′	15′	23°40′	33°	29°30′	45
1°38′	15′	7°4′	10°	12°36′	45′	18°10′	30′	23°52′	15′	29°42′	41°
1°44′	30′	7°16′	15′	12°46′	18°	18°22′	45′	24°04′	30′	29°54′	15′
2°00′	45′	7°26′	30′	12°58′	15′	18°32′	26°	24°14′	45′	30°4′	30′
2°8′	3°	7°36′	45′	13°8′	30′	18°44′	15′	24°26′	34°	30°16′	45′
2°16′	15′	7°48′	11°	13°18′	45′	18°54′	30′	24°36′	15′	30°28′	42°
2°28′	30′	7°58′	15′	13°30′	19°	19°6′	45′	24°48′	30′	30°38′	15′
2°36′	45′	8°10′	30′	13°40′	15′	19°16′	27°	25°0′	45′	30°50′	30′
2°48′	4°	8°20′	45′	13°52′	30′	19°28′	15′	25°10′	35°	31°00′	45′
2°58′	15′	8°32′	12°	14°2′	45′	19°38′	30′	25°22′	15′	31°10′	43°
3°10′	30′	8°42′	15′	14°12′	20°	19°50′	45′	25°32′	30′		
3°20′	45′	8°52′	30′	14°24′	15′	20°0′	28°	25°44′	45′		
3°32′	5°	9°2′	45′	14°34′	30′	20°12′	15′	25°54′	36°		
3°44′	15′	9°12′	13°	14°46′	45′	20°22′	30′	26°06′	15′		
3°54′	30′	9°24′	15′	14°56′	21°	20°34′	45′	26°16′	30′		
4°4′	45′	9°34′	30′	15°06′	15′	20°44′	29°	26°28′	45′		
4°16′	6°	9°44′	45′	15°18′	30′	20°56′	15′	26°40′	37°		
4°24′	15′	9°56′	14°	15°28′	45′	21°6′	30′	26°50′	15′		
4°36′	30′	10°6′	15′	15°40′	22°	21°16′	45′	27°2′	30′		
4°46′	45′	10°18′	30′	15°50′	15′	21°28′	30°	27°14′	45′		
4°58′	7°	10°28′	45′	16°00′	30′	21°40′	15′	27°24′	38°		
5°8′	15′	10°38′	15°	16°12′	45′	21°50′	30′	27°36′	15′		
5°20′	30′	10°48′	15′	16°22′	23°	22°0′	45′	27°48′	30′		
5°28′	45′	11°0′	30′	16°34′	15′	22°12′	31°	27°58′	45′		

made from a traverse table. As an example, take 1 centimetre = 0.3937 inch. Under 23° 11′ in a large traverse table 100 = 39.3675, but in a smaller table 100 = 39.47 under 23° 15′. By properly pointing off, we get 1 centimetre = 0.3947 inches, or for example 81 centimetres = 31.97 by inspection, and any other length by addition and proper pointing as in previous examples. With a large traverse table, 81 = 31.8876 as against 31.8897 by arithmetic. This is nothing more nor less than a multiplication, and any other multiplication or division may be made as well.

Tables of several columns may often be prepared for rapid calculation. Pyrite, FeS_2, contains 46.60% Fe and 53.40%S. Therefore, 100 = 46.60 + 53.40 at the end of the columns, and a rock containing 46% pyrite can be seen at a glance to contain 21.44% Fe and 24.56% S. If the remainder of the rock was, for example, limestone, its elements could be calculated in the same way. Thus mineral tables may be constructed having any number of columns, one for each oxide or element, as the case may be.

Australian Gold Production in 1914

Returns from five of the six states of the Commonwealth are now available, being as follows, in fine ounces:

State.	1914.	1913.
New South Wales	124,507	149,657
Queensland	248,395	263,343
Tasmania	27,320	33,400
Victoria	409,706	434,932
Western Australia	1,232,977	1,314,043

Mining at Santa Barbara

By F. J. DeWILDE

Santa Barbara is situated in the Parral mining district, in the southwestern portion of the state of Chihuahua, Mexico. Parral is about nine kilometres to the west. The mines are situated in the foothills of the Sierra Madre range, the elevation of the shaft collars being approximatly 2500 metres above sea-level. Production from this district is confined mainly to lead, silver, and zinc, although the ores contain some gold and a small amount of copper.

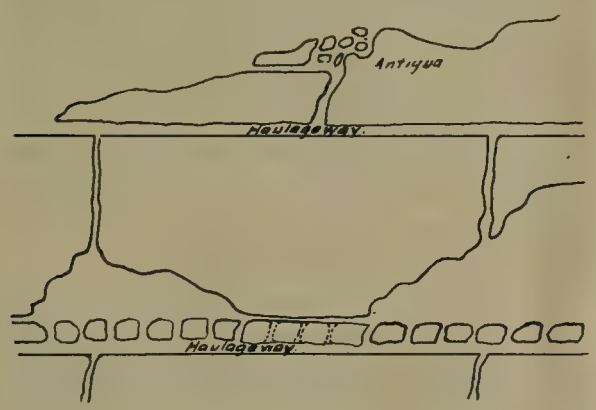
The geology of the district is quite simple. Large veins occur in a flat dipping series of impure limestones, shales and slates. The veins dip west at angles varying from 45° to 75°. Rhyolite and alaskite intrusions are contemporaneous with the mineralization. One large intrusive stock of alaskite divides the vein systems into the northern and southern portions.

The Los Angeles mine and other openings of the Montezuma Lead Co., have prospected the veins in the northern group; those to the south are being developed by the American Smelters Securities Co. at the Minas Tecolotes. The length of the prospected zones is approximately four kilometres; however, only a small portion of this zone was producing while I was employed in the district.

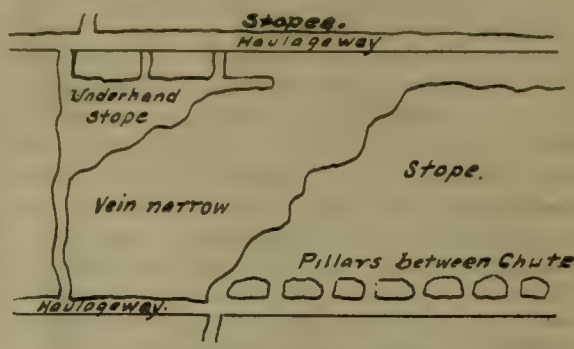
The Tecolotes mine has developed three veins, La Seca, Cabrestante, and Tecolotes, to a depth of about 150 metres below the collars of the shafts. During the early days, numerous adits were driven into the various veins and the richer oxidized ores mined. Antiguas worked by the Spaniards still contain some rich ores. The present Tecolotes shaft has cut the sulphide zone. Galena and sphalerite (associated with pyrite and chalcopyrite) were found in a disseminated form.

Stoping Methods

Because of the great length and width of the veins at the Minas Tecolotes, the shrinkage system of mining has been applied with excellent results. Where a vein has been properly developed by a system of rises and haulageways, stopes are started by driving small subdrifts off each side of a rise about 3 metres above the level. Short rises driven to the subdrifts and spaced about 7 metres apart, form the chutes whereby the ore may be drawn from the stope at various points. As the stope is enlarged, the subdrifts are kept in advance from 10 to 15 metres. Floor pillars are left for the



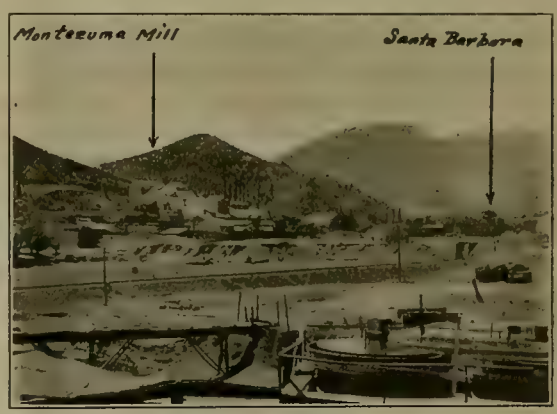
METHOD OF STARTING SHRINKAGE STOPES.



UNDERHAND SHRINKAGE STOPES.

level above and the stope gradually lengthened on each side of a rise until its length is defined either by a contracted portion of the vein or by a rise farther on. (See accompanying illustrations.)

Where a vein contracts and is too narrow for its economical stoping by shrinkage, the ore is mined by underhand methods as follows. Subdrifts are driven off a rise, about 3 metres below a level, and short rises



SANTA BARBARA.

driven to the level at 15-metre intervals to make the stope accessible. As the stope deepens and lengthens, the subdrifts are kept in advance from 10 to 15 metres. The levels are driven at 50-metre intervals and all the drifts are made large enough to permit of electric haulage. No timber is required either for the stopes or rises. The ore chutes are lined with 3-in. plank and open out above the tracks.

At the Los Angeles mine of the Montezuma Lead Co., the veins, although undoubtedly a continuation of the zone to the south, are narrower and therefore are better adapted to the room and pillar system, which has been extensively employed.

Swedish Iron Ore and Steel at the Exposition

Sweden is a busy manufacturing country, and a great deal of its wealth lies in its deposits of iron ore and the water-power available for various industries. The reserves of ore total many millions of tons, and water-power at 6,205,000 hp., of which 750,000 hp., or 12%, is being used. Most of the iron ore mined is shipped to England and Germany, and some to the United States, exports in 1913, a year of normal output and increase, being 6,459,950 tons. There were 104 blast-furnaces, 210 puddling furnaces, 62 open-hearth furnaces, and 17 bessemer converters operated in that year, producing 735,000 tons of pig iron, 153,400 tons of wrought iron, and 582,800 tons of steel. About 30% of this metal was exported. According to the Swedish Iron Workers' Union, which met at Stockholm on February 9, the war and lack of water for power have almost paralyzed their business to all countries. Iron ore exports decreased 1,472,000 tons compared with those of 1913. Only about 50% of the furnaces are in blast. Owing to the lack of water, the works in Sweden cannot manufacture enough even to meet the demands of the reduced Swedish consumption of iron and steel. Thus prices have kept steady and even rising, which helps to make amends for the increased manufacturing expenses, higher coal, increased export rates, increased war insurance, and other factors. Unfortunately, also, the question of the new water rights for power has not yet been settled, so that no ordering of water current can as yet be arranged.

In spite of the war, Sweden has a splendid exhibit at the Panama-Pacific Exposition, and an inspection revealed the following important features in rooms tastefully arranged, one of which is actually 'papered' with steel of all shapes and sizes:

Ore.—A glass model of the famous Dannemora mines, 30 miles northeast of Upsala and 65 miles from Stockholm. These were worked as early as the fifteenth century and are opened to 252 metres' depth. The ore is a 50% calcareous magnetic iron material, free from phosphorus, occurring as lenses in a bedrock of limestone. There is some faulting evident. Some zinc ore is also mined.

Another model is of the Falu mine, which is in central Sweden. It was worked as long ago as the fourteenth century, and is opened to 334 metres. It also produces copper pyrite, gold, and iron pyrite. Years ago the timbering in the central portion of the mine gave way, and a large cave-in resulted.

A relief map shows the Kiruna deposits, surface equipment, and transport arrangements. The ore dips under an arm of the sea in one place, and its existence there was traced by use of the magnetometer, an instrument made in Sweden and shown in the pavilion.

Samples of ore are displayed in a case in the centre of one of the rooms, and surmounting the case is a block of 72% iron ore weighing 5½ tons from the Kiruna mine. Below this block are samples from the following: Klackberg, 69% iron (a representative of Swedish calcareous ores); Gonas, near Ludvika, 43% iron, 0.09% phosphorus, a fairly coarse crystalline magnetite and hematite most suitable for concentration; Dalkarberg, 65.2% iron; Grangesberg, various ores; Malmberget, up to 67%; Stripa, a quartz-banded hematite with 50% iron and low in phosphorus; and Persberg, 55.8%, a self-fluxing magnetic iron ore from which a great part of the Swedish iron production is made, occurring on a bedrock of dolomite and liparite.

As so much ore is exported, it is natural that the handling and arrangements at the sea docks are capable of efficient work, and models of the old and modern types of ore docks and steamers are shown. The vessels differ from the ore carriers on the Great Lakes of America in this respect, that the holds consist of a number of V-shaped hoppers which empty into a skip at the bottom of the ship, which is then hoisted to any desired place by means of winches and derricks on the deck.

Smelting by electricity.—Water-power being in abundance in Sweden, the use of electricity in smelting has been tested to a considerable extent. A model of the Jernkontoret's electrical research blast-furnace at Trolhättan is shown. It is thoroughly constructed one-tenth of the full size. The furnace capacity is as follows: yearly production, 7500 tons of pig iron; charcoal consumption, 25 hectolitres per ton of ore; electrode consumption, 3 kilograms per ton; and electric energy, gross, 2500 and net 2200 kw.-hours. Some idea of the size of the operating furnace may be gained when it is said that the four electrodes are 30 in. square each.

Steel products.—The varied steel products for peaceful and warlike use are too numerous to detail here, suffice it to name a few, as follows: The Sheffield of Sweden is at Eskilstuna, near where are no mines, but the steel is worked up to the finest cutlery, knives, saws, files, scissors, and tools; spring steel, Sandviken and Uddeholm; structural iron, Domnarfvet; cast steel, Johannson; drill steel for mines, hollow, Forsbacka and Hofors; drop forgings, Laxo; drop forgings and tool steel, Osterby and Kohlswa; tubes, cables, etc., Fagersta; axes, Hult; and guns and projectiles, Bofors and Wirsbo. Samples of air-hammers, De Laval turbines, and other useful apparatus are shown. An interesting display is one of a new product, known as 'iron sponge.' By a chemical process the iron from low-grade dumps is recovered. The resulting 'pigs' are light, but when forged produce the best workable iron.

Sweden has large forests, and an exhibit shows the charcoal, tar, turpentine, wood alcohol, and wood by-products which are a source of wealth.

DEMAND for iron and steel in Canada is at present confined to a few grades, the Canadian steel works being largely occupied with government contracts. It is estimated that the mills now hold orders for $80,000,000 worth of shells.

Flotation: Its Sphere of Usefulness in Gold Metallurgy

By W. B. BLYTH

*The application of flotation to the concentration of gold ores is only a question of time. Already plants have been erected in this connection, and operated (so it is said) successfully. The process has reached the stage where its sphere of usefulness is not confined to the base metals. It must be recognized as a commercially applicable process by gold investigators also, and it is as well now to consider its possibilities. In the first place, being a concentration process, it is of value only where the valuable constituents of the ore are in the mineral, or when some refractory mineral is present in an otherwise free-milling ore, and it is desired to remove that mineral subsequent to cyanidation. In this latter connection the flotation process seems to have an extended field of usefulness in the preliminary concentration of cupriferous gold ores. These have been a bugbear to metallurgists for many years, not because the copper interferes with the dissolution of the gold, but because it consumes so much cyanide during the process. A small percentage of chalcopyrite will render the treatment of a low-grade gold ore unprofitable under existing conditions. The flotation process will remove the copper in the form of a marketable concentrate, and will do it effectively and at small cost. The remaining pulp will be in a fit state to undergo ordinary cyanide treatment. It is doubtful if it will ever pay to float mineral from an ore that yields its gold readily in an all-sliming process. It must be remembered in this case that the mineral that is slimed in a circulating cyanide solution during crushing will yield its gold by simple, inexpensive agitation. The coarse mineral can be removed, classified, and slimed in the usual manner, and the slimed product mixed again with the rest of the pulp prior to agitation. If the mineral is floated off, then the same ultimate procedure must be adopted with the floated portion. The additional expense of flotation will be incurred, as against the cost of agitation and filtration of a large proportion of more or less barren tailing. The latter will generally be found the cheapest and least complicated process. When studying the features of roasting refractory floated concentrate prior to cyanidation, it must be remembered that the standard flotation process is particularly efficacious in floating mineral slime. As tables do such excellent and cheap work in separating the coarse mineral, it may be said that, as regards gold ores, the chief field for flotation lies in the concentration of refractory slime. It must be borne in mind that the roasting of slime from a cyanidation standpoint is a difficult problem, and one that, as far as my information goes, has never been solved. The process of drying slime leaves lumps, and these lumps, however small, will never roast perfectly sweet. There is a vast difference between a cyanide roast and the roasting of lead and zinc concentrates prior to smelting. Filter-pressing and air-drying, followed by disintegration of the concentrate prior to roasting, might get over the difficulty. I would like, however, to emphasize that it is a problem in itself, and to warn investigators that the mere fact of being able successfully to float the valuable mineral in a given slime does not indicate that it can be successfully treated unless there is a smelter handy to buy the concentrate. In many cases in Western Australia the mineral constituents of the ore are so fine, and so intimately mixed with the gangue, that the whole ore must be reduced to a colloidal slime before the mineral is liberated. When liberated, the mineral in this kind of ore can be readily floated. Kalgoorlie ore, worth $9.60 per ton, can be readily reduced to 72c., with the production of from 10 to 15% of concentrate, in this manner. The expense of reducing to colloidal slime, however, is heavy, and this, as well as the question of the subsequent roasting prior to cyaniding of the floated slimed concentrate, does not make the undertaking a very attractive one. I consider that flotation will certainly occupy a prominent place in gold metallurgy during the next decade, but predict that there will be many commercial mistakes made in its application during that period.

*Abstracted from 35-page illustrated paper published by the Aust. I. M. E., 'The Consulting Metallurgist and Metallurgical Investigations.'

Profitable Use for Old Hammer Drill

MACHINE-DRILL USED AS A POWER HAMMER IN SHOP.

The accompanying picture shows a 3¼-in. Ingersoll-Rand hammer drill, serving the purpose of a power hammer in the Jewel-Denero smithy, near Greenwood, British Columbia. A drill of this kind, so arranged, is extremely useful for doing light power-hammer work, where the installation of the ordinary machine would be out of the question because of the capital investment and power required, according to C. A. Banks.

Centrifugal v. Reciprocating Pumps

*There are certain valid reasons why centrifugal pumps were installed at the Durban Roodepoort Deep instead of reciprocating pumps, and it may be of interest briefly to state these reasons.

Initial cost.—The capital cost of a centrifugal pumping plant, complete with motor, starter, and combined bedplate all delivered at Johannesburg, is approximately 60% of the cost of a reciprocating pumping plant, assuming conditions similar to those at this mine, which calls for 800 gal. per minute against 2500-ft. head. For a 2000-gal. per minute plant against 2250-ft. head, the centrifugal pumping equipment becomes 40% of the cost of reciprocating pumping equipment.

Weight of plant.—The centrifugal equipment weighs approximately 70 lb. per gallon of water pumped per minute. A reciprocating equipment would weigh approximately 350 lb. per gallon.

Reliability.—This was an unknown figure when the pumps were installed, but the authors were of the opinion that, in spite of a considerable amount of hostile criticism, the centrifugal pump was reliable if it had fair treatment, and the results of a year's run have confirmed this opinion, as there has been no trouble of any sort experienced with the pumps since they were installed.

Cost of maintenance.—This also was an unknown figure, and here again the authors believed that with clean water the maintenance costs could be reduced to a reasonable minimum.

Cost of excavations for pump chamber.—The larger the quantity of water to be handled, the bigger the proportional saving by using centrifugal pumps. Taking the Durban Roodepoort Deep plant as approximately 800 gal. per minute capacity, the net excavation for the pump chamber would be, allowing for no further installation of plant, 8000 cu. ft.; for a reciprocating equipment of similar capacity the excavation would be approximately 55,000 cu. ft., or the ground to be moved for the centrifugal equipment would be approximately 15% of that for the reciprocating pump. For a 2000-gal. per minute plant the excavation for a centrifugal equipment would be approximately 10% of the cost of excavations for reciprocating equipment. The figures are shown in the following table:

COMPARATIVE SIZES AND COSTS OF PUMP CHAMBERS

Capacity of plant.	—Centrifugal pumps—		—Reciprocating pumps—	
Gal. per minute.	Excavation, cu. ft.	Cost of chamber.	Excavation, cu. ft.	Cost of chamber.
800	8,000	£200	55,000	£1,375
2,000	13,000	325	130,000	3,200

We carefully studied several makers' drawings for the reciprocating pumps before compiling this table, and selected those pumps which occupied the smallest space for their capacity. If the figures given can be improved on in any way, the authors will welcome a correction, as they are anxious to be perfectly fair to both types of plant.

The above are the general points which appeal to the authors as indicating the merits of centrifugal pumps for high lifts, and after a year's experience with the particular plant under discussion there are other favorable features evident which cannot be assessed in cash or figures, such as (1) simplicity of repairs and replacements, (2) smoothness of running, and (3) minimum of attention required during operation, and other points which are beyond the scope of this paper.

*Conclusions in paper on the 'Centrifugal Pumping Plant at the Durban Roodepoort Deep Mine, Transvaal,' read by E. G. Izod and A. D. Roullard before the South African Institute of Engineers.

Costs at the Wasp No. 2 Mine

In 1914 this South Dakota property produced 176,140 tons of ore by open-cut work and simple cyanidation.

Costs were as follows:

	Total.	Per ton.
Mining:		
Labor	$ 56,434	$0.3204
Stripping	24,613	0.1397
Supplies	7,643	0.0434
Power	3,074	0.0174
Explosives	10,694	0.0607
Stable	2,253	0.0128
Repairs, machinery	1,699	0.0097
Repairs, tramway	1,548	0.0088
Superintendence	2,286	0.0130
Sundry expense	1,316	0.0075
Coal	3,512	0.0199
Surveying	184	0.0010
Prospecting	1,183	0.0067
Total	$116,439	$0.6610
Milling:		
Labor	$ 38,126	$0.2165
Supplies	12,857	0.0730
Power	15,154	0.0860
Repairs, buildings	48	0.0002
Repairs, machinery	10,509	0.0597
Superintendence	2,286	0.0130
Sundry expense	1,316	0.0075
Coal	697	0.0039
Cyanide	14,584	0.0828
Zinc	5,138	0.0295
Lime	1,499	0.0085
Assaying	1,825	0.0104
Total	$104,089	$0.5910
General:		
Repairs buildings	$ 73	$0.0004
Bullion expense	1,384	0.0079
Insurance	2,884	0.0164
Taxes	1,426	0.0081
Interest and exchange	88	0.0005
Assessment work	300	0.0017
Total	$ 6,155	$0.0350

RIVERS of the United States carry to tidewater every year 270,000,000 tons of dissolved matter and 513,000,000 tons of suspended matter. This total of 783,000,000 tons represents more than 350,000,000 cu. yd. of rock, or 610,000,000 cu. yd. of surface soil.

DISCUSSION

Readers of the MINING PRESS *are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.*

Who Will Engineer the Engineers?

The Editor:

Sir—I would like most respectfully to call the attention of 'A Engineer' and his collaborator 'KCN Engineer' to the list of engineers and their wives who attended the annual dinner of the American Institute of Mining Engineers in New York city, February 15, and to ask them, also most respectfully, if they cannot find it in their hearts to qualify, mollify, or ameliorate their statements somewhat, which are to the effect that an engineer hangs a "millstone around his neck" when he marries.

The writer, a married man, has observed that marriage to the right girl is more likely to act as a life preserver than a "millstone." Also that jobs worth having usually carry quarters in which the right kind of a woman can make a home. The mere fact that fifty per cent of mining graduates seek other professions signifies little, for it takes stamina as well as gray matter to mine.

The fact that the gentlemen who started this discussion withhold their names is strong evidence that even they are not yet ready to burn their bridges behind them. The query "Who will engineer the engineers?" could come only from an unmarried engineer.

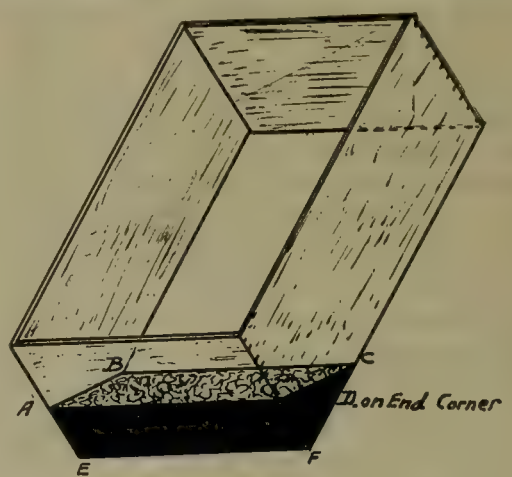
CLYDE M. BECKER.

Rincon, New Mexico, March 20.

Practical Points on Sampling

The Editor:

Sir—Referring to Arthur Feust's interesting article on this topic, in the March 6 issue of the *Press*, I would offer the following as a method which obviates the objection he raises to the use of a 'standard volume,' that of the 'double transfer.' In practice, after I have decided on the weight per foot of sample that I wish to obtain, I select a face of as representative ore as possible, and cut a 1-ft. sample to the weight required. The chippings are caught in a powder box. If in cutting the sample some of the chippings are above the average size of the whole, I break them so as to obtain as nearly an average size as possible. I then shake the sample into one end of the box, as is shown in sketch, until it occupies a space as nearly equal to a right prism as it can be made to do. The lines of contact with the end, sides, and bottom of the box are then marked on the inside with a pencil, as shown by A–D, A–B, D–C, and B–C. Then throwing out this sample, another 1 ft. is cut and treated in the same manner, and the operation repeated until lines representing the spaces filled by three or more 1-ft. samples are obtained. The mean of these is taken, and the lines representing it are scored, on the inside of each box used in the sampling, by a knife or chisel. By this means one obtains as fair an approximation of volume as is possible. It is always marked in the boxes used by the sampling gang, and every foot as cut can be brought to the right proportion by simply shaking it into the end of the box, and seeing if it is sufficient to fill the space required. If not, the sample is re-cut until the



necessary quantity is obtained, and then transferred directly to the sample sack. Parts of a foot in a sample length can be gaged by the eye. The method is capable of variation according to individual judgment, but is submitted as a means, which I have used with great satisfaction, of obtaining as uniform a volume per sample foot as is reasonably possible, as it eliminates any guess work whatever. It is not original on my part and has been evolved by me from various suggestions and ideas gathered in the course of my work.

WILSON W. HUGHES.

Los Angeles, March 10.

The Copper Beds of Coeur D'Alene

The Editor:

Sir—Let me hasten to reply to James C. Ray's criticism in the February 20 issue. I am not a college or mine school man. Left alone at the age of seven, life has been too strenuous to have learned the art of mapping. The most of my experience has been won

as a prospector, and paying for ventures in mining out of my own funds. I cut a section from plate 2, *Professional Paper* 62, sending it in for a guide. In this I imitated the old millman. He couldn't draw, but he 'doped out' a mill flow-sheet by pasting pictures of machines cut from manufacturers' catalogues in the correct position, as he saw it, and this made a successful and eminently practical copy for work. This was after the 'perfesh' had used quantities of ink and paper on rank failures.

The article was written to be understandable by the average steel pounder, and not for a society of 'high-brows.' The editor's map agrees with the facts in the field. Today all sorts of people usurp the term mining geologist. There is the apex litigation man and the thin-section man, both of whom generally inhabit the cañons of a large city. These should be classed as 'economic geologists.'

What is a mining geologist? He is a trained prospector, the link between the areal geologist—who has his uses—and the practical miner. He interprets the structure as given by the areal man, in the understandable terms of the miner, pointing out the shortest route to profitable ore. His function is to keep technically trained mining engineers from spending funds on useless development, and his earnings should be commensurate with what he saves—which they are not. Did you ever hear of an 'economic' geologist earning a fee by advising a hard-rock contractor the figure per foot he should bid, on what would be encountered in a 200-ft. contract?

In an apex suit "economic geology may be progressing toward an exact science." Its chief use is to befuddle the poor judge anyway, but mining geology is not in that class. In the field we will be wearing out shoe leather for the next hundred years, solving its many problems. If it is near to an exact science, why is it not taught in the schools?

Mr. Ray criticizes my presentation "of the first or top 350 ft." of the Revett holding the copper beds. The "first or top" can be reached soonest by an adit, and putting it that way stimulates the miner, particularly as the portion beyond that is harder than the hobs, etc. What's the use of adding to his agony by giving the high-brow interpretation?

Again, he says I've mixed the Snowstorm and Sonora faults. Have you ever run up against the, "well, the survey puts it there, but when we arrived it wasn't there"? What a comfort it would be if Dame Nature followed survey or straight lines. They wouldn't need mining geologists, only surveyors. But she doesn't. She hates them worse than she abhors a vacuum, and one sometimes thinks the dear old girl was bibulous in her wanderings. In mining terms, the faulting mentioned is along a sinuous line following the trend of the syncline.

What evidence has Mr. Ray that "the metallic sulphides were introduced after the metamorphism of the Algonkian sediments"? I tried to make clear in my manuscript that impregnation was coincident with metamorphism along with migration. I differ decidedly from F. L. Ransome and F. C. Calkins on this head, and hope to discuss it in a future article if I can muster courage to face the 'high-brows.'

As for A. F. Rogers, he certainly got his samples salted. The shipping ore of the Snowstorm is not tetrahedrite. The mine has milled and shipped over a million tons of copper ore, enjoying a low treatment rate because of its high silica, low iron, and the purity of its chalcocite. If the tonnage had contained an undue portion of tetrahedrite, with its uncertain and deleterious compounds, Mr. Smelter Man would have reminded them of the fact by an increase in treatment rates. You can't judge a million tons by a single one-inch thin rock section, and it is extremely bad practice basing one's opinion of seven miles of ore occurrence on a couple of sections. However, it saves shoe leather. Again, sericite is conspicuously absent from the copper beds, and this also proves that Mr. Rogers' samples were freaks.

The ease and celerity with which the city economic geologist can solve problems in the rarified air of a many-stored building is a constant marvel to the man in the field. The latter finds shoe leather a costly item, doing like work, and how often it is that his presentations of meritorious ventures are turned down by the former when advising investment. What is the combination? How does he do it?

GEORGE HUSTON.

Kellogg, Idaho, February 22.

[Having been in the field with the 'high-brow' geologists whose comment has disturbed our correspondent, we can assure him that the rarified atmosphere of the city cañons has had no weakening effect on their leg muscles, and that one wishing to save shoe leather would be well advised not to attempt trailing either of them.

Seriously, we do not sympathize with the attitude of mind so common among 'practical' men who assume that a professional geologist or other worthy bearer of the much misused title of 'expert,' is one who adopts methods of investigation on the basis of the relative amount of work involved. Pray, gentlemen, be fair about this. Our methods of approach may differ, but what warrant is there for assuming the other man is lazy because he works with a miscroscope rather than a pick? This assumption is a common one which vitiates much otherwise excellent argument—even in the sacred precincts of so 'high-brow' an institution as that of Mining and Metallurgy which flourishes in London.

It is not entirely fair to expect from the man who has made his own way up from the ranks, the same nice choice of words and the same precision of statement as from university graduates. He should be able to state his points clearly and to use understandingly the words he does write, but granted this, it is his message that is important. In this case the particular matter is whether or not certain faults do or do not occur

in certain designated places; what, assuming that they do, has been their influence on mineralization; and on the identification of the minerals in the ore. Has anyone further evidence on these points? —EDITOR.]

Electric Smelting at Tyssedal

The Editor:

Sir—In the *Press* of January 30 and February 20, I am pleased to note the corrections of Mr. Struthers and Mr. Crawford in connection with my statements regarding the Johnson electric furnace and the use of coke as a reducing agent by the Noble Electric Steel Co. My reference for the statement regarding the experimental run at Hartford, was the *Press* of March 21, 1914, page 480, in which it is stated that 17 tons of zinc ore from Colorado was smelted in January. In stating the amount of ore smelted, I merely wished to indicate the extent and size of work being done with the Johnson furnace in the electric smelting of zinc ores, which is further emphasized by the more complete account of the 42 days' run by Mr. Struthers.

It is evident, as Mr. Crawford states, that the use of the words 'finely ground,' in connection with the experiments at Heroult, might give an erroneous impression regarding the size of crushing for the coke. I did not intend to convey such an idea, as my impression received from the account of the experiments was of coke crushed not finer than one inch.

A few notes regarding the Hardanger Electric Steel Co. plant may be of interest. In the illustration, the structure in the lower left hand corner is the furnace building. At the right of this building, higher up the hill, is the roaster building, containing a Peterson shelf roaster of 27 tons daily capacity, which was used for agglomerating the ore and concentrate. At the right of the roaster is the crushing department, with bins. The ore, limestone, and coke were brought to the plant by freight steamers, as the works was situated directly on Hardanger fiord.

One furnace of the shaft type was in operation and another partly constructed. The complete plans of the plant also included two 2500-hp. electric steel furnaces which were never erected. The pig iron furnace had the following approximate dimensions: diameter of crucible, 10 ft.; diameter of shaft at bosh, 7 ft.; and height of shaft, 40 ft. The crucible was lined with a mixture of magnesite and tar, and the shaft with firebrick. The furnace required at full load about 3500 hp.

HARDANGER ELECTRIC STEEL PLANT, TYSSEDAL, HARDANGER, NORWAY.

of three-phase 25-cycle current at 60 volts. The furnace had six amorphous carbon electrodes of 24-in. diameter. The production of pig iron was much less than that obtained in the same type of furnace with charcoal as a reducing agent, being 2 tons per horse-power year. Power was purchased from the power plant of the Aktieselkab Tyssafaldene, about half a mile distant at Tyssedal, at a rate said to be $8.10 per horse-power year.

The pipe-line of the power plant is shown in the upper left hand corner of the view. The total head is about 1400 ft. The total possible development of the power-site is 125,000 hp., of which 86,000 hp. is now developed in four units of 13,500 hp. and seven units of 4600 hp. The power company has an electric furnace plant of 400-hp. capacity for experimental smelting of ores and production of ferro-alloys. The greater part of its power is used by the carbide plant of the Alby United Carbide Factories, Ltd., and the cyanamide plant of the North United Cyanamide Co., affiliated companies; both at Odde, four miles up Hardanger fiord from Tyssedal. These two plants take 50,000 hp. The yearly production of calcium carbide at this place is 50,000 to 70,000 tons. The electric furnaces are built in units of from 1500 to 2000 horse-power.

ROBERT M. KEENEY.

Cornucopia, Oregon, March 6.

OPERATIONS of the Crown Mines properties on the Rand in January were as follows:

Stamps working	660
Tube-mills working	25
Number of working days	26.8
Ore crushed, tons	191,000
Gold from mill, ounces	38,870
Gold from cyanide plants, ounces	15,169
Estimated value of output	$1,085,000
Estimated profit	336,000

CONCENTRATES

Readers of the MINING PRESS *are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.*

DAYLIGHT can be seen at the portal of the Snake Creek tunnel, Park City, Utah, from the face which is in over two miles.

ORE CONTAINING carbonaceous material caused premature precipitation of gold in the Porcupine-Crown mill, Ontario, during February and October of 1914.

EXCAVATION at Panama canal in January totaled 1,229,709 cu. yd. of earth, rock, gravel, and sand. The steam and hydro-electric plants produced 3,228,968-kw. hours. The Balboa air-compressor plant compressed 207,096,712 cu. ft. of free air to 105-lb. pressure.

COST of assaying cyanide bullion, preceding purchase, is generally higher than the cost of assaying amalgamation gold on account of the reduplication of results in the former case. In some cases cyanide gold is refined by a cupellation process before leaving the works. Among the advantages of this method may be mentioned the facts that freight charges are reduced, and all refining fees are avoided.

THERE can be no question but that the locator of a mining claim has the legal right to fence and cultivate his claim, so long as he does the necessary assessment work to preserve his title under the mining laws. He should, of course, bear in mind that if he ever expects to obtain a mineral patent on the claim, the burden will be on him to show that the land covered by it is more valuable for mineral than for agricultural purposes and that if he devotes most of his energies to the agricultural development of his ground it may militate against such a showing. But the ground is his so long as he complies with the requirements of the mining laws, and he may use it as he sees fit.

THE FOLLOWING CONCLUSIONS may be set down regarding the production and prevalence of rock dust in the Joplin sheet-ground mines of Missouri, according to a report by A. J. Lanza and Edwin Higgins: (1) rock dust is produced by the blowing of dry holes, squibbing, boulder popping, drilling without water, shoveling, tramming, roof and pillar trimming, and the dumping of the bucket on the surface; (2) each mine constitutes practically one large open chamber, which allows the dust to disseminate more quickly than would more restricted workings; (3) while the amount of dust in the air is not comparatively large, practically every man underground is exposed to a dusty atmosphere during his entire shift; (4) most holes are drilled nearly horizontally, these producing less dust than those drilled upward; and (5) the rock dust particles are derived almost entirely from flinty chert which breaks with splintery and knife-like edges.

MANY METHODS for the determination of gold or silver, or both, in cyanide solutions have been published, which with care in manipulation, and modification in some cases, will give results that are satisfactory. It is possible to classify or group these methods as follows, according to L. W. Bahney in the *Bulletin* of the A. I. M. E.: (1) Evaporating the solution in a porcelain or agateware dish containing litharge, or in a 'boat' made of lead foil; (2) forming a lead sponge containing the precious metals by means of zinc-shavings, zinc-dust, or a piece of aluminum; (3) decomposing the cyanide solution with an acid and precipitating the precious metals by the use of one or a combination of some of the following: copper sulphate, sodium sulphite, hydrogen sulphide, or cement copper; (4) precipitating the silver by zinc-dust held in a Gooch crucible, and determination with a standard solution of sulphocyanate; (5) electrolysis; and (6) colorimetry.

MINES pass through interesting stages in their lives, especially those which have produced rich ore for a time. This is illustrated in the annual report of the Crown Reserve company of Cobalt, Ontario, the general manager, S. W. Cohen, making the following remarks: "The Crown-Reserve mine has now entered the third phase of its history. For the first five years it produced practically nothing but high-grade ore (this yielded from 3611 to 4784 oz. silver per ton), and the average cost per ounce (7.508 to 14.027c.) was probably less, and the proportionate percentage of profit greater than any known silver mine in the world. For the past two years, the production has been partly high-grade and partly mill ore (15 to 17.71 oz. per ton), with the high-grade predominating, and the cost per ounce has been moderate (23.02 to 28.95c.). We have now worked out practically all of our large high-grade deposits, and what is left is mostly in the form of mill ore with the high-grade incidental to it. While the eastern portion of the property, only partly developed so far, gives promise of being ore-bearing, the probabilities are that the grade of the ore will not be high. As a result of these facts, namely, the lower rate of production and the smaller proportion of high-grade, the cost of production from now on will increase and the percentage of profit decrease." The output of the property to date is 18,429,141 oz. which realized an average of 54.57c. per ounce, at a cost of 13.675c. per ounce. Dividends amounting to about $5,854,279 net were paid from this production.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

DEADWOOD, SOUTH DAKOTA

MINE TAXATION.—SHAFT ACCIDENT AT THE HOMESTAKE.—GRIER MEMORIAL.—SHAFT SINKING AT THE ECHO.—HEIDELBERG AND OTHER PROPERTIES.

At a forthcoming meeting of the state tax commission, that body will be waited upon by representatives of mining companies who will endeavor to bring about certain modifications in taxation of mining lands and plants. The present custom in South Dakota is to assess property for the purposes of taxation at its full market value. The operators claim this is an injustice. Some of them believe a bullion or production tax would be more equitable. It is also pointed out that the purchase of property by a producing company has been the signal for an immediate rise in the valuation of that property. One operator claims that he purchased some neighboring property for a small consideration, that was assessed at a nominal value, and that the next year it was carried on the tax list at $400 to $500 per acre, even before he had an opportunity to prospect it, and prior to its yielding a pound of ore. These and other items will be called to the attention of the tax commission.

A falling cage in the Golden Star shaft of the Homestake, at Lead, will hamper operations at that opening for some time. The exact cause of the accident is not known; possibly it was a case of overloading the cage. It appears that cage, loaded with steel, was being lowered to one of the lower levels, and when a short distance below the surface it began to race. In a brief space of time it had gotten beyond the control of the engineer and fell to the bottom, 1250 ft., where it crashed into a bulkhead and stopped. The drum continued to spin and the rope unwound and dropped into the shaft, completing a bad wreck. There was no one on the cage, and there were no personal injuries. Otto Ellerman, state mine inspector, was at the 1000-ft. level, and had just rung for a cage to bring him to the surface when the runaway passed.

With contributions to the Grier memorial fund close to the $3300 mark, the committee having charge of the erection is preparing plans and drawings of the proposed location, for submission to sculptors and others desiring to submit sketches and models. The exact design of the memorial has not been decided on, and, in fact, it is proposed to allow the public an opportunity to have a hand in the choice. To this end it has been decided to place on exhibition the various sketches and models submitted, that all contributors may have the privilege of designating their choice. The location agreed upon, is that tract of ground between Recreation hall and the Hearst free kindergarten. The surface at this point is several feet below Main street, so it will be necessary to erect a suitable pedestal, and whether this will be surmounted by a monument or a statue of the late T. J. Grier, remains to be decided. It has been suggested that in case a statue is decided on, that it will be placed to face down Main street, toward the Homestake works and the scene of his many years' activity in Lead. The site is particularly suitable, on one of the prettiest grass plots at Lead. It is assured that the memorial will be completed during the coming summer.

That the Homestake has been making numerous purchases of ground south and east of Lead is revealed by a new map of the mining district just completed by Frank S. Peck, of Deadwood. In fact it may be said that the Oro Hondo is almost completely surrounded by Homestake territory, and that some of the Homestake's land is so close to the shaft that J. T. Milliken is now sinking to 2500-ft. in an endeavor to find the extension of the Homestake veins.——At a depth of 240 ft. a station is being cut in the Hidden Treasure shaft, preparatory to cross-cutting west to cut a vein which dipped out of the shaft some distance above. Fred Rossitter is superintendent. ——Everything is in good order at the Anaconda shaft, at Roubaix. This is a new opening, some distance north of previous work, and during the winter the machinery was moved to it and erected.——Station cutting is under way at the Oro Hondo, preparatory to cross-cutting, on the 1500-ft. level. It is planned to do considerable diamond drilling at this level. About 35 men are employed; the force will probably be double this number within a short time. Some hard rock has been encountered, but fair progress has been maintained. Jackhamer drills are used.

With two shifts of three men each, additional to a foreman who frames timbers and other work, the Echo shaft, at Maitland, is being deepened at a rate averaging 2 ft. per day. The shaft excavation is about 6 by 10 ft. It is timbered with 8 by 8-in. sawed timbers, and lagged with 2-in. material. The hoisting compartment is 4 ft. 2 in. by 4 ft. 4 in., and the ladderway 3 ft. by 4 ft. 4 in. Two men are constantly engaged in the bottom, except when timbering and blasting. With a Chicago self-rotating sinker they drill six holes to an average depth of 4 ft. in less than two hours; the holes are blasted, and in 15 minutes 'mucking' is started, after ventilation with a Buffalo fan driven by a 1-hp. motor. It requires an average of more than a full shift to remove the rock broken with six holes. The present plan is to break the shaft with 12 holes; first six cut holes are drilled, blasted and the débris removed, leaving a bench at either end. These are then broken with three holes in each end. Hoisting is done with a 22-hp. electric machine. The engineer acts as top man, dumping the centre swing buckets direct into a car and tramming to the waste dump. Equipment includes Bury 8 by 8-in. belt-driven compressor, a Shaw drill-sharpening machine, and a 24-in. circular saw in the carpenter shop. It is asserted that this shaft is being put down at a lower cost per foot than any similar work in the Black Hills.

GOLD BULLION WORTH $60,000 IN THE U. S. ASSAY OFFICE AT DEADWOOD.

The Heidelberg company has practically decided to install electric power and equip the shaft for continuation to quartzite. The lines of the Consolidated Power & Light Co. are 2½ miles from the shaft, and it is estimated that the construction of a connecting line will cost $3500; however, as this sum will be remitted to the Heidelberg company in 20 monthly installments, it will practically pay the power bill for that length of time. The shaft is now 175 ft. deep. From the main adit

a winze was sunk 57 ft., and a rise made to the surface, making the total depth as stated. Although of rather heavy first cost, it has been decided that the power question can best be settled by securing electricity. The property is some distance from Deadwood, over a road that is not easily passable in the spring months. This would make hauling of fuel for a steam plant almost prohibitive in cost. Development continues to encourage the further expenditure of capital, and it is thought that on quartzite the largest and best bodies of ore on the ground will be found.

HELENA, MONTANA

MINING DEVELOPMENTS OF THE MANY DISTRICTS TRIBUTARY TO HELENA DISCUSSED.—INCREASED INTEREST BY LOCAL AND OUTSIDE CAPITAL.

There are several large combinations of capital being organized in this section, and it is the opinion of well informed mining men that the Helena mining region will give a good account of itself before the end of the year. The large amount of local capital which is going into mining shows the faith of the people in their own properties.

In the Rimini district the Valley Forge property is shipping regularly, and made a substantial profit in January and February. James Breen is getting ready to install a new unit in the mill with which he is working the porphyry dike. He now has 20 stamps dropping steadily, and has 26 men employed. The clean-ups so far have been better than expected.

During the past month Walter Harvey Weed was in Helena for the purpose of making an examination of the Wayside claims in the Scratch Gravel district, and the Hawkeye mine in the city limits, both of which properties are operated by the Helena Mining Bureau. Mr. Weed gave these two properties the strongest possible endorsement, and the Bureau will continue development. It is sinking the shaft on the Blue Bird claim in the Wayside working in ore assaying from $11 to $30 gold per ton. The orebody extends outside of the shaft, and it was his opinion that the shaft should be sunk to a depth of $60 ft., and then a cross-cut driven from wall to wall. The Bureau is financially able to carry the work through to completion, and all stockholders are much pleased with the prospects. The Scratch Gravel district is one of the old gold areas of the state, and several million dollars have been taken out of it. Mr. Weed also recommended a continuation of work on the Hawkeye to a depth of 350 ft., when driving will be started on the vein. Mining activity continues on the increase at and around Helena. In the Scratch Gravel district the Franklin mine is shipping three cars of high-grade gold ore per week, and is on a profitable basis. H. H. Pigott and Thomas Flynn have taken a lease and bond on 160 acres of ground from the W. G. Conrad estate in this district. They are also gathering up claims, making a combination for some outside capitalists who are coming here.——A few days ago a development of good gold ore was made on the Yellow Boy, at the head of Nelson gulch. Some of this ore was so rich that from a few pounds treated with mortar and pan, $110 was secured. The latter grade ore is being worked over at the Tandy mill on the old Shober claim.

The Butte men who have taken over the Souvenir properties, near Park City, purchased the old Shafer mill and are crushing some good ore.——A party of New York men arrived here some days ago and acquired properties in Mitchell gulch, where several good discoveries have been made within the past few months.——A Los Angeles combination is also here negotiating for some large zinc properties.——The York Mining Co., at York, is still running its mill, making some good clean-ups, which it is shipping to the United States Assay Office at Helena.

Charles Whitcomb and associates have installed a steam-shovel and washing plant capable of handling 1000 yd. per day to test the old Murray placers near Winston, owned by Joseph Smith.——Fred Christman and associates have given a lease and bond to some miners from the Little Rockies on the Golden Wedge five claims near Montana City, and work will be started there in the near future.——Scharrenbroich and Madden have bought the Jacquemin properties in the Scratch Gravel district and are now shipping to the East Helena smelter. They are making arrangements to sink a 100-ft. shaft on the big vein to lay out stoping ground.

The Mineral Mountain Mining Co., owned by Oscar G. Beck, Pete Scharrenbroich, Frank Steele, and others, which has been driving a long adit on the properties at the head of Sheep creek, between Cañon creek and Prickly Pear cañon, has cut a large vein of high-grade copper-gold-silver ore and will start shipping at once.

In the Marysville district the Barnes-King company is doing well with the Gloster. This Company has splendid prospects for the future.——Development on the Shannon property, owned by Marlow, Lanstrum, and Holter, is being continued, and is opening some fine orebodies. It is understood that they have refused a good offer for purchase.——The St. Louis company has given a lease on the Nine Hour claim, and the manager announces that within a short time its financial difficulties will be adjusted, and the entire property, including the old Drumlummon, will be again in operation.

In the Radersburg district the lessees on the old Black Friday are shipping regularly, and the Keating property maintains its usual output, also shipping.

PORCUPINE, ONTARIO

SERIOUS POWER SHORTAGE IN ONTARIO.—DOME OUTPUT.—ELECTRIC HAULAGE IN THE HOLLINGER.—WEST DOME AFFAIRS.—MCINTYRE YIELD.—KIRKLAND LAKE DISTRICT.

In northern Ontario, during the summer and fall of 1914, the rainfall was exceptionally light, and as a consequence the hydro-electric plants supplying Cobalt and Porcupine, are suffering from a shortage of water. Cobalt was affected to a greater extent than Porcupine, and the supply of power for the mines was partly cut off several weeks ago. Recently consumers in Porcupine were notified that the power companies would be able to supply only about half the regular quantity. The condition in Porcupine has been aggravated by the con-

PART OF ONTARIO.

stantly increasing consumption at the Dome and the Hollinger mines, where the enlarged plants have necessitated augmented power requirements. The production of some of the companies will be curtailed, but at other mines there are steam reserve plants that will permit of operations being carried on at practically normal capacity. The shortage of power will continue until about the middle of April, at which time the spring break-up is expected to occur. The Hollinger is using its steam reserve plant in order to maintain its output. It is the intention of the Hollinger management to use electric locomotives on the main haulage levels of the new shaft. These levels will be 400 ft. apart.

LONDON

THE INSTITUTION OF MINING AND METALLURGY HONORS T. A. RICKARD WITH A DINNER. COMPLIMENTARY SPEECHES.

I ought to preface my remarks about the complimentary dinner to T. A. Rickard by stating that during war time, ceremonial functions are usually omitted. The Institution of Mining and Metallurgy had decided not to hold the customary annual dinner this year. These occasions are graced by the presence of official guests a member of the Cabinet, for instance, or a President of the Royal Society, besides many distinguished lights in the educational and engineering worlds. Now that the Institution has won its Royal Charter we shall expect to have the Prime Minister or one of the Princes as chief guest. The dinner question assumed a different aspect, however, when it was heard that 'T. A.' was intending to return to San Francisco to resume the editorship of the *Mining Press*. It was felt that the Institution must make some corporate expression of the regret of its members at the impending loss of one who has always been an instrument for good. Therefore it was decided that members should dine together informally and have T. A. as their guest. In addition, a committee was formed by his friends for the purpose of making a substantial gift to represent an expression of their esteem and admiration. The dinner was held on the evening of March 2 at the Café Monico, in Piccadilly Circus. In spite of the darkened streets and restricted means of locomotion, in spite of the fact that hundreds of mining men are at the war or in training, a large and representative gathering assembled. The only soldier in khaki present was Peter Nissen, and you could tell by the expression on his face that he was wondering how he could utilize the blow of his 2000-lb. stamp for pulverizing the enemy. Many of the older members have sons in the army and navy, and it is appropriate to mention that the President, Dr. F. H. Hatch, has two soldier sons, while a third is an army surgeon. The first toast of the evening was 'The Institution,' moved by Sir Robert Hadfield, famous for his armour-piercing projectiles. He referred to the granting of the charter and to the generous response of the profession to the call to arms. He also referred to his first acquaintance with T. A. when the latter was an editor in New York, and asked him to bear to San Francisco the good wishes of British manufacturers for the success of the great Panama-Pacific Exposition. The President then rose to give the toast of the evening: 'T. A. Rickard.' He paid a dignified tribute to the services rendered by T. A. in advancing the interests and promoting the solidarity of the profession, through the pages of *The Mining Magazine* and in other ways. His campaign against incompetent and irresponsible directors, and his demand that mining engineers should be given fuller representation in the management of companies had been for the benefit of the profession. A man of so forceful a character inevitably propounded opinions and views that did not receive unanimous approval or agreement. Dr. Hatch raised a loud and sympathetic cheer from his auditors when he said that probably there was not a man in the room who had not at one time or another differed from T. A. He referred in well chosen words to the picturesque originality of the editorial language that had caused the *Magazine* not only to provide instruction and mental pabulum, but amusement and relaxation also. T. A. had done great service to the Royal School of Mines by creating an efficient organization of the old students. No graduate of the School had proved more faithful to its traditions or had fought more strenuously for its well-being and independence.

The presentation of an illuminated address and a sum of money wherewith to purchase a piece of plate was entrusted to Mr. F. H. Hamilton. Mr. Hamilton used to be editor of *The Star* at Johannesburg in early times, and he was one of Kruger's political prisoners on the occasion when John Hays Hammond, among others, was condemned to death. Of recent years since then Mr. Hamilton has been a financier in London. One of the companies he helped to form was the Spassky, which operates the noted copper mine in Siberia, and was practically the pioneer of the recent movement of English capital into Russian mining. Mr. Hamilton is an unusually good speaker, whether at dinners or at meetings of shareholders, shrewdly humorous, and with the gift of ingenious phrase. He referred to T. A.'s jealous care of the honor of the mining profession, to the vigilance with which he always watched the interests of the public, and to the lucidity of style and the spirit of broad humanity that redeemed from dullness even a technical article. He supposed that if T. A. had ever submitted himself to examination by a phrenologist he would have been told that his combative faculties were sound and in good working order. With regard to the form the presentation should take, one suggestion was a jeweled niblick, but this proposition was unanimously rejected, for they felt it might have awakened memories of too poignant a character, and they did not want to remind him of the only lapses from the straight and narrow way of which they had ever known him to be guilty.

T. A., in replying, was reminiscent of his connection with technical journalism. He told us how his chief interest as a journalist had always been to act as spokesman for the mining engineer and to do his part in improving the status of the profession. He had been touched and surprised to hear it said that he had succeeded in his efforts to raise the status of the profession. To use a golf simile, he was like the man that tried to make a shot and was surprised when it came off; he felt like the man that made an approach put across a bumpy green and saw the little ball drop into the hole. The fact that he had aimed to do so did not lessen his surprise when he 'holed out.' As for his combativeness, he owned to being belligerent but he was not vindictive, he might be one of those people who thought themselves upright when they were only downright, but at least he hoped that no one would impute to him a descent from a long line of maiden aunts.

Thus ended a memorable evening. Probably T. A. never before fully understood the feeling of esteem and admiration with which English mining men regard him. That dinner must have given him one of the proudest moments of his life.

NEW YORK

AMALGAMATED COPPER'S DISTRIBUTIVE VALUE.—A. S. & R. IN 1914.—ALASKA EBNER MINE.

The probability of the early dissolution of Amalgamated Copper has not in any way affected the market in the stock. It was not at first announced that the Anaconda was to acquire all of the stocks and securities in the Amalgamated treasury, as now appears to be the case. This does, however, more nearly reduce 'Copper' to its lowest terms, so that it is fairly easy to get at its distributive value. Without making up figures in detail, it may be said that Amalgamated could give each of its own shareholders two shares of Anaconda and have about 35,000 shares still on hand. In the present market this would represent practically $1,000,000; other items would add $2,000,000 more, or just about enough to make up a final cash dividend of $2 per share.

The annual report of the American Smelting & Refining Co. has just been issued, and shows that the Company earned within $700,000 of its net for the preceding year. The report will be reviewed in a future issue of the *Press*.

The Alaska Juneau syndicate, which was supposed to have underwritten the 400,000 shares of stock to be offered to the public, put a stop to the "as when and if issued" trading in the shares, when the stock had been marked up to $14 per share on this basis. Bernard M. Baruch, who is supposed to have been chosen as syndicate manager, gave out a statement that any anticipatory commitments by traders would be wholly premature, as nothing had been fully passed upon as

between the Company and the syndicate. It is a matter of regret that the United States Smelting, Refining & Mining Co. has not found its development work on the Ebner such as to justify the further carrying out of its plans. The work which has been done includes 4000 ft. of development in vein formation, but this has not been sufficient to disclose the $15,000,000 in net profits, the development of which was one of the conditions on which the United States company took up the Ebner. As the matter now stands, the Ebner interests must repay to this Company $400,000 within a few days, or a right of foreclosure accrues to it. In view of the past history of the Ebner, it may be doubted whether it will be possible for this payment to be made. The Ebner has never been really financed on a basis that held out much hope of real progress. It may be, therefore, that in the end the United States Smelting, Refining & Mining Co. will develop and operate the property. Perhaps the management will have to be content with something less than the designated $15,000,000 in net profits, but certainly it will want to make the property pay its board bill already in arrears.

There has been a considerable spirit of revival noticeable in the Canadian section of the market. The recent work of the Temiskaming, the branching out of the Crown Reserve into the Central American field, and the payment of the regular dividend of 5% by the Nipissing Mines Co. have all contributed as market factors to add to the interest in Canadian issues.

VANCOUVER, BRITISH COLUMBIA

SNOW AND LANDSLIDE AT THE BRITANNIA MINE. FATALITIES. SITUATION OF MINE, PAST HISTORY, AND PROSPECTS.

At about midnight on March 21 a serious snow and land slide occurred at the Britannia mine, on Howe Sound, about 30 miles north of Vancouver. The total loss of life is definitely fixed at 56, including 5 women and 6 children. The loss in property is represented by the total destruction of the entire town, except eight houses. Included in the buildings destroyed are the cook and No. 1 bunk-houses, store, tool and candle-houses, as well as the Company's offices, and serious damage to the upper terminal of the tramway.

The mining town is situated about 3 miles from the beach, at an elevation of about 4000 ft., and is connected with the town of Britannia Beach, where the concentrator is, by an aerial tramway built in two sections, with a half-way station at an elevation of about 2000 ft. above sea-level.

The mine workings are in two mountains, known as the Mammoth and Fairview bluffs, which rise precipitously from a flat basin in which the buildings that comprised the mining town had been built, at about the same level as the portals of the main adits. The workings and upper terminal of the tramway are connected by a long snowshed, because the snowfall at this altitude so near the coast is usually excessive, but the buildings were supposed to be sufficiently far away from the danger zone to be secure. Most of them were built about ten years ago; during that period there has never been any apprehension of danger from slides, and the present awful calamity testifies to the unusual severity of the conditions that caused it, because the avalanche swept down the valley from the base of Fairview bluff for a distance of more than a mile, carrying snow, boulders, trees, and portions of the wrecked buildings, as well as some of the bodies of its victims, almost to the transfer station of the tramway. The calamity is thus somewhat similar to the big slide at Frank, Alberta, which happened about ten years ago, resulting in much loss of life and property, and was followed by the removal of the entire townsite as well as a part of the Canadian Pacific Railway Co.'s tracks to a new site.

The Britannia mine was discovered by some trappers in 1897, was sold to Leo. Boscowitz, a fur-buyer of Victoria, soon after, and in the late summer of 1899 was sold to a syndicate made up principally of Montana men, who organized the Britannia Copper Syndicate. This is capitalized at $250,000, divided into 400 shares of a par value of $625 each. In 1902 control of this stock was acquired by the late George Robinson, of Butte, and Henry Stern, of New York, who commenced development work, erected the tramway, also the concentrator at the beach, and purchased the Crofton smelter, on Vancouver island, built by Messrs. Breen and C. H. Bellinger in 1901. Since then the mine has been developed into one of the biggest copper mines on the Pacific coast, but the Company has been reorganized and the capital increased since the death of Mr. Robinson, when the control was secured by New York interests, headed by the banking firm of Moore & Schley.

A long adit is being driven, with its portal at a little higher elevation than the half-way station on the tramway, and when that has been completed and has cut the orebodies, it is the intention of the Company to abandon the upper part of the tramway, transport all ore through the adit, and take advantage of the opportunity of handling the product, amounting to about 1000 tons of ore per day, by gravity from the mine levels above this main adit, instead of by hoisting as at present. The new adit will be more than one mile long and will develop the mineralized zone, in which the

MAP OF BRITISH COLUMBIA. HOWE SOUND, THE SITUATION OF THE BRITANNIA MINE, IS JUST NORTH OF VANCOUVER.

orebodies occur, at a depth of about 1500 ft. below the present lowest level.

This mineralized zone consists of crushed eruptives and slates occurring as inclusions in the coast granite batholith, with veins and veinlets filled with quartz. The eruptives are in part altered to micaceous schists, and are usually heavily mineralized with pyrite, chalcopyrite, some zinc-blende, and occasionally galena. This zone is about 7 miles in length, with a southeastern strike, and exhibits a width of 200 to 500 ft. of low-grade copper ore. On the Britannia property there are three known orebodies totaling about 3000 ft. in length so far as the present drifts have demonstrated. The average metal content is about 2% in copper and 40c. in gold per ton. The Company was one of the first big copper-mining companies to adopt the flotation process of concentration after unsuccessfully attempting water concentration. About 1000 men are employed on the works and in the mine.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press.

ALASKA

Juneau

February returns of the mines on Douglas island were as follows

	Alaska Mexican.	Alaska Treadwell.	Alaska United.
Development work, feet	178	831	964
Stock of broken ore, tons.....	14,803	46,954	16,775
Stamps dropping	120	540	270
Ore crushed, tons	17,395	69,185	38,661
Concentrate cyanided, tons...	330	1,509	861
Total gold recovered	$32,662	$142,249	$86,091
Operating expenses	22,867	84,259	28,699
Construction expenses	3,892	8,854	5,703
Estimated net profit	5,577	47,713	26,622

According to D. C. Jackling, who was recently in Alaska, everything at the Alaska Gold mines is in excellent shape. The mill is doing splendid work. Both the tonnage treated and the recoveries are fully up to expectations. When finally adjusted a unit will handle 2500 tons, giving a capacity of 10,000 tons to the entire plant. That the recoveries will be fully as good as determined by experimental results is now certain. The second unit will be ready in 60 days, and the mine will be sufficiently opened at that time to supply the ore for it. The third unit should be started about July 1. The ore now milled is coming from six different and widely separated points in the mine, thus giving a good average to the property, and is holding at nearly $2 per ton, and the mill is treating 1800 tons per day. The quantity for March should be about 40,000 tons. The mill is the simplest and most economical in all points, and the most satisfactory one the Hayden-Stone interests have ever built.

In the suit of Colich *v.* the Alaska Gastineau company for $10,000 damages for injuries, the verdict was in favor of the defendant. The plaintiff was a mine shift-boss, and argued that another set of timber should have been placed where he was hurt, but the defense argued that, being a boss, he should have attended to such necessary timbering.

Tolovana

News from Fairbanks states that encouraging reports are coming from Tolovana. Over 210 claims have been staked, more than half being on Livengood creek. On Wilbur creek, a tributary of the Tolovana river, 60c. per foot ground has been found. Hudson Bros., on Livengood, opened $1.50 gravel, but lost it on driving 22 ft. On 2 Below Livengood, McQueen and Marsh are down 110 ft., with no bedrock. Others are down from 84 to 120 feet.

ARIZONA

Cochise County

Churn-drilling is to be resumed at the Sacramento hill area of the Copper Queen property at Bisbee. Two machines are ready, in charge of C. J. Barkwell.

The Shattuck-Arizona company will resume operations with a full force in a few days. Only development has been done since October 1, 1915, previous to that time ore shipments were 400 tons per day. This will mean the employment of at least 300 men.

Gila County

The heavy flow of water in the Old Dominion mine is being held in check on No. 12 level, and not allowed to overflow to the lower levels.

Mohave County

What is known as the Tom Reed-Gold Road district of this county is attracting considerable attention of late, and Haff and Colwell, of Los Angeles, California, have prepared a preliminary map of the claims, to be followed by a complete plan showing all properties, for the Tom Reed-Gold Road Association. Some details are given as to the operations of the 26 principal companies. In 1914 the Tom Reed produced gold worth $1,101,750, and the Gold Road, $667,375.

A wide body of rich ore has been cut at 460 ft. in the United Eastern mine, which property consists of claims adjoining the Tom Reed.——At 600 ft. in the latter mine a cross-cut is being driven toward the Tip Top vein in ground recently purchased.——The Bi Metal mine was sampled last week.

Pinal County

(Special Correspondence.)—The mill at the Magma Copper Co.'s mine is working regularly. Construction on the railway to connect with the Arizona Eastern line at Webster is progressing at a good rate at both ends.

Superior, March 25.

Yavapai County

(Special Correspondence.)—The Commercial mine was reopened on April 1. Future ore shipments will go to Needles instead of Douglas as formerly.

Copper Basin, April 1.

CALIFORNIA

The hearing on the bills affecting the mining industry in California, which was adjourned until March 26 to allow the representatives of the miners to appear to speak for them, was held on the date set, but no miners put in an appearance. Of operators, Albert Burch, W. G. Devereux, James Parks, John Mocene, C. E. Uren, Webb Smith, C. R. Downs, and others were present. Messrs. Wolfin and Bradley appeared on behalf of the Industrial Accident Commission. In regard to the eight-hour law, the latter stated that they would object to have the men come in and leave the mines on company time, as there would be a tendency to hurry the men, which would lead to accidents. This bill will probably be reported on unfavorably. It was brought out at the hearing that the results which the dust bill and the mine inspection bill are desired to secure will be amply covered by the rules which will shortly be promulgated by the State Industrial Accident Commission, and if the laws were enacted in their present form it would entail additional expense, with no additional advantage. Most of the operators present spoke in opposition to these bills, and they probably will not be reported out of the committee. Mr. Harris, of Kern county, was the only man present who supported the bills. The bill appropriating $5000 for the study of the metallurgy of nickel at the University of California was referred to the Committee on Ways and Means.

Oil production of the state in February was as follows: New rigs, 17; wells drilling, 148; completed during month, 19; abandoned, 1; producing, 6104; and production per day, 246,869 bbl., against 250,528 bbl. in January. Shipments were only 202,190 bbl. per day. Stocks of crude oil at the end of February totaled 60,527,306 bbl. To the end of 1914 California

had produced 761,693,641 bbl., the Midway-Sunset field contributing 177,018,440 bbl.; Kern River, 173,712,101 bbl.; Coalinga, 153,004,536 bbl.; Whittier-Fullerton, 69,718,444 bbl.; Lompoc-Santa Maria, 66,156,141 bbl.; Los Angeles, 47,568,946 bbl.; and McKittrick, 42,078,772 barrels.

Amador County

Twenty of the forty stamps are dropping at the Central Eureka. The wrecked tailing flume has been repaired. The main shaft is being overhauled, after which it will be sunk deeper.

In the case of the Kennedy Mining & Milling Co. to quiet title to two claims in the Jackson townsite, the Supreme Court on March 30 upheld the previous decision of the lower court by which the Company retains full title to the property.

The Argonaut Mining Co. has paid a special dividend of 2½c. per share, in addition to the regular quarterly distribution, making a total of $20,000.

Butte County

The P. B. Steifer Mining Co. is mixed up in another lawsuit; this time Henry T. James, of Los Angeles, alleges an attempt is being made to swindle 800 shareholders by the levy of an assessment, ostensibly for development, but probably for other purposes. The case seems to be considerably involved.

Inyo County

Preliminary work is being arranged at the Wilshire Bishop Creek mine, and E. W. Walter, superintendent, has returned to the property, where two feet of snow is still on the ground.

Nevada County

The second annual meeting of the Golden Center of Grass Valley Co. was held at Sacramento last week, and the president, Rodney McCormick, stated that steady and consistent progress is being made. Revenue for 1914 totaled $118,576, of which bullion recovered contributed about $50,000. Expenses amount to $112,881. The superintendent, Charles A. Brockington, stated that a new steel head-frame is to be erected, and improvements made to surface buildings. Underground development during the 14 months ended January 25, 1915, totaled 2204 ft., with only 12 miners. Over 2000 tons of $18 ore was extracted from No. 7 level and in shaft sinking on the Dromedary and Whiskey veins. The Garage vein was cut on February 1, where it showed 16 in. of quartz showing free gold. The vertical shaft and incline shaft remain to be completed. The pumps have a capacity of 1125 gal. of water per minute.——At 500 ft. depth in the Oustomah mine, at Nevada City, ore worth $100 per ton has been cut. ——The Willow Valley district shows signs of increased activity.

Development in the Native Son mine at Blue Tent is resulting favorably, the vein opened in the lower adit getting wider. ——A new adit is to be driven below the old one at the Arcade on Minnesota flat.

Placer County

The company owning the Dairy Farm copper mine has constructed a narrow-gage line, 9 miles long, to carry ore from the mine to Sheridan, where it will be transferred to the Southern Pacific.——Work has been resumed on the Bellevue and Bullion mines in the Ophir district.——The Red Bird mine, about six miles from Colfax, has been examined by D. F. Godfish of Stockton.

Shasta County

A 5-stamp mill has started crushing ore at the Gambrinus mine on lower Whisky creek, near Stella. The plant contains a concentrator, as the concentrate is rich. According to the superintendent, H. W. Rogers, 3 ft. of $15 ore has been cut on No. 5 level. About $10,000 was spent on the property in the past year.

Trinity County

With plenty of water, Carter and Williams Bros. are ready to start sluicing with two giants at the Coffee Creek gravel claims. Good returns are expected, according to prospecting results.

Yuba County

The Marysville Dredging Co., which is operating two 9-cu. ft. boats at Marigold, contemplates constructing one of 16-ft. capacity. T. D. Harris is manager.——The Solano Wonder mine, near Brownsville, is reported to be again producing good returns.

COLORADO

Lake County (Leadville)

(Special Correspondence.)—The Empire Gold Dredging Co., a new concern, has acquired a tract of placer ground containing about 125 acres that has been proved and 1500 acres that remains to be proved. This ground lies about 10 miles west of Leadville and is known as the Derry ranch. The Company will shortly begin construction of a 6-cu. ft., electrically driven dredge with all modern improvements, including a manganese steel bucket-line. The property has been favorably known during the past few years, but the difficulty in the past has been to secure the ground on favorable terms. The Company will be controlled and managed by the New York Engineering Co., and before the summer passes some data concerning clean-ups, yardage, and costs may be available for the *Press*.

Leadville, March 25.

The Fanny Rawlins Operating Co. has been organized to develop the Fanny Rawlins, in which ore has been opened 150 ft. northwest of the main shaft.——New York people and G. W. Boyce, of the Gordon Tiger mine at Twin Lakes, have secured title to the old Bwlchcogh property in the Red Moun-

BIG EVANS GULCH, LEADVILLE, COLORADO.

tain district. J. M. Vivian, of England, has held the claims since 1896. Work will be started as soon as the weather permits. At a depth of 1500 ft. there is said to be a 4-ft. vein worth $20 to $30 per ton in gold. The mine is opened by adits, and is equipped with a mill.——The Colonel Sellers mine in California gulch is producing about 200 tons of sulphide of zinc, iron, lead, and silver ores per day.——Lessees at the La Plata, on Rock hill, are preparing to ship iron-silver ore.——The Beaton and Boggs lease on Jonny No. 4 is to resume ore production from the lower workings.—— The Western Mining Co. is retimbering its Harriett shaft. ——In the Lackawanna district rich gold ore has been opened, larger in extent than previously.

San Juan County

Lessees at the Little Giant mine, on King Solomon mountain, have opened a shoot for 200 ft., and are shipping to the smelter. They are negotiating for the Contention mill and tramway, which is in the hands of creditors.——Tailing

from the Iowa mill at Atlanta is to be treated by McKenzie and Kanes.——Work is to be resumed at the Vermilion mine near Arkansas Forks.

TELLER COUNTY (CRIPPLE CREEK)

After several improvements had been effected, including a new electric hoist work has been resumed at the Howard shaft of the Mary McKinney property.——Development in the St. Thomas on Raven hill is promising.

IDAHO

SHOSHONE COUNTY (COEUR D'ALENE)

On April 15 the Stewart Mining Co. will pay a dividend of 10c. per share. In 1914 a total of 62½c. was distributed, equal to $773,676. The total to date is $1,383,997.——The crosscut from the main adit of the Ray-Jefferson has passed through 12 ft. of lead-zinc ore. It is 800 ft. below the upper adit, in which there is also a good shoot.——The main shaft at the Success is down nearly 1100 ft., and will be continued to 1300 ft. A Deane pump of 415-gal. capacity per minute will be placed at the bottom. At 1100 ft. the east drift continues on the rich zinc ore.——A 50-ton mill is to be erected on the Amy-Matchless mine, on Pine creek, this spring, according to the manager, Gus Smith. It will cost $16,000.——Work is to be resumed at the Morning mine and mill of the Federal Mining & Smelting Co. The Montana Power Co.'s transmission line has been connected with the system on the property.

The town of Kellogg is considering the installation of its own water supply at a cost of about $125,000. Water from Big creek is suggested, but mining companies have water rights on the creek.

MICHIGAN

HOUGHTON COUNTY (THE COPPER COUNTRY)

Shipping people of Portage lake are preparing for the opening of navigation, which will take place about the usual time.

It is reported that H. F. Key, of Hancock, will ship about 50,000 tons of sand from the old Franklin stamp-mill to Cleveland this season for the manufacture of concrete blocks.

Wages at the Copper Range Consolidated mines were increased 10% on April 1, making them equal to those paid in July.

MISSOURI

JASPER COUNTY

On the Rex land, at Joplin, four drill-holes have entered ore at an average depth of 100 to 105 ft., showing 24 to 34 ft. of 15 to 20% blende and galena, the former mineral predominating.——The highest price paid for zinc-blende during the recent boom was $79.40 per ton for ore assaying 64.4% metal to C. D. Meyers of Springfield. The ore occurs at a depth of 90 ft.——Several companies are prospecting new ground northwest of the Oronogo Circle mine.——Northwest of Oronogo, a company is driving at 125 ft., at which depth drill-holes cut good ore some time ago.

MONTANA

CASCADE COUNTY

The contractors, Clifton and Applegate, for the refinery at the plant at Great Falls, have started excavating with 60 men, a steam-shovel, three dinky locomotives, and dump-cars. Ground to be moved amounts to 110,000 cubic yards.

LEWIS AND CLARK COUNTY

It is probable that the Yellow Jacket mine, near the Big Indian, not far from Helena, will be reopened this summer. A good tonnage of ore is said to be ready for the stamp-mill on the property.

SILVER BOW COUNTY

The Butte Miner states that by May 1 there will be 11,500 miners employed at Butte, who will receive $1,150,000 per month in wages. Other employment will increase this number to 14,500 men. The Anaconda mines have 6550 at present, and other mines 2500.

NEVADA

The report of the Nevada Industrial Commission from July 1, 1913, to December 31, 1914, has been published. The total income for the first 18 months of the Commission was $360,267; compensation expense, $279,127; administration, $39,844; reserve fund, 10% premium income, $37,790; and surplus, $5505. The contributors include 364 from mines and smelters; all other industries, 449; total, 813. The average number of employees within the protection of the act is 10,709, including 7348 in the mining and smelting industry and 3361 in all other industries. The mining and smelting industry contributed 80.5% of the premium receipts, $288,111; and other industries, 19.5%, or $69,792. In the mining industry the average number of employees has been 7348; average yearly premium on each employee, $26.28; total payrolls, $13,125,242. The pension awards made in this industry and required for pending claims, $178,179. The administration expense of the commission has been 11.13% of the premium income. The number of employers rejecting the act has been 364, the largest number being mercantile houses numbering 153. There were 107 hotels, restaurants, and saloons rejecting the act. During the period named there were 1849 accidents reported to the Commission, 986 incapacitated for less than two weeks, and 812 for more than that period. There were 503 disabilities and 29 fatal cases upon which final settlement was made, and 53 deaths from accidental causes reported.

ESMERALDA COUNTY

The Goldfield Consolidated company reports as follows for February: Development, 2926 ft., at $5.90 per foot; ore treated, 29,862 tons; net realization, $168,279; cost per ton, $5.36. Lessees produced 1271 tons of ore valued at $28,442, from which the Company received $14,599, less transport and treatment charges.

LYON COUNTY

The new 100-ton plant of the Rocklin Mining Co., 25 miles south of Yerington, started work on April 1. Mine development totaling 13,000 ft. has developed 70,000 tons of ore, down to a depth of 1300 ft. E. J. Schrader is general manager.

NYE COUNTY

Tonopah mines last week produced 10,723 tons of ore worth $218,974.——On April 21 the Tonopah Mining Co. will pay 25c. per share, equal to $250,000.——Some development in the Montana has been encouraging.——The Extension made a profit of $60,218 in February.——On March 21 the Belmont shipped 131,535 oz. silver bullion.

A valuable article on 'The Cost of Mining and Milling in Tonopah' appears in *The Tonopah Miner* of March 27, written by Jay A. Carpenter. This will be published in the *Press* at an early date.

WHITE PINE COUNTY

(Special Correspondence.)—The Nevada Consolidated company is working at the mine six of the eight steam-shovels and 11 of the 13 dinky engines. All men are working full time and the mill at 75% capacity. The Company lacks power to run more units on account of the agitators (oil-flotation machines) requiring so much more, and is spending $250,000 for increased electric power. While the agitators make a better saving, they do not, as yet, increase the tonnage per day. The old Ward property, 18 miles south of Ely, is being put in shape, some Salt Lake City people (presumably smelter interests) having taken a bond and lease on it. There are more lessees working and shipping ores from the district and county than in many years, and 'making good,' too.

Ely, March 15.

OREGON

The U. S. Geological Survey has issued *Bulletin* 590, dealing with oil prospects in northwestern Oregon. According to C. W. Washburne, the geologist who made the investigation, the chance of getting oil and gas in commercial quantity there is very slight indeed.

Jackson County

(Special Correspondence.)—Another 10 stamps are to be added to the Braden mine near Gold Hill, which is owned by the Messrs. Ray. The mine has been well developed, making this extension advisable.——Lessees at the old Gold Hill found specimen ore recently worth $200. Development in the Blue Ledge copper district, just over the boundary in California, has stimulated interest in the copper claims of the upper Applegate district of this county. The roads are now passable, and miners are going in.——The Cinnabar in Ramsey cañon is being reopened, with A. L. Lewis in charge, after being idle for a year. New equipment is to be ordered.——The Sylvanite mine is also to be reopened by R. W. Ford and others.

Philomath, March 21.

UTAH

Grand County

Extensive placer work is to be done on the Dolores river several miles south from its junction with the Grand river, by Elkins Bros. of Juneau, Alaska, and E. O. Weston of Victoria, British Columbia. J. W. Brengman, of Grand Junction, has been examining some of the ground.

Juab County

Ore shipments from the Tintic district last week totaled 108 cars. It is hoped to have the new Tintic Tunnel Co., for

KNIGHT-CHRISTENSEN MILL AT TINTIC, UTAH.

the drainage of the district, organized in a few weeks. The cost of the proposed 5-mile tunnel will be about $1,000,000. Zinc ore from nine Tintic mines passed through the Utah Ore Sampling Co.'s sampler at Silver City during the past few weeks.

Piute County

Gold ore which is expected to return $1000 per ton has been sent to Salt Lake City from the Wedge company's mine in the Ohio district.

Salt Lake County

(Special Correspondence.)—Although the smoke bill passed the Legislature, it was vetoed by the Governor of the state. It is a pity that such is the case, as it was hoped that the U. S. Bureau of Mines would be able to carry on an investigation at Salt Lake City which would not only enable it to find some feasible means of doing away with the black smoke problem, but would also settle beyond a doubt whether or not the smelter smoke in the Salt Lake valley had any bearing on the black-smoke problem in the city. However, the Governor's veto has put a quietus on aspirations along this line, at least for the time being. The Bureau officials have hopes of being able to take up the problem at some future date, and hope that they will be able to work out some scheme which will enable them to do so.

Salt Lake City, March 27.

In February the Utah-Apex Mining Co. made a profit of $18,056 from 3594 tons of shipping and 9873 tons of milling ore.

The sixth annual report of the Bingham Mines Co. shows the following results in 1914: The Company operates the Dalton & Lark and Commercial mines, also has an interest in the Eagle & Blue Bell of Tintic. The general manager, Imer Pett, reported that the Dalton & Lark return from 29,347 dry tons of lead and copper ore smelted was $160,448 net. Copper ore from the Commercial was 20,433 tons, yielding $50,850 net. The total smelter return was $211,298. Although 10,792 tons more was shipped in 1914 than in the previous year, owing to the metal market receipts were $10,679 less. The Company's net operating profit was $68,281, and dividend from the Eagle & Blue Bell $104,250. The profit and loss account shows a credit of $172,682, from which is deducted $171,711, including $122,677 for miner's depreciation account of ore shipments, leaving a surplus of $971. The total surplus is $104,833.

The new powder manufacturing plant of the Hercules Powder Co. was officially opened at Bacchus on March 29. The capacity will be 1,000,000 lb. of dynamite and 25,000 lb. of black powder per month, with 90 men employed under Stanley B. Moore. The new town of Bacchus is laid out on the latest system.

The Bingham-New Haven Gold, Copper & Silver Mining Co. paid a dividend of 10c. per share on March 8.. This amounts to $22,869, making $674,635 to date.——As soon as the snow disappears, repairs will be made to the upper portion of the Michigan-Utah tramway in the Alta district. It was damaged by fire some time ago.

VIRGINIA

Wythe County

(Special Correspondence.)—The Bertha Mineral Co., controlled by the New Jersey Zinc Co., is down 455 ft. in its lead-zinc mine near the New river, near Ivanhoe. The first lead extracted in this state was mined here over 150 years ago.——S. S. Boggs and Pittsburgh people are developing a promising zinc property, and will erect a 100-ton mill at once.

Ivanhoe, March 9.

WASHINGTON

Ferry County

(Special Correspondence.)—The annual stockholders' meeting of The Western Union Mines, called at Republic, the principal place of business, to take place on February 27, was adjourned from time to time, awaiting arrivals from West Virginia. C. O. Jarrell, of Emerson, West Virginia, arrived on February 26. William Osborne, one of the leading men of the Company (who went back to West Virginia a few weeks ago, and was expected to return with the money to pay the Company's indebtedness, of which $21,000 is owing for labor and over $60,000 for supplies), returned to Republic March 1. J. L. Harper, the promoter and former general manager of the Company, is a large stockholder, and was a director and leading spirit. It is the evident intention of the West Virginia people to drop him. A majority of the stock, including proxies, was held by Jarrell and Osborne. At the meeting the following trustees were elected: C. O. Jarrell, president; William Osborne, vice-president; C. S. Craft, J. H. Hapkins, and Mr. Smith, all of West Virginia; P. P. Otey and G. J. Tompkins, of Republic, respectively secretary and assistant secretary. In the last letter from Republic it was stated that the Company's options had been forfeited. The West Virginia people have departed, and the

debts and installments on the options remain unpaid. It appears to me that the purpose of the West Virginia people is to wind up the Western Union Mines, organize a new company, take up the option of the Republic Consolidated Mines Corporation, and drop Mr. Harper entirely; but whether to pay off the debts of the Western Union Mines is another question.

The orebody on the 200-ft. level of the Ben Hur mine is widening and improving in value. The Ben Hur Leasing Co. shipped seven cars of ore to the smelter since the last of February.——After the change of management in the Knob Hill mine, two weeks were given to development work. Fourteen men are employed, and nine cars of ore have been shipped to Trail, British Columbia.

Republic, March 5.

SPOKANE COUNTY

A total of $495,850 was paid in dividends during March to shareholders in the following companies operating in the district of which Spokane is the centre: Bunker Hill & Sullivan, $81,750; Caledonia, $52,100; Consolidated Mining & Smelting Co. of Canada, $117,000; Federal Mining & Smelting, $120,000; Interstate-Callahan, $115,000; and Hecla, $10,000.

STEVENS COUNTY

(Special Correspondence.)—The United Copper Co., at Chewelah, has been successful with the copper flotation process and is planning for 50 additional stamps, to more than double its mill capacity.

Chewelah, March 26.

Ten mines in the Chewelah district, which either have never shipped any ore or have been closed down for more than a year, will commence shipping during the next three or four months. These are the Blue Star, Security Copper, Juno Echo, Copper Cliff, Chewelah Standard, Hecla, Washington group, Copper Queen, Krug, and Liberty. The Hecla, which came into prominence last year, will install new equipment, all of which is on the ground at the present time. The Blue Star has commenced work on a new double shaft which it expects to sink to the 800-ft. level.

The largest hoist sent into the Chewelah copper district has been received at the Hecla mine. The machine is known as a double-carriage 8⅛ by 10-in. Lidgerwood shaft hoist. Its capacity is two to four tons from a depth of 800 to 1000 ft. Fred Foster is manager.

CANADA

BRITISH COLUMBIA

Ore reserves in the Copper mountain property of the British Columbia Copper Co. are now estimated at 6,600,000 tons, an increase of 1,100,000 tons compared with five months ago. The metal contents average 1.82% copper and 35c. gold and silver per ton. An adjoining property contains 750,000 tons of 1.54% ore.——Three feet of ore assaying 65% lead and 268 oz. silver has been cut at 900 ft. in the Rambler-Cariboo mine.

ONTARIO

A slab of ore weighing 2600 lb., and containing about 4000 oz. silver per ton, was extracted from an open-cut of the Townsite mine at Cobalt last week. It was found only a few feet below the surface.——The Beaver Consolidated has resumed dividend payments with 3c. per share, equal to $60,000. The total to date is $530,000.——The Peterson Lake has paid $43,000 for its last dividend. The surplus at January 31 amounted to $182,380.

MEXICO

SONORA

Reports sent to Nogales on the border, tell of the raids made by Yaqui Indians in the southern part of this state, especially in the districts between Guaymas, Toniche, and Telsa on the Mayo river. Traffic and travel in the Rio Yaqui country is at a standstill.

PERSONAL

W. J. LORING is at St. Louis.

JAMES E. HARDING has returned from Ocampo, Mexico.

ROSS B. HOFFMANN is in London, on his way to Siberia.

C. E. DWYER is now with the Federal Mining & Smelting Co. at Wallace.

J. A. AGNEW passed through New York on his way from London to Nicaragua.

H. E. PERRY, manager for the Chisos Mining Co. of Terlingua, Texas, has been visiting in San Francisco.

A. W. ALLEN has left London for the Argentine, where he will manage a property at Rodeo, San Juan district.

E. H. CLAUSEN has left the Penn Mining Co., of Campo Seco, California, and is now mine-surveyor to the Colorado Mining Co. at Masbate, Philippine Islands.

RALPH STOKES, until recently with the Canadian Exploration Co., has been promoted from the ranks to a commission in the Royal Engineers. He is now at the front.

H. CROUCH, formerly of Grass Valley, California, is at Hilltop, Nevada, where he has charge of the mill and cyanide plant of the Kimberly mine.

WALTER HARVEY WEED is at Butte, Montana, as geological witness in the Anaconda *v.* Pilot-Butte case. He will be at Helena early in April and will go from there to San Francisco.

W. F. RITTER, who for several years has been manager for the Eighty-five Mining Co. at Lordsburg, New Mexico, has resigned his position. A. J. INTERRIDEN has been appointed by the directors as his successor.

Obituary

CLARENCE EDGAR COPELAND, mining engineer, and his wife were killed with 53 others in a snow and rock-slide that demolished part of the settlement adjoining the Britannia mine in British Columbia, shortly after midnight on March 22. Clarence Copeland graduated with honors from the Colorado School of Mines in 1913 and since then had been engaged in professional work on the Pacific coast. He was 25 years old only, and had begun a most promising career. On January 6, 1915, he married KATHERINE NORA HOLLAND, of Seattle, Washington, who died with him. He is survived by his father and mother, Mr. and Mrs. J. S. COPELAND, of Los Angeles, California.

Schools and Societies

The Southern California branch of the A. I. M. E. will hold a meeting on April 8, when lunch will be served, and Algernon Del Mar will read a paper entitled 'Mechanics of Crushing.'

The biennial report of the instructor, Dwight T. Smith, of the VIRGINIA CITY SCHOOL OF MINES, Nevada, states that an average of 23 students attended in 1913-14, compared with 38 in 1911-12. The 'Announcement' of the school briefly describes the courses given.

The executive committee of the COLORADO SCIENTIFIC SOCIETY reports that the membership totals 233, 10 being elected in 1914, and there was a loss of 15 in that period. Of the total, 142 reside at Denver. The revenue amounted to $2036. Cash on hand is $82, against $144 at the end of 1913. New quarters were secured in the Colorado State Museum. The Society's bulletin contains a paper by Richard A. Parker entitled 'The European War and the Mining Industry.'

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, April 1.

Antimony	25 —25¾
Electrolytic copper	15½ 15¾
Pig lead	4.40—5.35
Quicksilver (flask)	$80.00
Spelter	10¾—11
Tin	40 —41½
Zinc-dust, 100-kg. zinc-lined cases	15

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, March 31.—Copper is firm; lead strong, and spelter quiet.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.		Average week ending	
Mch. 25	50.50	Feb. 17	48.42
" 26	50.50	" 24	48.70
" 27	49.50	Mch. 3	49.02
" 28 Sunday		" 10	49.81
" 29	50.12	" 17	51.18
" 30	50.37	" 24	50.33
" 31	49.87	" 31	50.14

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	....
Feb.	57.53	48.45	Aug.	54.35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	....	Oct.	51.12	....
May	58.21	....	Nov.	49.12	....
June	56.43	....	Dec.	49.27	....

Silver worth $141,600, say 290,000 oz. left San Francisco for the Orient on March 27 by the 'Mongolia.' Exports from London to India and China to March 18 totaled £1,457,500, compared with £1,567,500 in the same period of 1914, according to Pixley & Abell. A succession of foreign coinage orders have lifted quotations in London, but Samuel Montagu & Co. say that before higher prices can be maintained, China has to be reckoned with. It must be remembered that not only are stocks in Shanghai extremely large, but also a substantial portion of the stock in London, about £1,250,000, is held on account of the same quarter. A sudden upward rise in the price of silver provokes necessarily a somewhat similar movement of the China exchanges. This movement, in turn, often causes exchange operations that set free some of the silver held on China account in this market. Thus an automatic reaction takes place, more or less effective in proportion to the amount of silver set free, the power of the silver market here to absorb it, and the limits set to sales by the conditions which govern the China exchanges at the time. These considerations throw light on the movements during the third week of March.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Mch. 3	70.00	Mch. 17	80.00
" 10	80.00	" 24	80.00
		" 31	80.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60.00	Aug.	80.00	....
Mch.	39.00	78.00	Sept.	76.25	....
Apr.	38.90	....	Oct.	53.00	....
May	39.00	....	Nov.	55.00	....
June	38.60	....	Dec.	53.10	....

The report of the New Idria Quicksilver Mining Co. for 1914 supplies food for thought on the quicksilver situation. The output totaled 6550 flasks, for which an average of $41 per flask was received. The whole position will shortly be discussed editorially in the 'Press.' A New York daily of March 12 states that an order for 100 flasks was received in New York from Europe on the previous day. The leading dealer was asking $85 per flask on that date.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	....
Feb.	39 76	37 23	Aug.	60.20	....
Mch.	38.10	48.76	Sept.	33.10	....
Apr	36.10	....	Oct.	30.40	....
May	33.29	....	Nov.	33.51	....
June	30.72	....	Dec.	33.60	....

The British Government has prohibited the exportation of tin from the Straits to other than British ports. Efforts are being made to obtain special permits for shipments to consumers in the United States.

While the official figures are not available, the approximate exports of tin from Bolivia during 1914 amounted to 34,624 metric tons. The last three months show a falling off of 36% compared with the pre-war period months. One cargo of 6000 tons was recently sunk.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Mch. 25	15.20	Feb. 17	14.30
" 26	15.25	" 24	14.42
" 27	15.30	Mch. 3	14.38
" 28 Sunday		" 10	14.50
" 29	15.40	" 17	14.59
" 30	15.50	" 24	14.90
" 31	15.60	" 31	15.37

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	....
Feb.	14.46	14 38	Aug.	12.34	....
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	....	Oct.	11.10	....
May	13.97	....	Nov.	11.75	....
June	13.60	....	Dec.	12.75	....

Exports of copper during the week ended March 27 amounted to 11,725,133 lb. The Calumet & Hecla company is reported to have sold out its metal at 16⅞c.——China produced 3,722,800 lb. in February, and Ray, 4,850,000 lb.——The A. S. & R. company earned 6.93% on common stock in 1914, against 7.47% in 1913. Franklin Guiterman, general manager for the Company, recently stated in Denver that the mining industry generally was encouraging.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Mch. 25	4.15	Feb. 17	3.85
" 26	4.15	" 24	3.85
" 27	4.15	Mch. 3	3.87
" 28 Sunday		" 10	3.95
" 29	4.15	" 17	4.01
" 30	4.15	" 24	4.15
" 31	4.15	" 31	4.17

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	....
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	....	Oct.	3.60	....
May	3.90	....	Nov.	3.68	....
June	3.90	....	Dec.	3.80	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date		Average week ending	
Mch. 25	8 to 9	Feb. 17	8.24
" 26	8 to 9	" 24	8.25
" 27	8 to 9	Mch. 3	9.05
" 28 Sunday		" 10	8.00
" 29	8 to 9	" 17	7.92
" 30	8 to 9	" 24	8.59
" 31	8 to 9	" 31	8.59

Monthly averages.

	1914.	1915.		1914.	1915.
Jan	5.14	6.30	July	4.75	....
Feb.	5.22	9.05	Aug.	4.45	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr	4.98	....	Oct.	4.75	....
May	4.91	....	Nov.	5.01	....
June	4.84	....	Dec.	5.40	....

During the 12 weeks ended March 20 the Missouri-Kansas-Oklahoma district produced zinc-blende worth $3,241,972; calamine, $174,569; and lead, $403,172. During the week ended March 27, another $5 per ton was cut off the price of ore at Joplin.

New York Metal Review

Unusual influences affected the metal market in March. The demand for copper created by the war continues to be the largest factor in the present activity, although a betterment in home consumption is reported. The latter is not great, but enough to be felt. The exports of copper in March were good, considering all the handicaps, and prices mounted to higher levels. The exportation of tin from England is under restrictions which amount to an embargo, and shipments from there are made most sparingly. There is a great scarcity of the metal, and war prices again have prevailed. Repeated efforts have been made to break the high prices which have been quoted for spelter and a great deal of uncertainty has been created. Lead prices have advanced as a result of the heavy exports, which would have been larger but for the difficulty in getting cargo space on trans-Atlantic vessels. The domestic demand is quiet. English brands of antimony are nearly exhausted here and their prices are nominal. Practically all of the business is in Chinese antimony. Aluminum is weaker. A tremendous export business continues to be done in iron and steel and in certain kinds of machinery for the domestic manufacture of explosive shells. With all the big demand from abroad for war supplies, there is a growing opinion that the cessation of the war is not far off. Machinery manufacturers whose machines are in demand for shrapnel and explosive-shell making seem to hold this opinion, as they are hedging their sales with greater precautions. They realize that wholesale cancellations of orders in case of an abrupt termination of the war would be a serious matter. In the past week between 300,000 and 400,000 tons of pig iron was sold in the heaviest movement of months. Low prices set the buying in motion. It calls for deliveries as far ahead as December.

COPPER

The heavy consumption of copper for war purposes has been maintained. The exports in March were excellent. They aggregated, up to March 26, 25,103 tons. Prices showed an advancing tendency, especially in the latter part of the month. Up to March 17, prime Lake was quoted at 15.25c. cash, New York, but thereafter it mounted to 16c., and higher. Early deliveries of prime Lake were difficult to obtain and choice brands commanded a premium at all times. In general, the domestic demand for electrolytic showed little betterment, although some improvement was discernible near the end of the month. Electrolytic prices stood at about 14.62½c. cash, New York, from March 1 to 9, when there was an advance to 14.75c. cash. On March 17 an upward trend set in, and March 23 the quotation was 15.37½c. cash. The foreign demand called not only for the metal itself, but for many finished products, including firebox plates, copper bolts, brass rods, cartridge brass, disks, etc. Some of the inquiries specified extremely large quantities, but about some of these there was uncertainty, as the inquiries were not direct, or came from persons not known to be responsible. Some of them, however, resulted in business, and the payments were prompt. The base price of hot rolled sheet copper was advanced March 22 to 20¼c., and March 25 to 20½c., by the American Brass Co., which subsequently advanced its quotations for brass products. Exports in February, unlike those of March, were disappointing, as they totaled only 14,778 tons, compared with 26,193 tons in January, and 22,166 tons in December 1914. The February exports were the smallest since the war started.

LEAD

Large exports were the cause of several advances in March. On the first day of the month the New York price went up $1 per ton, making the new quotation 3.90c., and that at St. Louis 3.85c. On March 5 there was another advance of $1 per ton, making 3.95c. the quotation at New York, and 3.87½c. at St. Louis. On March 16 the American Smelting & Refining Co. increased its price to $3 per ton, or 4.10c. New York, and independents made the St. Louis price 4.05c. On March 24, the metal again advanced $1 per ton. The market was strong throughout the month, and more so abroad than here. Exports up to March 26 totaled 3133 tons, and would have been larger had it not been for the difficulty in securing cargo space on trans-Atlantic vessels. Toward the end of March the London quotation was strong at a high enough level to make export sales profitable. The London quotation advanced from £20 3s.6d., March 2, to £23 2s.6d., March 25. The usual spring buying for domestic consumption is slow in getting under way.

SPELTER

Uncertainty has filled the minds of all who have to do with spelter. Prices have soared, declined quickly, mounted again, then again declined. There have been charges of gross manipulation, allegations that the market has been unduly inflated, and also assertions that the recent high prices were entirely justified by a scarcity of spot and prompt metal. Some features cannot be denied. First of all, it is certain that in the open market between 10.50 and 11.25c. was asked in the first 10 days of the month. Brass mill special was quoted higher. Then came a slump based on offerings which were made on the floor of the New York Metal Exchange at fully 2c. under quotations prevailing outside. The metal was offered at 8½c. Ordinarily, few actual transactions are recorded on the Exchange. The market broke, and about 9.50c. was quoted in the open market. Then came a recovery. On March 23 renewed efforts were made to get the market down to a more normal level, and 25 tons of prompt were sold on the Exchange at 8c., while May delivery was offered at 7.62½c. and June at 7.25c., with no takers. On March 24 the Exchange reported the sale of about 75 tons. Probably 200 tons were sold altogether in the interest of those who believed prices to be too high. The broker executing the selling orders is understood to have had about 400 tons for the purpose in view. The outside market quoted 9.50c., despite the selling referred to. The galvanizers are not busy and are buying little spelter, but it is definitely known that some of them would take metal if they could get it at a price which they consider reasonable. In support of the higher prices of the open market, it is asserted that some of the smelters are sold up for April delivery. Up to March 26, the exports of the month totaled 5122 tons. The exports in March 1914 were but 130 tons. Shipments to Europe since August 1914 have been heavy.

TIN

The important features of the month were the small arrivals, and the placing of an embargo on exportations of tin from England. The embargo was not complete, as it permitted shipments under certain restrictions. It was stipulated that a shipper must be licensed by the Government and that his shipments must be consigned to the British consul at New York. The importer must then give a guarantee which will satisfy the consul that the tin will not be exported to any other country. England's purpose is to prevent the exportation of tin to Germany by way of Scandinavia. It is interesting to note that of late several inquiries from Sweden and Norway have been received here, and it has been wondered why the inquiring parties came here instead of going to London, which is their natural market. Up to March 26 only 780 tons of tin arrived here. On that date 2945 tons was afloat, but the time of arrival of much of this is uncertain, as it is coming from the Far East on vessels that have been delayed for repairs. Under the conditions alluded to, the price advanced to 51c. by March 15. February deliveries of tin amounted to 3375 tons. The total deliveries for two months of this year were 5675 tons, against 6900 tons in the same period of 1914. Of the arrivals in February, 3650 tons, 475 tons entered Pacific ports. The total visible supply February 28, 1915, was 14,548 tons, against 13,901 tons January 31, 1915, and 17,308 tons February 28, 1914.

Current Prices for Oils and Candles

(Corrected monthly by Standard Oil Co., California.)

All prices are f.o.b. San Francisco except where otherwise specified, and are subject to change without notice.

Granite Mining Candles.	Per set, cents.	Granite Mining Candles.	Per set, cents.
6s-12 oz.-40s	8¾	6s-14 oz.-20s	9½
6s-12 oz.-20s	9	6s-16 oz.-40s	10
6s-14 oz.-40s	9¼	6s-16 oz.-20s	10¼

Extra hard 1c. per set higher than the above.

The following prices are for oils (Calol) in wood barrels; cases (2-5 gal.) 3c. per gallon higher.

	Per gal., cents.		Per gal., cents.
Compressor oil	40	Light gas engine oil	28
Amber gas engine oil	40	Red compressor oil	26
Castor machine oil	20	Red engine oil	17
Dynamo and motor oil	24	Turbine oil	30
Engine oil	24	Turbine oil, heavy	30
Gas engine oil	26	Diesel engine oil	40
Heavy gas engine oil	45	Cylinder oil	37
Heavy red engine oil	19	High-pressure cylinder oil	50
Heavy red journal oil	21	Low-pressure cylinder oil	37
Ice machine oil	28	Valve oil	44

The following prices are for oils in iron barrels, cases (2-5 gal.) 7c. per gallon higher, except on Eocene, which is 8c. per gallon higher.

	Per gal., cents.		Per gal., cents.
Pearl oil	9	Engine distillate	7
Headlight oil	10	Aroturps	15
Eocene oil	11	V. M. and P. Naphtha	10½
Red Crown gasoline	11½		

	Per bbl.
Star fuel oil, f.o.b. Richmond Refinery	$0 85

	Per ton.
Petrolastic cement X	$13.00
Petrolastic cement XX	12.00
Asphaltum	$5.50 to 12.50

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted, except as noted, f.o.b. San Francisco. Buying prices marked *.

	Min.	Max.
Antimony ore, 45 to 55%, per ton	$32.50	$42.50
Arsenic, white, refined, per lb	0.04	0.05
Arsenic, red, refined, per lb	0.12	0.15
Asbestos, chrysotile	100.00	350 00
Asbestos, amphibole	5.00	7.50
Asphaltum, refined, per ton	11.50	20.00
Barium chloride, commercial, per ton	50.00	60.00
Barium sulphate (barytes), prepared, per ton	20.00	30.00
Bismuth ore, 15%, per ton	*250.00	upward
China clay, English, levigated, per ton	15.00	20.00
Chrome ore, according to quality, per ton	7.50	10.00
Cobalt metal, refined, f.o.b. London, per lb	1.90	....
Coke, foundry, per 2240 lb	12.00	15.00
Diamonds (according to size and quality):		
Borts, per carat	2.00	15.00
Carbons, per carat	55.00	80.00
Feldspar, per ton	5.00	25.00
Firebrick:		
Silica, per M	50.00	55.00
Snowball, per M	40.00	45.00
Flint pebbles for tube-mills, Danish, per 2240 lb	21.00	24.00
Fluorspar, per ton	10.00	15.00
Fuller's earth, according to quality, per ton	20.00	30.00
Gilsonite, per ton	35.00	40.00
Graphite:		
Amorphous, per lb	0.01	0.02½
Crystalline, per lb	0.04	0.13
Gypsum, per ton	5.00	7.50
Infusorial earth, per ton	10.00	15.00
Iridium	55.00	....
Magnesite, crude, per ton	5.00	7.50
Magnesite, dead calcined, per ton	20.00	25.00
Manganese ore, oxide, crude, per ton	10.00	15.00
Manganese, prepared, according to quality, per ton	50.00	75 00
Mica, according to size and quality, per lb	$0.05	$1.00
Molybdenite, 95% MoS_2, per ton	1000.00	1500.00
Monazite sand (5% thoria), per ton	150.00	200.00
Nickel metal, refined, per lb	0.45	0.60
Ochre, extra strength, levigated, per 100 lb	2.00	3.00
Osmiridium, per oz	30.00	40.00
Platinum, native, crude, per oz	30.00	45.00
Silex lining for tube-mills, per 2240 lb	35.00	45.00
Sulphur, crude, per ton	25.00	30.00
Talc, prepared, according to quality, per ton	20.00	50.00
Tin ore, 60%, per ton	425.00	450.00
Tungsten ore, 65%	400.00	425.00
Uranium ore, 10% min	25.00 per unit	
Vanadium ore, 15% V_2O_5, per ton	150.00	180.00
Wolframite (see tungsten ore).		
Zinc ore, 50% up, per ton	*15.00	20.00

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Heimann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are f.o.b. San Francisco and subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66°, drums, per 100 lb.	$ 0.80	$ 1.10
Acid, sulphuric, com'l, 66°, carboy, per 100 lb.	1.25	2.00
Acid, sulphuric, C. P., 9-lb. bottle, bbl., per lb.	0.18	0.18
Acid, sulphuric, C. P., bulk, carboy, per lb.	0.09½	0.12
Acid, muriatic, com'l, carboy, per 100 lb.	1.60	3.00
Acid, muriatic, C. P., 6-lb. bottle, bbl., per lb.	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, per lb.	0.10½	0.15
Acid, nitric, com'l, carboy, per 100 lb.	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., per lb.	0.16	0.22
Acid, nitric, C. P., bulk, carboy, per lb*	0.12½	0.15
Argols, ground, bbl., per lb	0.10	0.20
Borax, cryst. and conc., bags, per 100 lb	3.00	4.35
Borax, powdered, bbl., per 100 lb	3.38	4.50
Borax glass, gd. 30 mesh, cases, tin lined, per 100 lb.	11.50	14.50
Bone ash, 60 to 80 mesh, bbl., per 100 lb	0.50	6.50
Bromine, 1-lb. bottle, per lb	0.55	0.65
Clay, domestic fire, sack, per 100 lb	1.50	2.00
Cyanide, 98 to 100%, 100-lb. case, per lb	No quotes	
Cyanide, 98 to 100%, 200-lb. case, per lb	" "	
Cyanide, 129%, 100-lb. case, per lb	" "	
Cyanide, 129%, 200-lb. case, per lb	" "	
Lead acetate, brown broken, casks, per 100 lb.	9.00	10.50
Lead acetate, white broken, casks, per 100 lb.	10.50	10.75
Lead acetate, brown broken, casks, per 100 lb.	9.00	10.50
Lead acetate, white, crystals, per 100 lb.	12.50	13.25
Lead, C. P., test., gran., per 100 lb	13.00	15.00
Lead, C. P., sheet, per 100 lb	15.00	18.00
Litharge, C. P., silver free, per 100 lb	11.50	13.50
Litharge, com'l, per 100 lb	8.00	9.50
Manganese ox., blk., dom. in bags, per ton	20.00	25.00
Manganese ox., blk., Caucasian, in casks, per ton (85% MnO_2—¾% Fe)	130.00	140.00
Nitre, double ref'd., small cryst., bbl., per 100 lb.	13.50	14.00
Nitre, double ref'd., granular, bbl., per 100 lb.	13.50	14.00
Nitre, double ref'd., powdered, bbl., per 100 lb.	13.50	14.00
Potassium bicarbonate, cryst., per 100 lb	14.00	16.00
Potassium carbonate, calcined, per 100 lb	25.00	35.00
Potassium permanganate, drum, per lb	0.55	0.65
Silica, powdered, bags, per lb	0.03	0.05
Soda, carbonate (ash), bbl., per 100 lb	1.45	1.75
Soda, bicarbonate, bbl., per 100 lb	2.00	2.50
Soda, caustic, ground, 98%, bbl., per 100 lb	2.75	3.25
Soda, caustic, solid, 98%, drums, per 100 lb	2.50	2.75
Zinc shavings, 850 fine, bbl., per 100 lb	17.50	....
Zinc sheet, No. 9—18 by 84, drum, per 100 lb.	No quotes	

*Extra charge for packing nitric acid for shipment to conform to regulations.

Roessler & Hasslacher quoted as follows March 12:

Ammonia, anhydrous, in 50-lb. cylinders, per lb	$0.27
Arsenic, white powdered, in 500-lb. bbl., per lb	0.05
Cobalt oxide, black, in 10-lb. tins, per lb	1.05
Cyanide, potassium, 38.4% cyanogen, per lb	0.27
Cyanide, mixtures, potassium cyanide equivalent 39 5% cyanogen, per lb	0.20
Sodium, metallic, in 1-lb. tins, per lb	0.40
Zinc dust, in bbl. 1600 lb	0.12

New conditions have arisen which may temporarily result in the elimination of many German chemicals. The list of unquotable products is increased.

New Machines and Devices

Information based on letters and catalogues from manufacturers.

Caterpillars at the Exposition

The attractive and interesting exhibit of the Holt Manufacturing Co., of Stockton, California, occupies 15,000 sq. ft. of floor space in the Palace of Agriculture at the Panama-Pacific Exposition. Briefly, the display consists of an old English cottage in the centre, which serves as an office, and in the upper floor is a moving picture theatre showing Holt machines at work. Of most interest to mining men, across the aisle from the cottage are shown the Caterpillar '75' and the '45.' The former is an interesting study, being mounted so that the track revolves as in actual work. The motor is shown in full motion, with glass sides to the crank case, cylinders cut away to show pistons and rings, and a glass cover to the gear case. The 45-hp. Caterpillar, the type without a front wheel, is equipped with an electric motor and cable so that it actually moves about on its own tracks and demonstrates its short turning capacity. Another 75-hp. machine, with 30-in. tracks and military equipment, is shown with two 10-ton Caterpillar trailers. Several other exhibits more of interest to farmers are displayed, and the whole is an excellent arrangement showing the capabilities of this system of traction.

75-HP. HOLT CATERPILLAR, TWO-SPEED, WITH 30-IN. TRACK AND TWO 10-TON TRAILERS.

Commercial Paragraphs

The JUST PROCESS Co., of 45 Broadway, New York, shows its 'rapid sampling filter,' or 'silica sponge laboratory filter,' in a leaflet recently issued. The filter is immersed in the pulp sample, connection made through a Wolff bottle with a vacuum line, and a cake of any desired thickness is drawn on the porous cylinder, the clear solution being caught in the bottle.

The PELTON WATER WHEEL Co., of San Francisco, briefly describes a large installation of its products at the Granby Consolidated company's property on Granby bay, British Columbia. Water for generating over 6000 hp. is taken from Falls creek and conducted to tidewater. Ten Pelton-Doble tangential wheels, ranging in size from 3 to 24 ft. diameter, drive air-compressors and blowing engines for mine and smelter operation, and the hydro-electric plant for supplying electric energy to all parts of the property.

The MONARCH ENGINEERING & MANUFACTURING Co., of Baltimore, Maryland, has published *Series* 25 to 38, inclusive. These cover the following apparatus: No. 25, a combination tool-room gas furnace, which includes eight furnaces in one; No. 26, a bell ladle heater; No. 27, rivet-heating furnaces; No. 28, the simplex melting furnace, oil or gas fuel, for melting aluminum, brass, bronze, copper, gold, silver, ferromanganese, gray iron, semi-steel, and other material; No. 27-F, drill-steel forges; No. 28-F, Eclipse heating forge for tool and drill steel; No. 29, Monarch furnaces for the requirements of mines, mills, smelters, refiners, mints, and manufacturers of articles of gold and silver (the double-chamber furnace is used at Tonopah); No. 30, furnace for galvanizing and tinning; No. 31, reverberatory scrap-melting furnace; No. 32, oil burners; No. 33, the double-chamber melting furnace; No. 34, miscellaneous soft metal melting furnaces, using all fuels; No. 35, portable heaters; No. 36, hand pump for all liquids; No. 37 and 37-A, core ovens; and No. 38, the Monarch tilting reverberatory furnace.

In 'Catalogue 12-F' the COLORADO IRON WORKS Co., of Denver, gives some details as to smelting practice and equipments. This publication covers 160 pages, with illustrations and an index. The work deals with ore sampling; lead and copper smelting, including small plants, hot-blast matting furnace, copper matting and converting, hot-blast smelting, and vaporization of jacket water; data required for estimates; the blast-furnace structure in detail; silver-lead blast-furnaces of all types, also all types of copper furnaces; furnace hoods; blowers; blast gates; hot-blast stoves; forehearths; slag-handling apparatus; ore cars; hoists, charging buggies; scales; reverberatory smelting furnaces; Bruckner roasting cylinders; copper converters; and miscellaneous machinery. The whole covers the smelting practice in a practical manner, the result of considerable experience in making plants for widely different ores.

Tube-mills and pebbles were the subject of recent articles in the *Press*, and the use of steel balls for grinding was discussed. The Marcy ball-mill, which uses steel balls, was mentioned in an editorial at the time. The MINE & SMELTER SUPPLY Co., of Salt Lake City, has distributed a 24-page illustrated booklet containing 'Notes on the Practice and Design of Wet Crushing Ball-Mills,' by F. E. Marcy. After numerous tests, the writer has designed a mill which is 4 ft. diameter and 26 in. long inside of the liners, and which produces a minimum size product, an increase in capacity, a low horsepower per mesh-ton, an equal chance for all products, either gangue or mineral, discharging from the mill and creating an accelerating action on the fines as they are produced. The energy available for crushing by steel balls in a ball-mill is three to four times that of flints, all other conditions remaining equal. With the screen arrangement feed as large as 2 to 3 in. may be fed into the mill, and is reduced to 16 to 40 mesh. What is known as the 4, 6, and 8-ft. grate mills have also been devised. Some interesting diagrams show the work of the various mills.

A. LESCHEN & SON'S ROPE Co., of St. Louis, has published an attractive number of *Leschen's Hercules* for March, it being a Panama-Pacific International Exposition issue. As many of the exhibits at the Exposition are exceedingly heavy, the safe handling of these was quite a problem. The Palace of Machinery, in which some of the heavy exhibits are displayed, is equipped with four electric traveling bridge-type cranes. This building is traversed from north to south, its greatest dimension, by three aisles which are 937 ft. long, and the cranes operate the entire distance. These cranes are equipped with 'Hercules' red strand wire rope. They were constructed and installed by the Cyclops Iron Works of San Francisco. Another big undertaking was the installing of the monster locomotives on exhibition in the Palace of Transportation, for which 'Hercules' wire rope was used.

What Mine Supplies Should Cost

(Continued From Page 509)

Article. (Assaying and Cyaniding Supplies, listed alphabetically below.)	Purchased from.	F.o.b.	Duties. Frac	Amount.	Unit.		F.o.b. cost.*	Delivered cost.*
Acetate of lead, commercial	48	Galveston	516	₱0.06	k.l.	1 lb.	₱ 0.16	₱ 0.24
" " " C. P.	208	El Paso	"	"	"	" "	0.56	0.61
Acid—Acetic, glacial, 80%	"	" "	520	0.04	"	" "	0.48	0.56
" Hydrochloric, C. P.	"	" "	510	0.015	k.b.	" "	0.26	0.35
" Lactic, 22%	"	" "	546	0.03	k.l.	" "	0.08	0.16
" Muriatic, 18°, carload (includes cost of cb. at $2 each)	346	Denver	519	0.015	k.b.	" "	0.054	0.13
" Muriatic, less than carload	208	El Paso	"	"	"	" "	0.11	0.20
" Oxalic, C. P.	"	" "	520	0.04	k.l.	" "	0.80	0.96
" Nitric, C. P.	"	" "	519	0.015	k.b.	" "	0.28	0.40
" Sulphuric, C. P.	"	" "	"	"	"	" "	0.22	0.34
Alcohol—Wood	"	" "	526	0.06	k.l.	" "	1.80	1.95
Aluminum—Dust, commercial	"	" "	260	0.70	"	" "	2.40	3.50
" Foil	75	Denver	"	"	"	" "	3.00	3.60
Ammonia—C. P.	208	El Paso	519	0.015	k.b.	" "	0.34	0.45
" Anhydrous, 100-lb. drums	209	Douglas	528	0.01	"	" "	0.70	0.80
" Anhydrous, 45-lb. drums	346	Denver	"	"	"	" "	0.54	0.68
Ammonium—Acetate, C. P.	208	El Paso	520	0.04	k.l.	" "	1.20	1.33
" Carbonate, C. P.	75	Denver	"	"	"	" "	0.80	0.88
" Chloride, C. P.	"	"	"	"	"	" "	0.56	0.70
" Hydrate, C. P.	"	"	"	"	"	" "	1.50	1.70
" Oxalate, C. P.	208	El Paso	"	"	"	" "	0.90	1.09
" Phosphate, C. P.	"	" "	"	"	"	" "	1.60	1.78
Annealing cups, No. c	"	" "	612	0.0162	k.b.	doz.	1.50	1.65
Asbestos—Board, ¼ by 42 by 48-in.	97	" "	677	0.04	k.b.	each	15.30	18.00
" Paper, 3 by 1	75	Denver	609	exempt		1 lb.	0.16	0.22
Balances—Ainsworth, 'F' button	3	"	"	"		1	315.00	342.05
" Baillon, No. 4060	30	Los Angeles	254	0.22	k.l.	"	51.00	61.53
" Bullion, Howe	"	" "	"	"	"	"	51.00	61.53
" Troemers, No. 75	75	Denver	609	exempt		"	10.80	15.80
" Union pulp, No. 3096	"	"	254	0.22	k.l.	"	10.00	14.90
Beakers—No. 2, lipped	208	El Paso	612	0.0162	k.b.	"	0.09	0.17
" No. 3, lipped	"	" "	"	"	"	"	0.13	0.22
" No. 4, lipped	"	" "	"	"	"	"	0.15	0.28
Blowpipe for furnace	75	Denver				"	54.00	78.65
Boneash	208	El Paso	534	0.02	"	1 lb.	0.10	0.16
Borax glass	"	" "	564	0.045	"	" "	0.21	0.28
Bottles—250 c.c., No. 970	"	" "	316	0.22	"	"	0.14	0.39
" 500 c.c.	"	" "	"	"	"	"	0.16	0.32
" 750 c.c., No. 968	"	" "	"	"	"	"	0.24	0.65
" 8-oz.	75	Denver	"	"	"	"	0.26	0.42
" 16-oz.	"	"	"	"	"	"	0.33	0.64
" Woulff, 2-qt., 3-neck	"	"	"	"	"	"	2.00	2.25
" 32-oz.	"	"	"	"	"	"	0.20	0.58
" 96-oz.	"	"	"	"	"	"	1.60	2.58
" Specific gravity, 25 c.c.	"	"	"	"	"	"	0.75	1.10
Bromine—Pure	"	"	520	0.04	k.l.	1 lb.	2.80	3.00
Brushes—Button, No. 564	"	"	271	0.22	"	1	0.70	1.00
" Button, No. 1080	208	El Paso	"	"	"	"	0.30	0.55
" 4-in. bristle, No. 566A	75	Denver	"	"	"	"	2.10	2.23
Burners—Case hydrocarbon, 2-in.	"	"	204	"	"	"	27.00	28.50
" Gasoline, No. 4732	30	Los Angeles	"	"	"	"	9.36	10.93
" Monarch oil	211	Baltimore	203	0.50	"	"	50.00	59.10
Burettes—50 c.c., No. 3344	208	El Paso	612	0.0162	k.b.	"	3.74	4.19
" 50 c.c., No. 3340	"	" "	"	"	"	"	1.40	1.80
" Clamp, No. 3462	"	" "	"	"	"	"	0.60	0.72
" Support, No. 1447	75	Denver	"	"	"	"	4.20	4.85
Calcium—Carbonate	208	El Paso	538	0.07	k.l.	1 lb.	1.26	1.35
" Chlorate, C. P.	"	" "	"	"	"	" "	4.00	4.32
" Chloride, C. P.	"	" "	540	0.01	k.b.	" "	0.79	0.89
" Oxide, C. P.	75	Denver	"	"	"	" "	0.60	0.72
Casseroles—No. 3, R. B.	208	El Paso	609	exempt		1	0.75	0.90
" No. 5	"	" "	"	"		"	2.10	2.90
Copper—Foil, C. P.	"	" "	"	"		1 lb.	2.40	2.64
" Sulphate (bluestone), C. P.	"	" "	562	"		" "	0.60	0.68
Cots—Finger	75	Denver	609	"		1	0.07	0.09
Crucibles—15-gm. clay	208	El Paso	265	"		"	0.05	0.07
" 20-gm. clay	"	" "	"	"		"	0.05	0.08
" Nickel	"	" "	"	"		"	0.90	1.01
" Steele Harvey, No. 125	80	Jersey City	"	"		"	10.60	17.50
" Steele Harvey, by Exp.	208	El Paso	"	"		"	15.00	23.00
" Hessian sand	75	Denver	"	"		"	0.13	0.14
" Porcelain, 1¼-in. diameter	208	El Paso	"	"		"	0.24	0.28
" Platinum, 30-gm.	75	Denver	"	"		gram	3.50	3.55
Crucible graphite mixture (Dixon)	208	El Paso	274	0.06	k.b.	1 lb.	0.14	0.24
Crucible tongs	"	" "	612	0.0162	"	1	1.00	1.43

Article		Purchased from	Duty	Invoice Date	Quantity	Unit	Cost	Delivered cost
Crushers (Braun pulverizer)	Stationary disc, U-11	30	Los Angeles	612	P0.016 k.b.	1	P1.00	P1.16
" " "	Movable disc, U-13	"	" "	"	" "	"	15.00	17.35
" " "	Ore pans, U-18	"	" "	"	" "	"	0.80	1.20
" Case Crusher		75	Denver	"	" "	"	180.00	210.18
" Chipmunk crusher	Cheek plates, V-21	30	Los Angeles	"	" "	"	0.68	1.06
" " "	Jaw plates, V-19	"	" "	"	" "	2	2.00	2.58
" " "	Movable jaw, V-1	"	" "	"	" "	1	10.00	12.27
" " "	Stationary jaw, V-2	"	" "	"	" "	"	7.00	9.27
Cupels—35-mm.		134	St Louis	15	exempt	100	8.55	14.67
" Machine, Hers. 1¼		75	Denver	612	0.0162 k.b.	1	50.00	60.74
" Tongs		"	"	"	" "	"	2.00	2.67
" Trays		"	"	609	exempt	"	1.00	1.30
Cyanide Sodium—128-130%, carload		206	New York	536	"	1 lb. 100%	0.285	0.35
" " 120% "		"	" "	509	"	" " "	0.28	0.35
Cylinder, graduated 10-c.c.		75	Denver	609	"	1	0.40	0.47
" " 25 "		"	"	"	"	"	0.48	0.55
" " 50 "		"	"	"	"	"	0.60	0.69
" " 100 "		"	"	"	"	"	0.80	1.01
" " 250 "		"	"	"	"	"	1.20	1.47
" " 500 "		"	"	"	"	"	1.60	1.87
" " 1000 "		"	"	"	"	"	3.00	3.42
Dish—Agate, 6-in.		"	"			"	0.22	0.25
" Platinum, 70-c.c.		208	El Paso			"	3.60	3.70
Emery—Powdered		75	Denver	264	0.01 k.b.	1 lb.	0.18	0.22
Envelopes—3¼ by 4-in. (pulp)		208	El Paso	605	0.45 k.l.	100	0.77	0.80
" 3 by 5-in.		"	" "	"	" "	"	0.60	0.66
Ferrocyanide, C. P.		"	" "	536	exempt	1 lb.	0.07	0.10
Filter paper—9-cm.		75	Denver	582	0.16 k.l.	1000	5.82	7.02
" " 12 "		"	"	"	" "	"	10.00	10.86
" " 15 "		208	El Paso	"	" "	"	7.00	7.45
" " 15-in. diam.		75	Denver	"	" "	"	12.00	15.52
" " 16 " "		208	El Paso	"	" "	"	13.76	17.50
" " 32-cm.		"	" "	"	" "	"	12.90	18.20
Fire clay		"	" "	265	exempt	100 lb.	1.50	5.22
Flasks (Erlenmeyers)—100 c.c.		75	Denver	609	"	1	0.24	0.27
" " 125 "		208	El Paso	"	"	"	0.16	0.19
" " 160 "		75	Denver	"	"	"	0.17	0.21
" " 250 "		208	El Paso	"	"	"	0.24	0.27
" " 300 "		75	Denver	"	"	"	0.40	0.45
" " 500 "		"	"	"	"	"	0.66	0.73
" " 2000 "		208	El Paso	"	"	"	1.80	2.67
Fluorspar, commercial		"	" "	271	0.10 k.b.	1 lb.	0.06	0.15
Forceps—No. 890		75	Denver	685	0.055 k.l.	1	0.30	0.33
" No. 886		"	"	"	" "	"	1.00	1.23
Funnels—3 in. long		208	El Paso	609	exempt	"	0.24	0.28
" 5 in. long		"	" "	"	"	"	0.69	0.80
" 7 in. long		"	" "	"	"	"	0.85	0.98
Furnace—Assaying:								
Doors, C. I., 72 lb.		97	El Paso	612	0.0162 k.b.	"	7.25	10.46
Door frame, 183 lb.		"	" "	"	" "	"	18.40	27.16
Grate, 430 lb.		"	" "	"	" "	"	43.80	64.25
Baffles, 228 lb.		"	" "	"	" "	"	23.29	35.00
" —Steele Harvey No. 125		211	Baltimore	"	" "	"	700.00	846.10
Base blocks		"	"	"	" "	"	2.40	8.10
Covers		"	"	"	" "	"	18.00	20.80
Linings		"	"	"	" "	set	29.18	61.07
Glasses, Watch—3 in. dia.		208	El Paso	609	exempt	1	0.08	0.10
" " 4 in. dia.		"	" "	"	"	"	0.12	0.15
Gold foil, c. p.		"	" "			gram	1.40	1.60
Gloves, Rubber		"	" "	652	0.45 k.l.	pair	6.30	6.85
Horns, Washing		75	Denver	609	exempt	1	1.00	1.10
Hydrate, Barium, C. P.		208	El Paso	619	0.06 k.l.	1 lb.	1.00	1.26
Hydrometers, Brine 400°		75	Denver	609	exempt	1	1.50	1.73
Iodide, Pot., C. P.		"	"	558	0.18 k.l.	1 lb.	7.00	7.30
Iron sulphate, crystals		208	El Paso	563	0.01 k.b.	" "	0.60	0.68
Iron sulphite, sticks		"	" "	"	" "	" "	0.24	0.30
Lamp—Dangler laboratory		"	" "	612	0.0162 "	1	6.12	9.83
Lead Acetate (See Acetate of Lead).								
Lead Carbonate, C. P.		"	" "	219	exempt	1 lb.	1.20	1.27
Lead, test, C. P.		"	" "	"	"	" "	0.26	0.31
Lead foil, C. P.		"	" "	543	0.08 k.b.	" "	0.36	0.45
Litharge, C. P.		"	" "	"	" "	" "	0.22	0.30
Litmus tape, blue		"	" "	204	0.22 k.l.	box	0.17	0.19
" " red		"	" "	"	" "	"	0.12	0.15
Magnesium Oxide		208	El Paso	558	0.18 "	1 lb.	1.30	1.42
Magnifier, Codington's 1 in. No. 1143		75	Denver	314	1.00 "	1	3.00	4.88
Mercury Bi-chloride		208	El Paso	546	0.03 "	1 lb.	2.50	2.65
Mittens, asbestos		"	" "	265	exempt	pair	4.50	4.66
Mortar, agate, 3½ in., with pestle		"	" "	609	"	1	10.00	10.65
Molds—Bullion, CI 76 lb.		97	" "	612	0.0162 k.b.	"	4.62	7.99
" Cupel		75	Denver	"	" "	"	3.00	4.61
" Pouring		"	"	"	" "	"	1.98	2.60

Article	Purchased from.	F.o.b.	Duties. Frac.	Duties. Amount.	Unit.	F.o.b. cost.*	Delivered cost.*
Muffles—'JJ'	75	Denver	265	exempt	1	₱3.25	₱5.25
" 'P'	"	"	"	"	"	3.00	5.64
" Doors for 'P' muffler	"	"	"	"	"	0.50	1.02
Oil of Cassia	"	"	547	1.00 k.l.	oz.	0.40	0.77
Pans—Sampling, 12x7x6	"	"	204	0.22 "	1	0.80	1.26
" Bottoms for 12-in. sieve	"	"	316	" "	"	0.70	0.98
Pans—Glass, 5¼-in. dia	"	"	"	" "	"	1.40	1.64
Paraffine	30	Los Angeles			1 lb.	0.78	0.86
Pencils for writing on glass	208	El Paso	292	0.15 "	1	0.20	0.22
" Blue, chemical	"	"	"	" "	"	0.18	0.24
Phenolphthalein	75	Denver	562	0.01 "	oz.	0.40	0.43
Pipettes— 10 c.c.	208	El Paso	609	exempt	1	0.30	0.35
" 20 "	"	" "	"	"	"	0.36	0.40
" 50 "	"	" "	"	"	"	0.65	0.75
" 100 "	"	" "	"	"	"	0.80	0.90
Pliers, button	"	" "	"	"	"	0.60	0.68
Potassium Carbonate—Com'l	"	" "	562	0.01 k.b.	1 lb.	0.14	0.17
" " C. P.	"	" "	"	" "	" "	1.40	1.53
" Chromate—C. P.	"	" "	"	" "	oz.	0.40	0.43
" Nitrate—Com'l	"	" "	"	" "	1 lb.	0.16	0.22
Pump, Richards filter No 5	"	" "	612	0.0162 k.b.	1	2.80	3.00
Respirators	75	Denver	"	" "	"	2.40	2.50
Rubber sheeting	"	"	677	0.04 k.l.	sq. yd.	11.20	11.54
Screens, brass wire— 80 mesh	"	"	204	0.22 k.l.	" "	8.10	8.90
" " " 100 "	"	"	"	" "	" "	11.70	12.90
" " " 150 "	"	"	"	" "	" "	27.00	29.00
Sheeting, black rubber, vulcanized	208	El Paso	677	0.04 k.l.	yd.	1.50	1.69
Sieves, brass cloth—1 set each 8, 10, 20, 30, 40, 60, 80, 100, 150 and 200 mesh, with top and bottom	"	" "	204	0.22 k.l.	nest	15.00	18.21
Sieve—100 mesh, 8-in. dia	75	Denver	"	" "	1	2.80	2.90
" 60 " 12-in. "	208	El Paso	"	" "	"	3.36	3.55
" 200 " 12-in. "	"	" "	"	" "	"	11.40	12.60
Sieve shaker	30	Los Angeles	"	" "	"	70.00	74.60
Silica—White, 97.56% SiO_2	208	El Paso	265	exempt	ton	40.00	154.00
" Buff, 96.94% SiO_2	"	" "	"	"	"	10.00	52.80
Silver foil, C. P.		" "			oz.	2.00	2.20
Silver Nitrate, C. P.	"	" "			1 lb.	16.00	16.80
Soda Ash	"	" "	534	0.02 k.b.	" "	0.038	0.09
Soda Bicarbonate—Com'l	"	" "	531	0.09 k.l.	" "	0.04	0.12
" " C. P.	"	" "	"	" "	" "	0.40	0.46
" Carbonate, C. P.	75	Denver	"	" "	" "	0.60	0.72
Sodium Acetate, C. P.	208	El Paso	516	0.06 k.l.	" "	0.60	0.70
" Nitrate, Com'l	"	" "	559	exempt	" "	0.12	0.16
" Peroxide, C. P.	"	" "	561	0.01 k.b.	" "	1.60	1.79
" Sulphide, C. P.	"	" "	562	" "	" "	0.80	0.90
Spatulas, 12 in.	"	" "	612	0.0162 k.b.	1	2.25	2.34
" 4 "	"	" "	"	" "	"	0.60	0.68
" 7 "	"	" "	"	" "	"	0.65	0.73
" 10 "	"	" "	"	" "	"	1.30	1.43
Stoppers, rubber	"	" "	688	0.10 k.l.	oz.	0.24	0.27
Sulphur Flowers, Com'l	"	" "	262	exempt	1 lb.	0.06	0.10
Tartar Emetic, C. P.	"	" "			" "	1.40	1.55
Thermometer, 400°F.	"	" "	254	0.22 k.l.	1	2.00	2.25
Tin, stick, C. P.	"	" "	540	0.01 k.b.	1 lb.	1.60	1.80
Tubing—Glass, ¼-in. dia	228	" "	316	0.22 k.l.	100 ft.	1.80	2.28
" " 5-mm. "	"	" "	"	" "	1 lb.	0.80	0.95
" —Gum, 5/32-in. dia	"	" "	134	0.12 k.l.	ft.	0.12	0.14
" —Rubber, ⅛-in. dia	"	" "	677	0.04 k.l.	"	0.09	0.11
" " ¼-in. "	"	" "	"	" "	"	0.10	0.12
" " ½-in. "	"	" "	"	" "	"	0.55	0.60
Vitriol, Blue	"	" "			1 lb.	0.20	0.27
Wash Horns	75	Denver	609	exempt	1	1.00	1.10
Weights—Metric, 1-200 gm.	208	El Paso	"	"	set	6.00	6.40
" 10 kg. to 10 gm.	75	Denver	"	"	"	12.00	16.00
" ½-mg. rider "A"	"	"	"	"	1	2.00	2.10
" 50 mg. to 1 mg.	208	El Paso	"	"	set	24.00	24.50
" 10-mg. rider	"	" "	"	"	1	1.25	1.35
" 500 mg.	"	" "	"	"	"	3.20	3.35
" 1000 mg.	"	" "	"	"	"	7.50	7.70
" 5 kg., iron	"	" "	"	"	"	2.40	5.31
Zinc Dust, 90-92% metallic	14	Douglas	221	"	1 lb.	0.15	0.16
Zinc dust feeder			612	0.0162 k.b.	..	.....	175.60
Zinc, granular, C. P.	75	Denver	221	exempt	1 lb.	0.90	1.05
Zinc shavings	"	"	"	"	" "	0.28	0.35
(Arms and Ammunition, listed alphabetically below.)							
Carbines, Winchester, 30-40	170	El Paso	638	2.00 k.l.	1	40.50	50.40
Cartridges—30-30	"	" "	640	0.60 k.b.	1000	61.20	90.00
" 30-40	"	" "	"	" "	"	80.76	110.00

Article	Purchased from.	F.o.b.	Duties Price	Duties Amount	Unit	F.o.b. cost *	Delivered cost *
(Athletic Goods listed alphabetically below.)							
Gymnasium							
Bag punching (Spaulding) No. 8 341	El Paso		30	P2.00 k.l.	1	P12.00	P17.28
Basketball, No. E ..... "	"	"	"	" "	"	6.00	6.80
Boxing gloves, No. 106 ..... "	"	"	"	" "	set	10.00	14.15
Chest weights, No. 5 ..... "	"	"	253	0.34 k.b.	1	27.00	38.50
Gymnasium shoes, No. 21 ..... "	"	"	75	1.75 pair	pair	3.50	5.80
Jumping standard, No. 11 ..... "	"	"	153	0.45 k.b.	1	16.00	22.08
Medicine ball, No. 12 ..... "	"	"	30	2.00 k.l.	"	7.50	11.36
Punching-bag platform, No. 1 ..... "	"	"	253	0.43 k.b.	"	21.00	38.66
Tennis equipment							
Balls (Wright & Ditson), 'Championship' ..... "	"	"	650	0.75 k.b.	"	0.70	0.90
Marking tape, No. 4 (without stap) ..... "	"	"	357	1.15 k.l.	"	7.30	13.22
Net, No. 3, double court ..... "	"	"	173	0.14 k.l.	"	9.00	13.10
Plates for corners 277	St. Louis		156	0.45 k.b.	set	2.00	2.66
Presses for racquets ..... "	"	"	254	0.22 k.l.	1	1.40	1.58
Racquet—Allcomers 341	El Paso		650	0.75 k.l.	"	12.00	14.50
" D. H. ..... "	"	"	"	" "	"	7.00	9.50
" Gold Medal ..... "	"	"	"	" "	"	12.00	14.50
" Slocum ..... "	"	"	"	" "	"	4.80	7.29
(Mill Supplies, listed alphabetically below.)							
Adzes, 4-in. 138	Chicago		232	1.65 k.b.	"	1.90	3.00
Anvils—85-lb. ..... "	"		685	5.50 k.b.	"	16.00	24.84
" 40 " ..... "	"		"	" "	"	9.10	13.86
" 50 " ..... "	"		"	" "	"	10.20	15.80
" 60 " ..... "	"		"	" "	"	12.00	18.75
Automobile, "Foredore," 1913 136	Douglas					1,330.00	.....
Axes—Single bit, 4-5 lb. 170	El Paso		"	" "	1	1.40	1.76
" Double bit, 5-6 lb. ..... "	"	"	"	" "	"	2.10	2.50
Babbitt Metal—Government Genuine ..... "	"	"	263	0.10 k.b.	lb.	1.30	1.48
" " Hard Genuine ..... "	"	"	"	" "	"	1.16	1.34
" " Manganese ..... "	"	"	"	" "	"	0.40	0.55
" " Nickel, Great Western 97	"	"	"	" "	"	1.10	1.25
" " Steel 209	Nacozari		"	" "	"	0.50	0.52
" " Wheel, Heavy Pressure 97	El Paso		"	" "	"	0.40	0.58
Barrel, C. I. Tumbling 170	"	"	612	0.0165 k.b.	1	370.00	452.71
Bearings—Flat Box, 1 15/16 97	El Paso		"	" "	"	3.30	4.37
" Adj. Step, 2 15/16 81	Mishawaka		"	" "	"	10.00	12.12
" Solid vert., 2 15/16 ..... "	"		"	" "	"	6.00	7.39
" Split vert., 2 15/16 ..... "	"		"	" "	"	10.00	12.12
Bearing Oil Rings—1 15/16 208	El Paso		"	" "	"	0.15	0.20
" " " 2 11/16 ..... "	"	"	"	" "	"	0.15	0.22
" " " 2 15/16 ..... "	"	"	"	" "	"	0.15	0.25
" " " 3 15/16 ..... "	"	"	"	" "	"	0.63	0.80
Bells, brass, Fig. 75, 10-in. ..... "	"	"	203	0.50 k.l.	"	7.34	10.06
Belting—Alpha, cotton, 10-in., 4-ply 7	Baltimore		654	0.11 k.l.	1 ft.	0.51	0.57
" " " 12-in., 4-ply ..... "	"		"	" "	" "	0.62	0.80
" camel's hair, 12-in. 251	Puebla		"	" "	" "	4.25	4.62
" Commander, 4-in., 4-ply 78	San Fran.		"	" "	" "	0.50	0.60
" " 6 " 6 " ..... "	"	"	"	" "	" "	1.08	1.25
" " 8 " 6 " ..... "	"	"	"	" "	" "	1.44	1.75
" Condor, 3-in., 3-ply 200	Passaic		"	" "	" "	0.34	0.38
" " 14 " 3 " ..... "	"		"	" "	" "	2.52	2.93
" " 4 " 4 " ..... "	"		"	" "	" "	0.57	0.64
" " 10 " 5 " ..... "	"		"	" "	" "	1.71	2.00
" " 6 " 6 " ..... "	"		"	" "	" "	1.11	1.24
" " 8 " 6 " ..... "	"		"	" "	" "	1.64	1.80
" " 10 " 6 " ..... "	"		"	" "	" "	2.02	2.29
" " 12 " 6 " ..... "	"		"	" "	" "	2.45	2.71
" " 18 " 6 " ..... "	"		"	" "	" "	4.20	4.60
" " 10 " 8 " ..... "	"		"	" "	" "	2.56	2.85
" " 12 " 8 " ..... "	"		"	" "	" "	3.26	3.70
" " 15 " 8 " ..... "	"		"	" "	" "	4.60	5.00
" " 18 " 8 " ..... "	"		"	" "	" "	5.05	5.70
" " 18 " 10 " ..... "	"		"	" "	" "	6.33	7.10
" Conveyor, Robin's Patent:							
12-in., 5-3 ply, 1/8-in. cover 254	New York		"	" "	" "	2.02	2.54
14 " 6-3 " 3/16 " " ..... "	"		"	" "	" "	2.70	3.40
32 " 7-6 " 3/16 " " ..... "	"		"	" "	" "	7.40	9.32
" Czar, 18-in., 10-ply 234	San Fran.		"	" "	" "	3.71	4.23
" " 18 " 15 " ..... "	"		"	" "	" "	5.90	6.65
" Defiance, 18 in., 10-ply 78	Akron		"	" "	" "	6.00	6.80
" Endless Gandy Thresher, 5-in., 4-ply 128	Baltimore		"	" "	" "	0.27	0.33
" " " " " 5 " ..... "	"		"	" "	" "	0.34	0.41
" " " " " 6 " ..... "	"		"	" "	" "	0.39	0.47
" " " " 6-in., 4 " ..... "	"		"	" "	" "	0.33	0.43
" " " " " 5 " ..... "	"		"	" "	" "	0.41	0.53
" " " " " 6 " ..... "	"		"	" "	" "	0.47	0.59
" " " " 7-in., 4 " ..... "	"		"	" "	" "	0.38	0.50
" " " " " 5 " ..... "	"		"	" "	" "	0.48	0.62
" " " " " 6 " ..... "	"		"	" "	" "	0.58	0.68
" " " " 8-in., 4 " ..... "	"		"	" "	" "	0.43	0.58
" " " " " 5 " ..... "	"		"	" "	" "	0.54	0.70
" " " " " 6 " ..... "	"		"	" "	" "	0.62	0.79

Article	Purchased from.	F.o.b.	Duties. Frac.	Amount.	Unit.	F.o.b. cost.*	Delivered cost.*
Belting—Endless Gandy Thresher, 10-in., 4-ply	128	Baltimore	654	P0.11 k.l.	1 ft.	P0.54	P0.72
" " " " " 5 "	"	"	"	" "	" "	0.67	0.87
" " " " " 6 "	"	"	"	" "	" "	0.79	1.00
" Vanner rubber belt, 325-lb.	200	Passaic	"	" "	1	192.00	231.00
" Duxbax waterproof leather, 16-in.	273	New York	60	0.55 k.l.	1 ft.	8.44	9.41
" " " " 2 " single	"	"	"	" "	" "	0.48	0.66
" " " " 3 " "	"	"	"	" "	" "	0.80	0.97
" " " " 6 " double	"	"	"	" "	" "	2.88	3.26
" " " " 12 " "	"	"	"	" "	" "	5.76	6.36
" International, 2-in., 3-ply	200	Passaic	654	0.11 k.l.	" "	0.18	0.20
" " 3 " 3 "	"	"	"	" "	" "	0.30	0.33
" " 4 " 4 "	"	"	"	" "	" "	0.48	0.54
" " 6 " 4 "	"	"	"	" "	" "	0.70	0.80
" " 8 " 4 "	"	"	"	" "	" "	0.93	1.06
" " 5 " 5 "	"	"	"	" "	" "	0.74	0.84
" " 8 " 5 "	"	"	"	" "	" "	1.18	1.33
" " 8 " 6 "	"	"	"	" "	" "	1.30	1.52
" " 6 " 6 "	"	"	"	" "	" "	1.05	1.19
" " 18 " 6 "	"	"	"	" "	" "	3.00	3.77
" Leviathan, 4-in., 4-ply	217	Philadelphia	"	" "	" "	0.44	0.50
" Lynx friction surface, 18-in., 13-ply	78	Akron	"	" "	" "	7.68	8.55
" Multiplex friction surface, 18-in., 11-ply	200	Passaic	"	" "	" "	3.84	4.22
" " " " 18 " 13 "	"	"	"	" "	" "	4.50	5.00
" " " " 18 " 15 "	"	"	"	" "	" "	5.14	5.74
" Prospector elevator, ½-in. rubber cover reinforcement, 18-in., 10-ply	"	"	"	" "	" "	7.75	8.73
" Scandinavia, 12-in., triple	271	New York	"	" "	" "	3.12	3.63
" Special elevator, 18-in., 10-ply	78	Akron	"	" "	" "	5.70	6.60
" Titan, 2-in., 2-ply	"	"	"	" "	" "	0.19	0.22
" " 2 " 3 "	"	"	"	" "	" "	0.20	0.23
" " 3 " 3 "	"	"	"	" "	" "	0.30	0.35
" " 2 " 4 "	"	"	"	" "	" "	0.24	0.28
" " 4 " 4 "	"	"	"	" "	" "	0.50	0.60
" " 6 " 6 "	"	"	"	" "	" "	0.72	0.83
" " 8 " 8 "	"	"	"	" "	" "	2.00	2.23
" " 12 " 8 "	"	"	"	" "	" "	3.12	3.50
" Transmission, leather, 16-in., double	273	New York	60	0.55 k.l.	" "	5.50	6.37
" Whalebone, 3-in., 3-ply	200	Passaic	654	0.11 k.l.	" "	0.25	0.28
" " 4 " 5 "	"	"	"	" "	" "	0.50	0.56
Belt Dressing (Dixon's)—1-lb. sticks	80	Jersey City	647	0.06 k.b.	1 lb.	0.43	0.53
" " 1-lb. sticks	208	El Paso	"	" "	" "	0.46	0.54
Belt Clamps—Jackson 'F'	307	New York	685	0.055 k.b.	100	21.08	27.24
" " Jackson 'H'	"	"	"	" "	"	28.56	35.63
Belt Lacing—Giant Leather	273	" "	59	2.00 k.l.	1 lb.	1.25	2.13
" " Bristol, Steel, No. 12	277	St. Louis	257	0.12 k.l.	1000 in.	13.90	18.00
" " " " No. 13	"	" "	"	" "	"	17.40	21.25
" " " " No. 15	"	" "	"	" "	"	24.30	30.70
" " 20th Century, No. 14	208	El Paso	"	" "	"	19.80	23.07
Belt Punches—Osborne's No. 8	277	St. Louis	685	0.055 k.b.	1	0.49	0.56
" " " No. 10	"	" "	"	" "	"	0.50	0.57
" " " No. 12	"	" "	"	" "	"	0.56	0.65
" " " No. 14	"	" "	"	" "	"	0.76	0.90
Bench, Work—Wood with iron japanned parts	"	" "	"	" "	"	170.00	255.28
Blocks—Yale & Towne Triplex Chain, ½-ton	208	El Paso	612	0.0165 k.b.	"	58.00	64.98
" " " " " 1 "	138	Chicago	"	" "	"	72.00	78.57
" " " " " 1½ "	330	New York	"	" "	"	96.00	108.26
" " " " " 3 "	138	Chicago	"	" "	"	144.00	161.57
" Pillow, Ring Oiling, 1 15/16	81	Mishawaka	"	" "	"	4.00	4.87
" " " " 2 7/16	170	El Paso	"	" "	"	11.97	15.53
" W. I. single, ¾-in. rope, 6-in.	"	" "	"	" "	"	1.22	2.05
" " double, " " "	"	" "	"	" "	"	2.20	3.84
" Self-lubricating, 8 bronze, auto snatch, 1-in. rope	138	Chicago	"	" "	"	5.80	7.85
" Snatch, automatic, plain bushed, for ¾-in. rope No. 6	"	"	"	" "	"	3.80	4.91
" Steel tackle, ¾-in. rope, roller bushed, double	"	"	"	" "	"	1.54	2.69
" " " for ¾-in. rope—single	170	El Paso	"	" "	"	2.00	2.83
" " " " " " double	"	" "	"	" "	"	3.50	5.13
" " " " " " triple	138	Chicago	"	" "	"	2.38	4.01
" Snatch, iron 1-in. rope, 8-in.	170	El Paso	"	" "	"	4.69	5.78
" " 1½-in rope, 10-in.	"	" "	"	" "	"	6.80	10.08
" No. 12 self-lub. bronze steel block, 1½-in. rope:							
Single	138	Chicago	"	" "	"	6.50	10.80
Double	"	"	"	" "	"	11.20	17.24
" Swage, No. 1, 18x18x4-in.	208	El Paso	"	" "	"	23.00	31.63
" Hand wheel for 3T duplex	360	New York	"	" "	"	5.96	7.60
" Pinion cage for 1T triplex	"	" "	"	" "	"	3.36	3.99
Bolts—Anchor, ¾x18-in.	70	El Paso	"	" "	"	0.29	0.42
" Elevator, ⅝x2	208	" "	257	0.12 k.l.	1000	34.60	53.20
" " ⅝x1¾	"	" "	"	" "	"	31.80	51.10
" " ⅝x1½	"	" "	"	" "	"	29.90	46.00
" " ¼x1½	"	" "	"	" "	"	16.18	29.10

Article			Purchased from		Duties			Unit	F o b cost *	Delivered cost *
Bolts	Machine,	⅛x1 o	208	El Paso	267	Po 12	k L	100	P0.84	P1.18
"	"	" x1½	"	"	"	"	"	"	0.94	1.26
"	"	" x2	"	"	"	"	"	"	0.98	1.33
"	"	" x2½	"	"	"	"	"	"	1.08	1.40
"	"	" x3	"	"	"	"	"	"	1.13	1.50
"	"	" x4	"	"	"	"	"	"	1.16	1.70
"	"	" x5½	"	"	"	"	"	"	1.30	1.92
"	"	" x6	"	"	"	"	"	"	1.40	2.02
"	"	⅜ x1¼	"	"	"	"	"	"	1.43	2.06
"	"	" x1½	"	"	"	"	"	"	1.44	2.10
"	"	" x2	"	"	"	"	"	"	1.48	2.13
"	"	" x2½	"	"	"	"	"	"	1.50	2.60
"	"	" x3	"	"	"	"	"	"	1.58	3.00
"	"	" x3½	"	"	"	"	"	"	1.69	3.24
"	"	" x4	"	"	"	"	"	"	1.76	3.54
"	"	" x4½	"	"	"	"	"	"	2.12	3.88
"	"	" x5	"	"	"	"	"	"	2.20	3.96
"	"	½ x1	"	"	"	"	"	"	2.25	3.81
"	"	" x2	"	"	"	"	"	"	2.42	4.75
"	"	" x2½	"	"	"	"	"	"	2.58	5.16
"	"	" x3	"	"	"	"	"	"	2.75	5.96
"	"	" x3½	"	"	"	"	"	"	2.90	6.47
"	"	" x4	"	"	"	"	"	"	3.08	6.90
"	"	" x4½	"	"	"	"	"	"	3.26	7.47
"	"	" x5	"	"	"	"	"	"	3.40	7.94
"	"	" x5½	"	"	"	"	"	"	3.56	8.38
"	"	" x6	"	"	"	"	"	"	3.76	8.80
"	"	" x7	277	St. Louis	"	"	"	"	4.04	9.90
"	"	" x7½	208	El Paso	"	"	"	"	4.56	11.52
"	"	" x8	"	"	"	"	"	"	5.58	8.58
"	"	" x9	"	"	"	"	"	"	6.00	12.56
"	"	" x10	277	St. Louis	"	"	"	"	5.00	12.70
"	"	" x11	208	El Paso	"	"	"	"	6.84	14.20
"	"	" x12	"	"	"	"	"	"	7.20	14.90
"	"	" x13	"	"	"	"	"	"	7.60	16.80
"	"	" x14	"	"	"	"	"	"	8.08	18.32
"	"	" x15	"	"	"	"	"	"	8.48	20.00
"	"	" x16	"	"	"	"	"	"	8.88	20.64
"	"	" x17	"	"	"	"	"	"	9.32	21.36
"	"	" x18	"	"	"	"	"	"	9.76	20.20
"	"	" x19	"	"	"	"	"	"	10.16	23.00
"	"	⅝ x2¾	63	Chicago	"	"	"	"	4.00	7.30
"	"	" x3½	208	El Paso	"	"	"	"	5.40	11.52
"	"	" x4	277	St. Louis	"	"	"	"	4.45	11.19
"	"	" x4½	170	El Paso	"	"	"	"	5.49	12.06
"	"	" x5	"	"	"	"	"	"	5.75	12.75
"	"	" x6	"	"	"	"	"	"	6.30	14.26
"	"	" x7½	208	" "	"	"	"	"	7.80	16.04
"	"	" x8	277	St. Louis	"	"	"	"	6.32	16.96
"	"	" x10	170	El Paso	"	"	"	"	8.54	20.30
"	"	" x11	208	" "	"	"	"	"	9.92	22.90
"	"	" x12	277	St. Louis	"	"	"	"	8.28	23.16
"	"	" x13	208	El Paso	"	"	"	"	11.14	21.70
"	"	" x14	277	St. Louis	"	"	"	"	14.48	26.58
"	"	" x15	208	El Paso	"	"	"	"	12.36	27.20
"	"	" x16	"	" "	"	"	"	"	13.00	25.52
"	"	" x17	"	" "	"	"	"	"	13.60	30.00
"	"	" x18	"	" "	"	"	"	"	14.24	30.80
"	"	" x19	"	" "	"	"	"	"	14.80	31.96
"	"	" x24	170	" "	"	"	"	"	14.85	35.80
"	"	" x26	138	Chicago	"	"	"	"	20.66	39.29
"	"	" x30	"	"	"	"	"	"	23.28	44.75
"	"	¾ x1½	170	El Paso	"	"	"	"	2.81	5.09
"	"	" x2	277	St. Louis	"	"	"	"	4.82	11.98
"	"	" x3	63	Chicago	"	"	"	"	5.90	8.20
"	"	" x3½	208	El Paso	"	"	"	"	7.84	14.60
"	"	" x4	"	" "	"	"	"	"	8.00	15.95
"	"	" x6	170	" "	"	"	"	"	9.26	21.24
"	"	" x6½	208	" "	"	"	"	"	10.56	21.82
"	"	" x7	"	" "	"	"	"	"	11.00	23.32
"	"	" x8	170	" "	"	"	"	"	10.88	25.42
"	"	" x10	"	" "	"	"	"	"	12.48	28.56
"	"	" x15	208	" "	"	"	"	"	18.00	39.68
"	"	" x16	"	" "	"	"	"	"	19.20	38.46
"	"	" x17	"	" "	"	"	"	"	19.76	40.68
"	"	" x19	"	" "	"	"	"	"	21.60	49.92
"	"	" x20	"	" "	"	"	"	"	22.40	51.60
"	"	" x22	138	Chicago	"	"	"	"	15.80	53.00
"	"	⅞ x3	208	El Paso	"	"	"	"	10.08	20.94
"	"	" x3½	"	" "	"	"	"	"	10.34	24.96
"	"	" x4	"	" "	"	"	"	"	11.20	26.54
"	"	" x5	"	" "	"	"	"	"	12.32	27.88
"	"	" x6	"	" "	"	"	"	"	13.44	28.00
"	"	" x16	"	" "	"	"	"	"	24.64	45.24
"	"	" x18	138	Chicago	"	"	"	"	14.49	58.71
"	"	" x20	"	"	"	"	"	"	20.80	67.70

Article.	Purchased from.	F.o.b.	Duties. Frac.	Duties. Amount.	Unit.	F.o.b. cost.*	Delivered cost.*
Bolts—Machine, ⅞x22	138	Chicago	257	₱0.12 k.l.	100	₱22.40	₱72.00
" " " x24	"	"	"	" "	"	36.16	74.45
" " 1x10	"	"	"	" "	"	13.50	41.64
" " " x12	"	"	"	" "	"	14.69	58.81
" " " x14	"	"	"	" "	"	16.24	64.50
" " " x16	"	"	"	" "	"	23.60	80.80
" " " x18	"	"	"	" "	"	25.40	83.60
" " " x20	"	"	"	" "	"	19.29	78.88
" " " x24	170	El Paso	"	" "	"	22.02	103.55
" " 1¼x20	138	Chicago	"	" "	"	49.70	162.10
" " " x24	"	"	"	" "	"	55.60	182.25
" Stove—Rd. Hd., 3/16x⅜	170	El Paso	"	" "	"	0.54	0.91
" " " " " x1	"	" "	"	" "	"	0.55	0.93
" " " " " x1¼	"	" "	"	" "	"	0.59	0.96
" " " " " x1½	"	" "	"	" "	"	0.68	1.06
" " " " ¼x½	"	" "	"	" "	"	0.54	0.91
" " " " " x⅝	"	" "	"	" "	"	0.58	0.91
" " " " " x1	"	" "	"	" "	"	0.60	0.96
" " " " " x1¼	"	" "	"	" "	"	0.63	1.15
" " " " " x1½	"	" "	"	" "	"	0.68	1.22
" " F. H., 3/16x1	"	" "	"	" "	"	0.40	0.76
" " " " " x⅝	"	" "	"	" "	"	0.39	0.58
" " " " ¼x½	"	" "	"	" "	"	0.54	0.92
" " " " " x⅝	"	" "	"	" "	"	0.58	0.96
" " " " " x1	"	" "	"	" "	"	0.63	1.15
" " " " " x1¼	"	" "	"	" "	"	0.66	1.20
Bolt Sets—Little Giant No. 7	138	Chicago	612	0.0165 k.b.	1	30.60	33.59
" " " " " 50	"	"	"	" "	"	72.00	80.81
Boots—Rubber gum hip, leather soles	257	Boston	687	1.00 k.l.	pair	12.34	17.00
Blowers—Buffalo B No. 3	208	El Paso	612	0.0165 k.b.	1	49.60	69.11
" Champion No. 400	170	" "	"	" "	"	40.00	48.20
" Ventilator, Koerting 1	296	Philadelphia	"	" "	"	75.00	91.82
" Electric Outfit No. 2, type 3222 GG, 1/6 hp., 110 v., 60 cycles	345	St. Louis	"	" "	"	84.00	134.20
Extra blast gates	"	" "	"	" "	"	3.50	5.59
" Electric Blacksmith, direct connected small frog ind. motor, 110 v., 60 cycles, No. 433088	"	" "	"	" "	"	84.00	99.10
Boiler—Water Tube No. 11, B. & K. (includes stack 40 in. by 75 ft. high, 37,000 lb., 200 hp., 2000 sq. ft. heating surface)	171	Chicago	"	" "	"	3,700.00	5,252.19
" Compound	73	"	560	0.03 k.b.	1 lb.	0.25	0.30
" Drum, 40 hp.	256	Mill	612	0.0165 k.b.	1	794.53	794.53
" Expander, 3¼-in. ID flues dudgeon	170	Oswego	"	" "	"	11.50	22.37
" Header (steam), 5-in. opening, 125 lb. pressure	70	El Paso	"	" "	"	153.46	239.71
" Grate bars, 3½ in. long	"	" "	"	" "	"	2.85	5.03
" " " 4 " "	97	" "	"	" "	"	3.30	5.81
" Tubes, 4x18 in.	"	" "	"	" "	"	0.60	1.00
Brads—Steel wire, No. 17, ¾-in	170	" "	257	0.12 k.l.	1 lb.	0.16	0.24
" " " No. 16, 1 "	"	" "	"	" "	" "	0.14	0.22
" " " No. 16, 1¼ "	"	" "	"	" "	" "	0.14	0.22
Brass Bars—3½-in. OD cored	97	" "	195	0.05 k.b.	" "	0.40	0.44
Bricks—Common wire cut	208	" "	291	0.0275	1	0.02	0.22
" Standard fire, 2½x4½x9			"	"	"	0.105	0.26
Brooms—Smelter, heavy	182	Davenport	171	0.22 k.l.	"	0.81	1.50
" Street, No. 10	277	St. Louis	"	" "	"	0.66	1.45
Brushes—File	208	El Paso	"	" "	"	0.52	0.57
" Kalsomine	277	St. Louis	"	" "	"	1.33	1.49
" Paint, Rd., 2-in	138	Chicago	"	" "	"	0.28	0.34
" " " 4 "	"	"	"	" "	"	1.15	1.36
" " " 5 "	"	"	"	" "	"	2.00	2.42
" Varnish	277	St. Louis	"	" "	"	0.59	0.68
" Whitewash	"	" "	"	" "	"	1.00	1.25
" Wire, flat, 8-in	"	" "	"	" "	"	0.75	0.87
Buckets—Ore, 750-lb., No. 11 steel, Fig. 433, No. 2	208	El Paso	612	0.0165 k.b.	"	32.00	39.67
" Windlass, No. 8	"	" "	"	" "	"	8.00	11.38
" " No. 9	"	" "	"	" "	"	9.00	12.60
" " No. 9½	"	" "	"	" "	"	10.00	14.31
(Builders' Hardware and Machinists' Tools listed alphabetically below.)							
Adze—Keen Kutter	277	St. Louis	585	0.055 k.l.	1	2.30	2.77
Bits—Auger, Anvil brand, 3/16-in.	170	El Paso	685	0.055 k.l.	"	0.30	0.37
" " " " 4/16 "	"	" "	"	" "	"	0.40	0.50
" " " " 5/16 "	"	" "	"	" "	"	0.37	0.34
" " " " 6/16 "	"	" "	"	" "	"	0.27	0.34
" " " " 7/16 "	"	" "	"	" "	"	0.30	0.38
" " " " 8/16 "	"	" "	"	" "	"	0.34	0.41
" " " " 10/16 "	"	" "	"	" "	"	0.40	0.48
" " " " 12/16 "	"	" "	"	" "	"	0.48	0.56
" " " " 14/16 "	277	St. Louis	"	" "	"	0.60	0.66
" " " " 16/16 "	170	El Paso	"	" "	"	0.60	0.70
" " " " 20/16 "	277	St. Louis	"	" "	"	0.83	0.95
" Machine, 18/16 ½-in. diameter	"	" "	"	" "	"	2.00	2.12
" " 20/16 " "	"	" "	"	" "	"	2.36	2.46
" Expansive to 3 in., Chipway	"	" "	"	" "	"	1.00	1.11
" Screw driver, No. 1	170	El Paso	"	" "	"	0.17	0.19
" Ship auger, 10/16-in.	277	St. Louis	"	" "	"	0.90	1.02

Article.	Purchased from.	F.o.b.	Duties			Unit	F. o. b. cost *	Delivered cost *
			Free	Amount.				
Bits—Slip auger, 12-16-in.	277	St. Louis	685	$0.055	k.l.	1	$1.05	$1.15
" " " 14-16 "	"	" "	"	"	"	"	1.20	1.32
" " " 16-16 "	"	" "	"	"	"	"	1.34	1.48
" " " 12-in twist, 13-16 in expansion	208	El Paso	"	"	"	"	8.60	9.10
Bob, Mercury plumb, 4x⅛-in., No. 87	"	" "	"	"	"	"	1.70	1.84
Bolts—Chain, No. 391	170	" "	"	"	"	"	0.31	0.50
" Foot	"	" "	"	"	"	"	0.26	0.44
" Window spring	277	St. Louis	"	"	"	gross	1.60	1.93
Braces—Bit 8-in. common	170	El Paso	"	"	"	1	0.60	0.66
" " 10 " "	"	" "	"	"	"	"	0.68	0.75
" " 12 " "	"	" "	"	"	"	"	0.80	0.87
" " Stanley ratchet, No. 915	"	" "	"	"	"	"	2.50	2.90
" " " " " 911	"	" "	"	"	"	"	3.25	3.83
Brackets—Shelf, 6x8-in	277	St. Louis	"	"	"	pair	0.10	0.15
Butts—Light narrow, 1½-in.	"	" "	"	"	"	"	0.04	0.06
" Loose pin, 2 x2 " bronze	170	El Paso	"	"	"	"	0.27	0.30
" " " 2½x2½ " "	"	" "	"	"	"	"	0.30	0.33
" " " 3 x3 " "	"	" "	"	"	"	"	0.32	0.39
" " " 4 x4 " "	"	" "	"	"	"	"	0.42	0.51
" " " 5 x5 " "	"	" "	"	"	"	"	0.60	0.75
" " " 6 x6 " "	"	" "	"	"	"	"	1.26	1.59
Calipers, 6-in., No. 42, lockpoint	208	" "	"	"	"	1	1.97	2.16
" 8 " " 39 "	"	" "	"	"	"	"	2.12	2.34
" 8 " " 38 "	"	" "	"	"	"	"	2.12	2.34
Casters—Gem, steel, No. 452	277	St. Louis	"	"	"	set	0.30	0.44
Chisels—Firmer socket, ⅛-in.	"	" "	"	"	"	1	0.53	0.56
" " " ¼ "	"	" "	"	"	"	"	0.53	0.56
" " " ½ "	"	" "	"	"	"	"	0.57	0.61
" " " ⅝ "	"	" "	"	"	"	"	0.61	0.66
" " " ⅞ "	"	" "	"	"	"	"	0.67	0.75
" " " 1 "	"	" "	"	"	"	"	0.71	0.81
" " " 1¼ "	"	" "	"	"	"	"	0.75	0.90
" " " 1½ "	"	" "	"	"	"	"	0.80	0.99
" " " 2 "	"	" "	"	"	"	"	0.91	1.14
Combination set, No. 9	208	El Paso	"	"	"	set	6.80	7.60
Cupboard, turns, Y4415	170	" "	"	"	"	1	0.18	0.24
Dividers, 4-in., Yankee spring, No. 83	208	" "	"	"	"	"	1.27	1.38
" 6 " Starrett " 92	170	" "	"	"	"	"	1.30	1.51
" 8 " Lockpoint " 43	208	" "	"	"	"	"	2.12	2.33
Drawer Pulls, 336 Y. T.	170	" "	"	"	"	"	0.08	0.10
Gages—Marking	170	" "	"	"	"	"	0.15	0.20
" Surface, No. 57B	208	" "	"	"	"	"	4.85	6.23
Hack saw frame, No. 155	"	" "	"	"	"	"	2.12	2.33
" " Blades	"	" "	"	"	"	"	0.12	0.15
Handles for screw driver bits	170	" "	"	"	"	"	0.12	0.15
Hinges—No. 2521	"	" "	"	"	"	pair	0.16	0.20
" 4-in. strap	"	" "	"	"	"	"	0.05	0.10
" 6 " T	277	St. Louis	"	"	"	"	0.12	0.15
" 8 " "	"	" "	"	"	"	"	0.15	0.20
" 10 " "	"	" "	"	"	"	"	0.24	0.33
Hinge hasps, No. 9154½ KK	"	" "	"	"	"	"	0.13	0.19
Keyseat clamp, No. 298	208	El Paso	"	"	"	1	1.02	1.30
Knives, drawing, 12-in.	"	" "	"	"	"	"	1.50	1.88
Level—Adj. bench, No. 96, 4-in.	170	" "	"	"	"	"	4.25	5.41
" Improved " 98, 6 "	208	" "	"	"	"	"	6.80	8.68
" For shafting, Starrett, 6-in.	170	" "	"	"	"	"	2.56	2.78
Lines—Masons' 100-ft. hanks, No. 1	"	" "	"	"	"	"	0.17	0.20
Miter box—Iron, No. 71	"	" "	"	"	"	"	21.00	23.80
Oil stones—Wachita	"	" "	"	"	"	"	1.50	1.65
Paper—Brown building, 20-lb. rolls	"	" "	589	0.12	k.l.	20 lb.	1.10	3.10
Planes—Adjustable, KK3	277	St. Louis	685	0.055	k.l.	1	2.50	2.85
" " KK5	"	" "	"	"	"	"	3.20	3.66
" " KK8	"	" "	"	"	"	"	5.40	6.39
" " No. 50 Stanley	"	" "	"	"	"	"	6.00	6.84
" " " 10CC "	"	" "	"	"	"	"	4.00	4.60
" " " 113 "	170	El Paso	"	"	"	"	4.30	5.80
" " " 148 "	"	" "	"	"	"	"	3.20	4.00
" Cutters, No. 10C Stanley	"	" "	"	"	"	"	0.39	0.44
" " " 5C "	"	" "	"	"	"	"	0.36	0.40
Plumbs and levels, No. 3	"	" "	"	"	"	set	1.91	2.61
Rules—Blacksmith folding, 1-ft.	"	" "	"	"	"	1	0.80	0.85
" Folding, No. 041	"	" "	"	"	"	"	0.50	0.61
" Log, 4-ft., " 16	277	St. Louis	"	"	"	"	2.25	2.57
" Stanley, No. 54, brass bound	170	El Paso	"	"	"	"	0.66	0.71
" Steel, No. 2220	208	" "	"	"	"	"	1.70	2.18
Screen door sets, No. J750 J.	277	St. Louis	"	"	"	1	2.31	2.40
Screw drivers—Ratchet No. 10, 4-in.	170	El Paso	"	"	"	"	0.80	1.00
" " " " 11, 6 "	277	St. Louis	"	"	"	"	0.75	0.81
" " Spiral, No. 30	"	" "	"	"	"	"	2.12	2.29
" " Starr, pocket	170	El Paso	"	"	"	"	0.40	0.50
Scriber—Pocket	208	" "	"	"	"	"	0.60	0.71
Snips—Tinners	170	" "	"	"	"	"	3.60	3.90
Springs—Door, No. 7	277	St. Louis	"	"	"	"	0.16	0.23
Squares—Steel, 2-ft., No. 14	170	El Paso	"	"	"	"	1.07	1.25
Screw-eyes—No. 1	277	St. Louis	"	"	"	gross	2.80	2.95
" " " 3	"	" "	"	"	"	"	1.90	2.33
" " " 4	"	" "	"	"	"	"	1.90	2.50

Article.	Purchased from.	F.o.b.	Duties. Frac.	Duties. Amount.	Unit.	F.o.b. cost.*	Delivered cost.*
Screw-eyes—No. 5	277	St. Louis	685	₱0 055 k.l.	gross	₱1.22	₱1.88
" " " 7	"	" "	"	" " "	"	0.80	1.70
" " " 9	"	" "	"	" " "	"	0.60	1.54
Cable—Wire cruciform steel, flattened strand, ½-in., 5-28	183	" "	234	0.011 k.b.	1 ft.	0.14	0.18
" " ½-in 6-19	"	" "	"	" " "	" "	0.11	0.16
" " ⅜ " 6-19	"	" "	"	" " "	" "	0.09	0.11
" " ¾ " 6-19	"	" "	"	" " "	" "	0.17	0.23
" " ⅞ " 6-19	"	" "	"	" " "	" "	0.20	0.30
" " ⅞ " 5-28	"	" "	"	" " "	" "	0.24	0.34
Candles—Hercules, 240 12-in	249	Hermosillo	83	0.20 k.b.	case	9.45	10.25
" LaFama B, " "	"	"	"	" " "	"	9.45	10.25
" " R " "	"	"	"	" " "	"	9.45	10.25
" Schneider (In carload lots)	"	"	"	" " "	"	.....	14.50
Canvas—No. 10 duck, 52-in., standard	9	San Fran.	337	0.20 sq. mt.	yd.	0.90	1.29
" 11-oz., 40-in., single f	99	El Paso	"	" " "	"	0.43	0.68
" Paulin, oz. 10, 24x50-ft	170	" "	"	" " "	1	70.00	93.16
Carbide—¾x1¼, carload	208	" "	535	0.04 k.b.	100 lb.	8.20	12.50
" Single drums	"	" "	"	" "	" "	8.70	19.80
Carbolite—⅜x1¼, carload	8	Duluth	"	" "	" "	5.40	13.00
Carborundum wheels—10x1x ⅝, fine	97	El Paso	264	0 01 k.b.	1	4.45	5.00
" " 12x2x1, grit	"	" "	"	" "	"	9.40	10.58
" " 12x2x¼, medium	"	" "	"	" "	"	9.40	10.58
Cars—Ore, D-H No. 9, 16-cu. ft, 12-in. wheel, 18-in. gage, 44x26x24-in.; weight, 730 lb. each	71	" "	612	0.0165 k.b.	"	107.00	139.95
" " Steel, 12-cu. ft, 10-in. wheel, 18-in. gage; side and end dump; weight, 550 lb each	160	Columbus	"	" " "	"	78.00	127.67
" " Same as above, 16-cu. ft.; weight, 670 lb. each	"	"	"	" " "	"	86.00	146.21
" " Scoop, No 575, 18-in. gage; weight, 795 lb. each	"	"	"	" " "	"	100.00	161.88
Wheels for above, 10-in. standard roller bearing for 24x24x20-in. cars	97	El Paso	"	" " "	"	4.00	5.34
" " 10-in., 18-in. gage; Anaconda, K. & J., 4 to set	"	" "	"	" " "	set	32.00	40.38
" " 12-in. wheels, with axles Anaconda	71	" "	"	" " "	"	26.00	33.82
" " 13-cu. ft. capacity, No 10-12 steel, 12-in. Anaconda wheels and axles; side and end dump; 18-in. gage, 750 lb.; 44x21x24-in	97	" "	"	" " "	1	82.00	117.00
" " 16-cu. ft. capacity, No. 10-12 steel, 12-in. Anaconda wheels and axles; side and end dump; 18-in. gage, 850 lb.; 44x26x24-in	"	" "	"	" " "	"	96.00	135.00
" " Kilbourne & Jacobs, No. 554, Leadville type; 12-cu. ft. capacity, 12-in. Anaconda wheels and axles, No. 10-12 steel; body on turntable; 18-in. gage, 650 lb.; 44x20x24-in. (in lots of ten)	169	Columbus	"	" " "	"	66.00	115.00
" " Kilbourne & Jacobs, No. 559, automatic, 600 lb. ea.	"	"	"	" " "	"	62.00	110.00
" " Truax—Fig. No. 14, No. 10 steel, 16-cu. ft capacity, 900 lb. each	314	Denver	"	" " "	"	130 00	180.00
" Journal boxes, set of 2	71	El Paso	"	" " "	set	8.00	9.90
Cement—El Toro (in carloads)	284	" "	268	0.007 k.b.	100 lb.	1.25	3.33
" Duxbax liquid leather	273	New York	694	0.04 k.b.	1 lb.	3.00	4.00
" Early's Commutator	91	Canton	"	" " "	" "	4.00	5.16
" Smooth-On Iron	279	Jersey City	"	" "	" "	0.60	1.23
Chain— ⅜-in. coil	208	El Paso	612	0.0165 k.b.	1 ft.	0.23	0.40
" 3/16-in., 1-in. links	"	" "	"	" " "	" "	0.19	0.30
" ¼-in. link for chain block	"	" "	256	0.11 k.l.	" "	0.44	0.60
" Ley, steel bushed, No. 823	185	Chicago	612	0.0165 k.b.	" "	1.32	1.50
" " pins with cotters	"	"	"	" "	100	12.10	16.94
" " bushings	"	"	"	" "	"	8.80	10.55
" " sprockets, 14 T FR	"	"	"	" "	1	9.90	10.86
Channels—4x16-in.	97	El Paso	"	" "	"	7.11	11.54
" 6x16-in	"	" "	"	" "	"	12.40	20.14
Charcoal—Made on ground					ton	.....	37.60
Charts—Bristol No. 1000	32	Waterbury	597	0.45 k.l.	1000	13.52	19.48
Clock—Newman's Watchman No. 9	138	Chicago	617	1.00 k.l.	1	99.00	107.49
" Charts for above	"	"	597	0.45 k.l.	1000	8.80	11.08
" New Haven Wall 227/T	277	St. Louis	617	1.00 k.l.	1	6.80	13.87
Clutch—Hill Friction, 36-in., 6-arm, 4 7/16-in. bore, weight 670 lb.	5	Cleveland	612	0.0165 k.b.	1	143.40	328.75
Coal—Blacksmith, carloads in sacks	70	El Paso	269	exempt	100 lb.	1.19	2.95
Coke—In sacks, less than carloads	97	" "	279	"	" "	1.50	4.81
Compressor, Air—Single stage, class NE1, 8x8-in., 210 r.p.m.	151	New York	612	0.0165 k.b.	1	664.00	802.80
" " Locomotive No. 2; New York 90 lb. pressure air pump	EPSW	El Paso	"	" " "	"	150.00	185.50
" " Sullivan, belt-driven, 2-stage, class WH-2, part No. 1524, 12x7½x14-in., wt. 8647 lb.	294	Claremont	"	" " "	"	2,470.00	2,973.62
" " Set of brass main bearings	"	"	"	" " "	"	108.00	125.29
" " Sullivan, class WI, 16x14-in., 900 cu. ft., belt driven, duplex, 48x12-in. (includes air receiver), total weight 17,580 lb.	"	"	"	" " "	1	4,330.80	5,079.74
" " Steel air receiver, 60 in. x 14 ft., complete	151	New York	"	" " "	"	554.00	859.55
Cord, Sash—Silver Lake	170	El Paso	325	1.32 k.l.	100 ft.	2.00	3.54
Crayons—Lumber	277	St. Louis	292	0.15 k.l.	gross	8.00	9.51
" Soapstone, No. 5	"	" "	"	" " "	"	4.56	6.48

Article			Purchased from.	F. o. b.	Duties—Frac.	Duties—Amount.		Unit.	F. o. b. cost.*	Delivered cost.*
Cutting and Threading Machine, Jarecki No. 13, for 2½ to ½-in. pipe			160	Erie, Pa.	612	P0.0165	k.b.	1	P1,650.00	P2,155.75
Dies, Bolt—No. 2, ¼, ⅜, ½, ⅝, ¾, ⅞, 1-in.			12	Connecticut	685	0.055	k.l.	1	1.72	1.88
" " No. 2, 1⅛-in.			"	"	"	"	"	"	1.92	2.10
" Pipe—¼, ⅜, ½, ¾-in.			"	"	"	"	"	"	1.20	1.28
" " Nye solid sq., ⅞-in., No. 4			208	El Paso	"	"	"	set	4.75	5.13
" " " " " ½-in., No. 3			"	"	"	"	"	"	3.32	3.76
Doors—2½ ft. x 6½ ft. x 1½ in.			84	Douglas	153	0.60	k.l.	1	5.00	11.00
" 3 " x 7 " x 1⅜ "			"	"	"	"	"	"	7.90	12.00
" 3 " x 6½ " x ⅝ "			"	"	"	"	"	"	14.00	21.05
" 3 " x 7 " x 1½ "			"	"	"	"	"	"	7.90	14.00
" 3½ " x 7 " x 1⅜ "			"	"	"	"	"	"	14.50	21.52
Drills, Rock—Hardsocg No. 1			133	El Paso	612	0.0165	k.b.	"	120.00	128.50
Bolts, No. 8 handle			"	" "	"	"	"	"	0.50	0.53
Bushings, No. 4 hex.			"	" "	"	"	"	"	5.00	5.25
C. Piston			"	" "	"	"	"	"	7.50	7.87
Female end for ½-in. hose			"	" "	"	"	"	"	0.80	0.86
Handle No. 2			"	" "	"	"	"	"	2.50	2.63
Hex. cap No. 5			"	" "	"	"	"	"	3.50	3.68
Hose coupler, ½-in.			"	" "	"	"	"	"	1.60	1.68
Hose coupler and air cock No. 5, ½-in.			"	" "	"	"	"	"	3.20	3.36
Hose nipple			"	" "	"	"	"	"	0.30	0.34
Male ends for ½-in. hose			"	" "	"	"	"	"	0.80	0.86
" " Ingersoll-Rand BC-21 Stopers, including 50 ft. ⅝-in. air hose and fittings			151	" "	"	"	"	"	295.70	308.13
Parts for above:										
Anvil block	21-BC2		"	" "	"	"	"	"	4.00	4.02
Cup leathers	78-BC21		"	" "	"	"	"	"	0.30	0.35
Feed piston retaining spring	71-BC11		"	" "	"	"	"	"	1.00	1.17
Front head	11-BC2		"	" "	"	"	"	"	10.00	11.06
Front head bolts and nuts	13-BC2		"	" "	"	"	"	"	2.00	2.36
Front head springs	160-BC2		"	" "	"	"	"	"	0.50	0.65
Piston	20-BC1		"	" "	"	"	"	"	8.00	9.78
Valve, 'Butterfly'	40-BC1		"	" "	"	"	"	"	10.00	10.96
" " Sullivan Stoper DA21, ¾-in., 176 lb.			294	" "	"	"	"	"	270.00	278.54
Parts for above:										
724-D Throttle valve			"	" "	"	"	"	"	5.00	5.40
732 Bushings			"	" "	"	"	"	"	2.66	2.78
733 Clamp keys			"	" "	"	"	"	"	4.00	4.29
736 Feed piston			"	" "	"	"	"	"	2.66	3.11
739 Feed cyl. bushing			"	" "	"	"	"	"	4.00	4.26
771 Striking blocks			"	" "	"	"	"	"	5.00	5.32
772 Inlet elbows			"	" "	"	"	"	"	4.00	4.12
777 Packing leather			"	" "	"	"	"	"	0.30	0.34
778 Valve box covers			"	" "	"	"	"	"	15.00	15.35
779 Valve box			"	Chicago	"	"	"	"	20.00	20.79
780 Valve			"	El Paso	"	"	"	"	8.00	8.36
795 Piston			"	Chicago	"	"	"	"	16.00	16.77
815 Lock ring			"	"	"	"	"	"	2.00	2.04
816 Lock spring			"	"	"	"	"	"	0.30	0.32
879 Rotating handles			"	"	"	"	"	"	10.00	10.16
" " Sullivan US, 2¼-in.			"	"	"	"	"	"	264.00	280.71
6-ft. columns for above, complete with arms and saddle			"	"	"	"	"	"	67.50	71.54
Parts for above:	US									
1-R Top cylinder head	2		"	"	"	"	"	"	4.50	4.69
2 Packing			"	"	"	"	"	1 lb	1.50	1.65
14 Side Rd. springs	8		"	"	"	"	"	1	0.80	0.84
15 Cylinder, bare	501		"	"	"	"	"	"	51.00	53.47
16 Air chest, bare	137		"	"	"	"	"	"	20.00	22.86
18 Air valve	107		"	"	"	"	"	"	6.20	6.40
20 Valve bushing	106		"	"	"	"	"	"	5.00	5.14
21 Buffer	166		"	"	"	"	"	"	2.30	2.55
22 Check nut	167		"	"	"	"	"	"	0.40	0.42
23 Rifle nut	36		"	"	"	"	"	"	12.00	12.90
24 Collar	38		"	"	"	"	"	"	1.50	1.60
25 Ratchet ring (2)	221		"	"	"	"	"	"	11.25	12.19
26 Ratchet spring	139		"	"	"	"	"	"	0.30	0.31
27 Ratchet pins (2)	40		"	"	"	"	"	"	0.30	0.31
29 Piston (complete)	320		"	"	"	"	"	"	55.13	57.50
31 Piston ring (2)	292		"	"	"	"	"	"	3.50	3.62
34 Piston ring spring	14		"	"	"	"	"	"	0.30	0.33
35 Clamp blocks	100		"	"	"	"	"	"	1.25	1.32
36 Clamp blocks	314		"	"	"	"	"	"	1.30	1.40
39 Bushing for chuck	183		"	"	"	"	"	"	2.80	2.95
40 Button for chuck	285		"	"	"	"	"	"	0.20	0.21
41 Lower cyl. head, bare	261		"	"	"	"	"	"	8.00	8.45
44 Bushing for 41 head	528		"	"	"	"	"	"	3.60	3.72
45 Leather for head	530		"	"	"	"	"	"	0.28	0.29
50 Bushing for 46 head	534		"	"	"	"	"	pair	3.60	3.71
54 Lower cyl. head	607		"	"	"	"	"	1	18.00	19.05
55 Bushing for 54 head	528		"	"	"	"	"	"	4.50	4.69
57 Lining for 54 head	613		"	"	"	"	"	"	3.50	3.60
57 Bolts for 54 head	608		"	"	"	"	"	"	0.45	0.48
61 Feed nut with c. n.	248		"	"	"	"	"	"	6.00	6.30
62 Check nut	632		"	"	"	"	"	"	0.60	0.63

Article.			Purchased from.	F.o.b.	Duties. Frac.	Duties. Amount.	Unit.	F.o.b. cost.*	Delivered cost.*
Drills, Rock—Sullivan US, 2¼-in.:									
Parts for above:		US							
63	Feed screws	247	294	Chicago	612	₱0.0165	k.b. 1	₱12.00	₱12.58
64	Crank handle	32	"	"	"	"	" "	2.75	2.90
67	Yoke studs	522	"	"	"	"	" "	2.50	2.73
68	Shell with gibs	94	"	"	"	"	" "	30.00	32.03
70	Gibs for R69		"	"	"	"	" "	5.10	5.46
71	Bolts for R70		"	"	"	"	" "	0.30	0.31
N1	Saddle, 1-U2		"	"	"	"	" "	15.00	17.60
	Chuck wrench		"	"	"	"	" "	2.00	2.05
N22	Clamp strap		"	"	"	"	" "	2.60	2.95
N56	Throttle valve, 12UX		"	"	"	"	" "	4.50	4.68
N62	Reducing spud, 108UX		"	"	"	"	" "	0.86	0.90
ullivan "UB", 2½-in.			"	"	"	"	" "	322.00	334.90
Parts for above:		UB							
1-R	Top cylinder head	2	"	"	"	"	" "	5.10	5.45
14	Side Rd. springs	8	"	"	"	"	" "	0.90	0.93
15	Cyl., bare, with stud	501	"	"	"	"	" "	54.00	56.20
16	Air chest, bare	387	"	"	"	"	" "	19.50	20.00
17	Studs with nuts	286	"	"	"	"	" "	0.24	0.26
19	Valves, 0.0015	107	"	"	"	"	" "	6.00	6.15
20	Valve bushing	106	"	"	"	"	" "	5.25	5.75
21	Buffers	763	"	"	"	"	" "	3.50	3.63
22	Check nuts	167	"	"	"	"	" "	0.52	0.54
23	Rifle bars	97	"	"	"	"	" "	15.75	16.13
24	Collars	38	"	"	"	"	" "	1.50	1.54
25	Ratchet ring	221	"	"	"	"	" "	12.75	13.25
26	Ratchet springs	139	"	"	"	"	" "	0.30	0.33
27	Ratchet pins	40	"	"	"	"	" "	0.30	0.33
28	Rifle nut	98	"	"	"	"	" "	4.15	4.48
30	Piston, complete	572	"	"	"	"	" "	59.63	62.00
31	Piston rings	292	"	"	"	"	" "	2.10	2.25
34	Piston springs	14	"	"	"	"	" "	0.22	0.25
36	Clamp blocks	314	"	"	"	"	" "	1.42	1.50
37	U bolts and nuts	131	"	"	"	"	" "	1.30	1.41
39	Chuck bushings	16	"	"	"	"	" "	3.00	3.15
40	Chuck buttons	285	"	"	"	"	" "	0.53	0.58
44	Lower head bushing	148	"	"	"	"	" "	4.50	4.78
45	Leathers	264	"	"	"	"	" "	0.23	0.26
54	Lower heads, bare	54	"	"	"	"	" "	19.00	19.25
55	Lower head bushings	431	"	"	"	"	" "	4.50	4.65
56	Lower head linings	613	"	"	"	"	" "	3.00	3.18
57	Lower head bolts, N.	608	"	"	"	"	" "	0.45	0.48
61	Feed nuts, complete	798	"	"	"	"	" "	6.00	6.15
63	Feed screws	247	"	"	"	"	" "	10.00	10.20
64	Crank handles	32	"	"	"	"	" "	3.75	3.88
65	Washers	33	"		"	"	" "	0.52	0.55
66	Yokes for feed S.	523	"	"	"	"	" "	4.50	4.75
67	Yoke studs with sleeve	522	"	"	"	"	" "	4.50	4.75
69	Loose gib shells	799	"	"	"	"	" "	31.50	32.78
" " Sullivan "UE2", 3⅛-in.:									
Parts for above:		UE2							
	Top cylinder head	2	"	"	"	"	" "	6.75	7.10
12-R	Side rods, nuts	521	"	"	"	"	" "	1.90	1.99
15	Cylinder, bare	501	"	"	"	"	" "	61.50	71.45
16	Air chest, bare	137	"	"	"	"	" "	24.00	25.10
17	Studs and nuts	286	"	"	"	"	" "	0.30	0.33
19	0.0015 valves	107	"	"	"	"	" "	8.28	8.68
20	Valve bushings	106	"	"	"	"	" "	6.50	6.80
21	Buffers, complete	763	"	"	"	"	" "	3.50	3.73
22	Check nuts for B.	167	"	"	"	"	" "	0.58	0.63
23	Rifle bars	36	"	"	"	"	" "	18.75	19.29
24	Collars	38	"	"	"	"	" "	2.25	2.34
25	Ratchet rings	39	"	"	"	"	" "	14.80	15.15
26	Ratchet springs	139	"	"	"	"	" "	0.40	0.43
27	Ratchet pins	40	"	"	"	"	" "	0.68	0.71
28	Rifle nuts	15	"	"	"	"	" "	5.20	5.57
29	Piston with chuck	320	"	"	"	"	" "	55.00	57.38
30	Piston, complete	909	"	"	"	"	" "	72.00	75.00
35	Clamp block	314	"	"	"	"	" "	1.85	1.93
37	U bolts and nuts	313	"	"	"	"	" "	2.05	2.11
38	Chuck nuts	594	"	"	"	"	" "	0.42	0.47
39	Chuck bushings	393	"	"	"	"	" "	3.75	3.90
40	Chuck buttons	580	"	"	"	"	" "	0.76	0.80
41	Lower head, bare	686	"	"	"	"	" "	26.10	30.10
42	Bolt for head 41	262	"	"	"	"	" "	0.40	0.44
45	Lower head bushing	528	"	"	"	"	" "	7.20	7.62
61	Feed nuts, complete	248	"	"	"	"	" "	7.25	7.91
62	Check nuts	632	"	"	"	"	" "	0.86	0.92
63	Feed screw	247	"	"	"	"	" "	12.00	12.58
64	Crank handle	32	"	"	"	"	" "	4.50	4.74
66	Yokes for shells	33	"	"	"	"	" "	5.30	5.56
69	Loose gib shell	306	"	"	"	"	" "	62.00	67.86
70	Loose gib	307	"	"	"	"	" "	5.25	5.53
" Waugh Stoper, No. 12-A			76	Denver	"	"	" "	270.00	290.00
Parts for above:									
Air feed cyl. nut		No. 6	"	"	"	"	" "	6.00	6.44
Lubricating plug		14	"	"	"	"	" "	12.00	14.87
Side rod and nut		3	"	"	"	"	" "	1.50	1.68

Article	Purchased from	Freight	Duties Line	Duties Amount	Unit	Unit	Freight cost *	Delivered cost *
Drills, Rock—Waugh Stoper, No. 12-A								
Parts for above:								
Valve, complete 15-6-7	76	Denver	612	0.0165	k.b.	1	₱30.00	₱32.15
Drill Sharpener—Leynet No. 2, complete with dies and dollies, weight 1888 lb	184	"	"	"	"	"	1,174.96	1,337.13
" " Steel guide	"	"	"	"	"	"	110.00	124.50
" " Hammer	"	"	"	"	"	"	35.00	39.34
" " Air valve, No. 15-16	"	"	"	"	"	"	4.00	3.16
" " Piston ring	"	"	"	"	"	"	11.50	12.57
" " Cup leathers	"	"	"	"	"	"	0.30	0.31
" " Rt. Hd. springs	"	"	"	"	"	"	3.50	3.53
" " Back buffer	"	"	"	"	"	"	2.00	2.30
" " Front buffer	"	"	"	"	"	"	2.00	2.30
" " Front cylinder rings	"	"	"	"	"	"	10.00	11.63
Drill—Steel ratchet No. ¾	277	St. Louis	685	0.055	k.l.	"	18.00	27.04
" Piston, Imperial A-1484	151	El Paso	612	0.0165	k.b.	"	144.00	147.68
Drills—Twist, taper shank, 1/16-in.	277	St. Louis	685	0.055	k.l.	"	0.26	0.30
" " " " 2/16 "	208	El Paso	"	"	"	"	0.30	0.35
" " " " 3/16 "	277	St. Louis	"	"	"	"	0.36	0.39
" " " " 4/16 "	"	"	"	"	"	"	0.42	0.44
" " " " 5/16 "	"	"	"	"	"	"	0.50	0.53
" " " " 6/16 "	"	"	"	"	"	"	0.56	0.60
" " " " 13/16 "	"	"	"	"	"	"	1.52	1.58
" " " " 15/16 "	"	"	"	"	"	"	1.98	2.15
" " " " 20/16 "	208	El Paso	"	"	"	"	3.24	3.41
" " " " 24/16 "	"	"	"	"	"	"	8.58	8.93
" " " " 26/16 "	"	"	"	"	"	"	9.36	9.71
" " " " 5/32 "	"	"	"	"	"	"	0.32	0.37
" " " " 7/32 "	"	"	"	"	"	"	0.36	0.43
" " " " 9/32 "	"	"	"	"	"	"	0.46	0.49
" " " " 13/32 "	"	"	"	"	"	"	0.62	0.68
" " " " 21/32 "	"	"	"	"	"	"	1.08	1.14
" " " " 27/32 "	"	"	"	"	"	"	1.66	1.85
Dusters—Feather	277	St. Louis	171	0.22	k.l.	"	1.28	1.76
(Electrical supplies, listed alphabetically)								
Arcing Rings—No. 2692 Small	186	Victor	612	0.0165	k.b.	1	0.94	1.15
" " No. 2925 Large	"	"	"	"	"	"	1.64	2.00
Armalac	135	Denver	302	0.01	k.b.	gal.	5.00	5.66
Armatures (See Motors).								
Batteries—Blue Bell	348	San Fran.	612	0.0165	k.b.	1	0.45	0.61
" Columbia No. 6	135	Denver	"	"	"	"	0.45	0.67
" Crowfoot (XP)	208	El Paso	"	"	"	"	2.00	4.20
" Ever-ready, 3-cell tungsten	135	Denver	"	"	"	"	0.44	0.79
Battery Voltmeter	93	San Fran.	"	"	"	"	8.50	9.94
Bells—Extension (Code 127) F 2500-ohm	345	St. Louis	"	"	"	"	5.50	6.26
" " (Code 292) E 2500-ohm	"	"	"	"	"	"	15.04	16.91
Buzzers—Eaco	348	San Fran.	"	"	"	"	0.75	0.88
Cable—Type G lead	"	"	"	"	"	"	16.94	26.30
Carbon Brushes (See Motors).								
Clamps—Havens No. 369	93	San Fran.	"	"	"	"	3.60	4.82
" " No. 368K	"	"	"	"	"	"	6.00	8.03
Cleats—Single wire	345	St. Louis	"	"	"	100	6.00	6.73
Compound—MIC No. 3	93	San Fran.	694	0.24	k.b.	gal.	2.00	2.50
" PB Electric	"	"	"	"	"	"	2.40	2.90
Copper—Sheet, 1/16x36x48	"	"	"	198	0.17	k.b	sheet	25.20	31.95
" " 3/32x36x48	"	"	"	"	"	"	"	36.06	45.55
" " 1/8 x36x48	"	"	"	"	"	"	"	49.34	62.24
Cord—Damp-proof, red and white	"	"	"	199	0.10	k.l.	lb.	0.56	0.62
" Lamp, 16-gage	"	"	"	"	"	"	1000 ft.	25.56	29.10
" Packing house, 16-gage	"	"	"	"	"	"	" "	81.22	92.32
Cut-outs— 30-amp., 600-volt	348	"	"	612	0.0165	k.b.	1	0.84	0.90
" 60 " "	"	"	"	"	"	"	"	1.26	1.36
" 100 " "	"	"	"	"	"	"	"	2.25	2.99
Fan—Emerson, 8-in.	345	St. Louis	203	0.50	k.l.	1	18.90	26.39
Fuses—10-amp., 250-v.	"	"	"	608	0.11	k.b.	100	25.00	27.94
" 20, 30-amp., 250-v.	"	"	"	"	"	"	"	25.00	27.94
" Knife-blade contact, 75-amp., 600-v.	"	"	"	"	"	"	1	1.50	1.71
" Refillable, Daum, 10, 20, 30-amp., 250-v.	72	Pittsburgh	"	"	"	"	0.30	0.39
" " " 30, 60, 80, and 100-amp., 600-v.	"	"	"	"	"	"	.....	.....
" " " 30-amp., 600-v.	"	"	"	"	"	"	1.00	1.21
" " " 60 " "	"	"	"	"	"	"	1.50	1.75
" " " 80 " "	"	"	"	"	"	"	3.00	3.65
" " " 100 " "	"	"	"	"	"	"	3.00	3.65
" Telephone, 7-amp.	348	San Fran.	"	"	"	100	14.00	16.50
" " mica No. 8	"	"	"	"	"	"	3.00	3.33
Fuse Plugs—10-amp., 125-v.	93	"	"	"	"	"	7.00	8.04
Gage—Wire standard	"	"	"	685	0.055	k.l.	1	6.00	6.25
Generator—50-kva., 3-ph., 60-cyc., 480-v., 1200 r.p.m.; No. 3G; with bed-plate, std. pulley 15x12x2⅜; gen. set of rails, complete; weight, 2631 lb.	351	E. Pittsb.	612	0.0165	k.b.	"	1,168.00	1,220.32
Gloves, rubber	93	San Fran.	652	0.45	k.l.	pair	7.00	8.81
Gong (See also Bells).								
Gong—5-in., for 110-v. motor, No. 101,553	348	" "	254	0.22	k.l.	1	15.08	20.06
Hot Plate—American Laboratory, 18x9, 110-v., No. 2930	93	" "	612	0.0165	k.b.	"	26.10	41.29
Igniter—Columbia No. 6	135	Denver	302	0.01	k.b.	"	0.45	0.55
Insulator Beads, No. 30,251	348	San Fran.	"	"	"	1000	2.00	3.00

Article.	Purchased from.	F.o.b.	Duties. Frac.	Duties. Amount.	Duties.	Unit.	F.o.b. cost.*	Delivered cost.*
Insulators—Locke No. 2114, slate glaze	345	San Fran.	302	₱0.01	k.b.	1000	₱270.00	₱420.00
Joints for wire No. 10	93	" "	612	0.165	k.b.	"	35.20	44.85
" " " " 4	"	" "	"	"	"	"	132.00	163.92
Knobs—Porcelain, No. 4½	345	" "	"	"	"	"	29.52	38.20
" Split, No 5½	135	Denver	"	"	"	"	29.52	40.25
" " No. 2	93	San Fran.	"	"	"	"	.....	92.32
Lamps—Arc, enclosed	345	St. Louis	611a	0.22	k.b.	"	35.40	48.35
" Carbon, 8-cp., 220-v.	283	El Paso	"	"	"	1000	320.00	360.00
" " 16-cp., 115-v.	208	" "	"	"	"	"	240.00	268.44
" Mercury, Cooper-Hew, vapor, 35-amp	345	St. Louis	"	"	"	1	100.00	110.98
bulbs for above	"	" "	"	"	"	"	5.00	5.33
tubes " "	"	" "	"	"	"	"	32.00	41.90
tripping attachment	"	" "	"	"	"	"	5.00	5.57
" Tungsten— 25-w., 115-v. Edison	283	El Paso	"	"	"	"	0.68	0.76
" " 40-w., " Westinghouse	208	" "	"	"	"	"	0.77	0.93
" " 40-w., " Packard	93	San Fran.	"	"	"	"	1.43	1.93
" " 60-w., " Westinghouse	208	El Paso	"	"	"	"	0.84	1.03
" " 100-w., " frosted, Westinghouse	"	" "	"	"	"	"	1.48	1.86
" " 100-w., " clear, "	"	" "	"	"	"	"	1.12	1.50
" " 150-w., " frosted "	"	" "	"	"	"	"	2.70	3.63
(All of the above tungsten lamps are priced in lots less than 100. Larger lots would lower cost 15%.)								
Lamp Coloring	345	St. Louis	302	0.01	k.b.	oz.	0.28	0.33
Lamp Guards—"Eaco," portable	93	San Fran.	612	0.0165	k.b.	1	2.50	2.77
Lightning Arresters—No. 5 OB	348	" "	"	"	"	"	0.84	0.95
" " Wood, No. 2750, 1000-v., A. C. Garton	135	Denver	"	"	"	"	9.60	12.45
Meter—Factor, 400-v., 5-amp	72	Pittsbg.	"	"	"	"	100.90	103.08
" Volt, type 'P', portable, No. 92,774	"	"	"	"	"	"	75.90	79.08
" Watt, 5 to 10-kw., 100 to 200-v.	"	"	"	"	"	"	153.50	159.84
Mica—No. 013,662	135	Denver	302	0.01	k.b.	1 lb.	6.50	6.60
Pliers—Kleins side cutting, 6-in.	"	"	685	0.055	k l.	1	3.02	3.27
" " " " 7 "	"	"	"	"	"	"	3.45	3.70
" " " " 8 "	"	"	"	"	"	"	3.61	3.87
Plugs—Wood, No. 119	"	"	302	0 01	k.l.	100	14.40	15.52
" Hubbell, No. H-5408	"	"	"	"	"	"	51.00	55.00
Receivers, No. 32-a	166	Chicago	612	0 0165	k.b.	1	2.80	3.50
Resistance Bars—Style No. 121,137, double, No. 12 iron wire	348	San Fran.	302	0.01	"	"	0.20	0.33
Rosettes, fuseless cleat	135	Denver	612	0.0165	"	"	0.23	0.30
Searchlight—Niagara	236	Niagara	611a	0.22	k.l.	"	20.00	24.60
Battery sets for above	"	"	"	"	"	set	2.00	2.37
Sockets—Edison, cleat base	345	St. Louis	612	0.0165	k.b.	1	0.72	0.81
" " keyless, ⅜-in.	"	" "	"	"	"	"	0.55	0.61
" " key, Shurlock attachment	"	" "	"	"	"	"	0.72	0.81
" Waterproof	135	Denver	"	"	"	"	0.35	0.38
Solder—Wire, No. 016,931	"	"	203	0.50	k.l.	1 lb.	0.56	0.76
Soldering Copper—No. 1506	"	"	"	"	"	" "	1.80	2.59
Soldering Salts—Allen's	"	"	"	"	"	" "	1.00	1.54
Shades—Aluminum, 9½-in.	93	San Fran.	205	1.80	k.l.	1	0.65	1.30
Strain Balls—Porcelain, 2½-in.	135	Denver	612	0.0165	k.b.	100	13.56	21.64
Straps—Angle bottom	348	San Fran.				pair	0.96	1.60
Switches—Baby Jack Knife, 15-amp., single-throw	93	" "	608	0.11	k.b	1	0.65	0.84
" 3-head, plug, and receptacle	"	" "	"	"	"	"	2.40	2.72
" Quick break, single-throw, 300-amp., 600-v., 3-pole, knife	345	St. Louis	"	"	"	"	46.52	58.46
" 25-amp., 250-v., knife	135	Denver	"	"	"	"	1.56	1.90
" 200 " 600 " q. b.	348	San Fran.	"	"	"	"	15.36	26.22
" 300 " 450 " disconnecting	122	Schen't'y.	"	"	"	"	53.20	69.23
" 300 " 600 " 3-p., s. t.	208	El Paso	"	"	"	"	17.52	26.03
Switch—Solenoid, complete, for changing 45,000-v., non-automatic, hand-operated oil switch to solenoid operated	122	Schen't'y.	"	"	"	all	960.00	1,469.42
Stye—Aluminum, frosted	135	Denver	"	"	"	1	1.92	2.00
Switchboard—Complete, No. S-O-422,010; 2263 lb.	351	Pittsbg.	"	"	"	"	525.00	738.40
Tape—Black, Manson, friction	93	San Fran.	109	0.10	k.l	1 lb.	1.25	1.54
" P. B. insulating, No. 5240	"	" "	"	"	"	" "	0.90	1.16
Telephone—For desk, No. 45-E, includes stand and generator	"	" "	612	0.0165	k.b	1	30.50	33.68
" Lineman's portable test set	142	Brookline	"	"	"	"	29.00	34.00
" Wall, 4-magnet	93	San Fran.	"	"	"	"	23.50	30.02
" Wall, type 1317 S	348	" "	"	"	"	"	24.16	31.77
" Switch, metallic, automatic, No. 48	61	Boston	"	"	"	"	15.00	16.80
Telephone Brackets—Adjustable phone holder, 4¼-in., No. 09745	135	Denver	"	"	"	1	6.00	9.95
Telephone transmitters	166	Chicago	"	"	"	"	2.80	3.43
Telephone Wire—2/0 extra braid RC, DB	93	San Fran.	207	0 06	k.l.	1000 ft.	269.84	306.86
" " Heater cord, No. 16, 3C	"	" "	"	"	"	" "	89.00	105.10
" " No. 6 RC, copper, SB	"	" "	"	"	"	" "	56.78	68.62
" " No. 8 RC, copper, SB	348	" "	"	"	"	" "	36.10	43.81
" " No 8 asb. cov., Salamander	150	New York	"	"	"	" "	40.32	52.20
" " No. 8 asb. cov., Copper	243	Douglas	"	"	"	" "	50.00	55.00
" " No. 8 Slow B., waterproof	348	San Fran.	"	"	"	" "	35.20	48.00
" " No. 12 RC copper, SB	93	" "	199	0.10	k.l.	" "	20.18	25.76
" " No. 14 RC Dble. B	"	" "	"	"	"	" "	7.34	10.00
" " No. 12 Galv. iron wire, BB	348	" "	224	0.011	k.b.	" "	3.50	7.00
" " No. 14 B&S Black "D" D AC	150	New York	199	0 10	k.l.	1 lb.	0.86	1.11
" " No. 15 do.	"	" "	"	"	"	" "	0.92	1.23

Article	Purchased from	F.o.b.	Duties — Price	Duties — Amount	Unit	F.o.b. cost *	Delivered cost *
Telephone wire, No. 24 Bare copper wire.	93	San Fran.	139	₱0.10 k.l	1 lb	₱ 1.00	₱ 1.26
" " No. 8 Std. Galv. steel wire	348	" "	234	0.011 k.b.	100 ft	27.50	50.00
" " No. 8 THWP solid wire.	283	El Paso	207	0.06 k.l	100 lb.	15.30	20.00
" " No. 8 Med. Hard drawn bare copper wire	"	" "	"	" "	" "	15.50	20.50
Engine, Clarke, plain vert., 15-hp., 1907 lb.	97	" "	612	0.0165 k.b.	1	370.00	356.25
Insulators—Deep groove, dble. petticoat.	93	San Fran.	302	0.01 k.b.	1000	81.68	132.00
" Thomas, No. 3002, 3 point, porcelain and iron (by express)	122	Schen'ty	"	" "	$	3.96	8.72
" No. 4½ Standard	348	San Fran.	"	" "	1000	24.90	31.50
" No. 9 Pony	"	" "	"	" "	"	54.60	69.96
Engineering Supplies—Paper and Cloth.							
B. P. Parchmine, 36-in.	168	" "	594	0.15 k.l	roll	1.96	3.00
Black Print, direct process, Carlton							
Medium, No. 145, 36-in.	46	Brook.	"	" "	"	2.10	4.11
Heavy, No. 210, 36-in.	"	"	"	" "	"	4.20	6.29
Drawing Paper, Anvil, 36-in., No. 60, 10 yd.	168	San Fran.	"	" "	"	3.88	5.37
Imperial Duplex No. 10.	"	Hoboken	"	" "	quire	2.25	5.40
Cross section books No 375	"	"	600	1.40 k.l.	1	1.12	1.68
Slide Rule No. 4071	"	San Fran.			"	10.20	12.44
Tape, Excelsior, Steel, No. 7694	"	" "			"	4.50	5.33
Transit, Buff & Berger, Mining, No. 3F.	B&B	Jamaica			..	.....	518.68
(Motors, Generators, and Transformers, listed alphabetically below.)							
Generators—No. 1, 2 kw., 125 v., 1400 r.p.m., 'S,' 2 bearings.	351	E. Pittsb.	612	0.0165 k.b.	1	200.00	232.77
" 50 kva., 3 ph., 60 cyc., 480 v., 1200 r.p.m., No. 3G, with bedplate; pulley 15x12-2⅜; set of rails; complete, 2630 lb.	"	"	"	" "	"	1,168.00	1,220.32
Motors (all are 3 phase, 60 cycles):							
1 hp., 110 v., 1700 r.p.m., 3½x2½	351	Pittsb.	"	" "	"	80.00	90.32
3 " 550 v., type AN Bullock, A.C.	5	Milwaukee	"	" "	"	180.00	212.31
5 " No. 6a, 1120 r.p.m.; weight 700 lb.	351	Pittsb.	"	" "	"	200.00	231.00
5 " No. 7a, CCL, 440 v., 850 r.p.m., with plate and pulley	"	"	"	" "	"	294.55	372.00
5 " 440 v., 1150 r.p.m.	5	Milwaukee	"	" "	"	200.00	228.00
5 " square cage, No. AN-10, 680 r.p.m., 690 lb.	"	"	"	" "	"	336.00	373.80
7½ " form 'M' MTC, 1200 r.p.m., 600 lb.	122	New York	"	" "	"	352.00	385.00
7½ " form 'M' MTC, 900 r.p.m., 600 lb.	"	" "	"	" "	"	410.00	445.00
10 " squirrel cage, 860 r.p.m., 11x9, No. A-19, 770 lb.	5	Milwaukee	"	" "	"	354.00	394.00
11 " form 'M,' type ITC, 900 r.p.m., 750 lb.	122	New York	"	" "	"	481.00	535.00
15 " 440 v., 870 r.p.m., type HF, No. 9A; wt. 1530 lb.	351	Pittsbg.	"	" "	"	539.10	664.56
15 " 440 v., 1200 r.p.m., splp. ring type, form M hoist motor; 750 lb., with cont.	122	Schenectady	"	" "	"	443.00	483.00
15 " 440 v., 900 r.p.m., slipring type, form M. hoist motor; 800 lb.	"	"	"	" "	"	491.00	541.00
20 " 440 v., 1200 r.p.m., squirrel cage, form K induct.; pulley 13x11, without compensator; 1170 lb.	"	"	"	" "	"	342.00	410.00
With compensator	"	"	"	" "	"	430.00	505.00
20 " 220 v., 1200 r.p.m., squirrel cage, form K; 1470 lb.; without compensator	"	"	"	" "	"	402.00	482.00
With compensator	"	"	"	" "	"	549.00	635.00
25 " squirrel cage, 440 v., 560 r.p.m., 10x9, AN-20; 2000 lb.	5	Milwaukee	"	" "	"	484.00	585.00
35 " squirrel cage, 440 v., 870 r.p.m, 13x11; type AN-8-20-5½; 2255 lb.	"	"	"	" "	"	612.00	729.00
50 " squirrel cage, 440 v., 860 r.p.m., 13x13; type AN-8-20-7½; 2610 lb.	"	"	"	" "	"	702.00	838.00
50 " CCL induction, 440 v., 850 r.p.m.; type A; 1955 lb.,; without bedplate or pulley.	351	Pittsburgh	"	" "	"	750.00	959.00
50 " 440 v., 860 r.p.m., 3 ph., 60 cyc., No. 12-A, type HF; complete with starter, bedplate, set grid resist.; weight 2411 lb.	"	"	"	" "	"	1,019.68	1,270.38
75 " slip-ring, 580 r.p.m., 19x15; controller and rheostat; No. ANY-12-26; weight 4225 lb.	5	Milwaukee	"	" "	"	1,536.00	1,755.59
75 " squirrel cage, 1165 r.p.m., 15x13; starting compensator; weight 3125 lb., No. AN-6-17.	"	"	"	" "	"	884.00	1,046.00
100 " squirrel cage, 490 r.p.m., 24x17 in.; type A-39; with potential starter; weight 5517 lb.	"	"	"	" "	"	1,590.00	1,876.73
150 " slip-ring, polyph., 1150 r.p.m., 21x17 in.; with controller and rheostat; 6215 lb.	"	"	"	" "	"	1,710.00	2,033.00
Switchboard complete, for 5 squirrel cage motors; 75 hp.; weight 4553 lb.	351	Pittsburgh	"	" "	"	1,600.00	1,973.00
Starter for HF motor, S No. 74885-D.	"	"	"	" "	"	95.00	107.63
Transformer—15 kva., type S, 2400 v., 480-240 v., single ph., 60 cyc., S No. 124367.	"	"	"	" "	"	224.39	268.00
Volt ammeter, Kents, No. 2795.	93	San Fran.	"	" "	"	80.00	98.25
Motor Coils and Core:							
5 hp., starter No. 18774.	5	Milwaukee	"	" "	"	set	40.40	46.48
10 " " M 18658.	"	"	"	" "	"	"	40.40	46.48
25 " " M 17469.	"	"	"	" "	"	"	70.00	83.42
35 " " M 17754.	"	"	"	" "	"	"	70.00	83.42
50 " " M 17457.	"	"	"	" "	"	"	70.00	83.42
75 " " M 17956.	"	"	"	" "	"	"	80.00	97.00
100 " " M 18763.	"	"	"	" "	"	"	80.00	97.00
Coils, primary, for 12-A, 50 hp., HF motor.	351	Pittsburgh	"	" "	"	"	94.60	111.00
Secondary coils for above (216) S No. 74125.	"	"	"	" "	"	"	120.00	135.00
Coils, stator, for 50-kw. generator (36).	5	Milwaukee	"	" "	"	"	200.00	218.00

(For Explosives see Fuse and Caps, and Powder.)

Article.	Purchased from.	F.o.b.	Duties. Frac.	Duties. Amount.	Unit.	F.o.b. cost.*	Delivered cost.*
Farriers' Supplies.							
Farriers' knives IXL	277	St. Louis	685	₱0.055 k.l.	1	₱ 0 60	₱ 0.75
Hoof parers	"	" "	"	" "	"	.....	3.79
Figures and Letters							
Steel, 3/16 in. figures	208	El Paso	"	" "	set	0.88	1.09
" 3 16 " letters	"	" "	"	" "	"	2.62	3.22
Files.							
Files—Band saw, 6-in	277	St. Louis	"	" "	1	0.14	0.16
" Cant saw, 8 "	"	" "	"	" "	"	0.19	0.23
" " " 10 "	"	" "	"	" "	"	0.26	0.31
" Flat bastard, 8-in	"	" "	"	" "	"	0.24	0.29
" " " 10 "	"	" "	"	" "	"	0.28	0.34
" " " 12 "	"	" "	"	" "	"	0.42	0.55
" " " 16 "	"	" "	"	" "	"	0.80	1.00
" " 2nd cut 12 "	"	" "	"	" "	"	0.48	0.60
" " " " 16 "	"	" "	"	" "	"	0.88	1.08
" " smooth 8 "	"	" "	"	" "	"	0.26	0.32
" " " 10 "	"	" "	"	" "	"	0.34	0.41
" " " 12 "	"	" "	"	" "	"	0.48	0.60
" " " 16 "	"	" "	"	" "	"	0.90	1.17
" Hf. Rd. bastard, 10 "	"	" "	"	" "	"	0.30	0.37
" " " " 12 "	"	" "	"	" "	"	0.39	0.50
" " " " 14 "	"	" "	"	" "	"	0.50	0.64
" " " " 16 "	"	" "	"	" "	"	0.67	0.83
" " " 2nd cut, 8 "	170	El Paso	"	" "	"	0.35	0.43
" Mill bastard, 16 "	"	" "	"	" "	"	0.64	0.80
" Rd bastard, 10 "	"	" "	"	" "	"	0.22	0.25
" " 2nd cut, 8 "	"	" "	"	" "	"	0.22	0.25
" " " " 10 "	"	" "	"	" "	"	0.25	0.28
" Sq. bastard, 10 "	"	" "	"	" "	"	0.30	0.34
" " " 12 "	"	" "	"	" "	"	0.52	0.62
" Slim taper, 5 "	"	" "	"	" "	"	0.09	0.11
" " " 6 "	"	" "	"	" "	"	0.13	0.16
" " " 8 "	"	" "	"	" "	"	0.16	0.20
" Wood rasp, ½ Rd., 14-in	277	St. Louis	"	" "	"	0.81	1.11
" Horse rasp, 14-in	"	" "	"	" "	"	0.60	0.80
Filters.							
Filter (stone)—Success, No. 15	138	Chicago	315	0.24 k.b.	"	6.70	16.24
" " Blocks, extras	"	"	"	" "	"	1.80	2.00
Fire Extinguishers.							
Pyrene	313	Phoenix	606	exempt	"	14.00	17.50
(Fittings, listed alphabetically below.)							
Fittings—Pipe:							
Return bends, 1½-in	208	El Paso			"	0.29	0.47
Bibbs, brass hose, No. 892, ¾ in	277	St. Louis	203	0.50 k.l.	"	0.71	1.06
" plain, No. 873, ¾-in	"	" "	"	" "	"	0.88	1.25
Bushings—⅛ x ¼-in.	208	El Paso	235	0.025 k.b.	100	2.10	3.13
" ¼ x ⅜ "	"	" "	"	" "	"	2.40	3.13
" ⅜ x ½ "	"	" "	"	" "	"	2.64	2.88
" ½ x ¾ "	"	" "	"	" "	"	3.32	3.84
" ⅜ x 1 "	"	" "	"	" "	"	4.21	5.31
" ½ x 1 "	"	" "	"	" "	"	4.21	5.31
" ¾ x 1 "	"	" "	"	" "	"	3.92	4.72
" ½ x 1¼ "	"	" "	"	" "	"	4.90	6.49
" 1 x 1¼ "	"	" "	"	" "	"	5.41	7.00
" ¾ x 1½ "	"	" "	"	" "	"	3.28	4.36
" 1 x 1½ "	"	" "	"	" "	"	5.36	7.48
" 1¼ x 1½ "	"	" "	"	" "	"	5.44	7.64
" 1½ x 2 "	"	" "	"	" "	"	9.30	11.45
" 1½ x 2½ "	"	" "	"	" "	"	14.70	20.86
" 2 x 2½ "	"	" "	"	" "	"	14.70	20.98
" 1 x 3 "	63	Los Angeles	"	" "	"	11.68	21.64
" 1¼ x 3 "	"	" "	"	" "	"	21.00	25.00
" 1½ x 3 "	208	El Paso	"	" "	"	21.00	27.00
" 2 x 3 "	63	Los Angeles	"	" "	"	11.68	22.44
" 2½ x 3 "	208	El Paso	"	" "	"	21.00	28.36
" 3 x 4 "	"	" "	"	" "	"	35.00	45.00
" 5 x 6 "	"	" "	"	" "	1	0.70	0.85
" 6 x 8 "	170	" "	"	" "	"	1.83	2.49
" Solid cast iron, 4x12-in	208	" "	"	" "	"	2.90	4.10
" " " " 6x12 "	"	" "	"	" "	"	5.64	10.14
" Brass, cored, 1⅜ x 12 x ½-in	97	" "	254	0.022 k.l.	"	3.83	4.46
" " " 2½ x 12 x 1 "	"	" "	"	" "	"	6.48	7.53
Caps, malleable, 4 in	208	" "	235	0.025 k.b.	"	0.56	0.80
" " 5 "	"	" "	"	" "	"	0.86	1.32
" " 6 "	"	" "	"	" "	"	1.10	1.24
" " ½ "	"	" "	"	" "	"	0.20	0.24
" " 1 "	"	" "	"	" "	"	0.22	0.26
" " 2 "	"	" "	"	" "	"	0.25	0.35
" " 3 "	"	" "	"	" "	"	0.30	0.40
Couplings, ¼-in	"	" "	"	" "	"	0.03	0.05
" ½ "	"	" "	"	" "	"	0.05	0.07
" 1 "	"	" "	"	" "	"	0.09	0.13
" 2 "	"	" "	"	" "	"	0.20	0.23
Crosses, flanged, 2-in	63	Los Angeles	"	" "	"	0.80	1.02
" " 3 "	"	" "	"	" "	"	2.30	3.10
" " No. 537, 4-in	"	" "	"	" "	"	7.90	13.83
" " " " 8 "	"	" "	"	" "	"	19.00	41.48
Elbows, ½-in	63	Chicago	"	" "	100	5.56	8.84

Article	Purchased from	F.o.b.	Duties — Frac	Duties — Amount	Duties — Unit	Pre-b cost *	Delivered cost *
Fittings—Pipe							
Elbows, 1 in	208	El Paso	235	P0.025	k.b.	100	P 9.12	P 12.64
" 1½ "	63	Chicago	"	"	"	"	14.00	20.00
" 2 "	208	El Paso	"	"	"	"	24.00	34.08
" 3 "	170	" "	"	"	"	"	84.10	117.20
" 4 "	"	" "	"	"	"	1	0.86	1.47
" 5 "	208	" "	"	"	"	"	1.14	2.21
" 6 "	"	" "	"	"	"	"	1.96	3.10
" 45°, 2 in	63	Los Angeles	"	"	"	"	0.29	0.42
" " 3 "	"	" "	"	"	"	"	0.55	0.80
" Street, ¾ in	167	Salt Lake	"	"	"	"	0.16	0.25
" Longsweep, flanged end, reducing 6 in. to 4 in	63	Chicago	"	"	"	"	12.20	16.51
" Longsweep, 4-in	"	"	"	"	"	"	4.20	8.17
" Flanged, No. 525, and drilled, 4 in	"	"	"	"	"	"	0.95	3.41
" " " " " " 8 "	"	"	"	"	"	"	9.90	19.16
" Not drilled, 8-in	"	"	"	"	"	"	8.60	16.21
" Screwed, 8-in	"	"	"	"	"	"	3.65	7.54
Expansion ring, 2½-in. hose	208	El Paso	"	"	"	"	0.24	0.31
Flanges, 1x13½-in	63	Chicago	"	"	"	"	3.50	4.09
" 1x15 " FD	"	"	"	"	"	"	7.00	10.31
" 3x 7½ "	"	"	"	"	"	"	1.50	2.25
" 4x 9 "	"	"	"	"	"	"	1.64	2.41
" 3x15 "	"	"	"	"	"	"	7.00	11.96
" 4x15 " comp'n	"	"	"	"	"	"	4.50	5.99
" 8x13 " "	"	"	"	"	"	"	2.47	3.09
" 8-in. radius, circ	"	"	"	"	"	"	6.30	8.78
" 8 " blind	208	El Paso	"	"	"	"	13.25	18.90
" 9x15-in	63	Chicago	"	"	"	"	2.47	3.09
Hose clamps, brass, 1 in	97	El Paso	257	0.12	k.l.	"	0.12	0.14
Nipples, ⅛x1 in	170	" "	235	0.025	k.b.	100	1.76	2.04
" ⅛x1½ "	"	" "	"	"	"	"	1.80	2.08
" ⅛x2 "	"	" "	"	"	"	"	2.72	3.02
" ¼x1 "	"	" "	"	"	"	"	1.80	2.10
" ¼x2 "	"	" "	"	"	"	"	2.72	3.14
" ¼x3 "	"	" "	"	"	"	"	2.72	3.18
" ½x1 "	"	" "	"	"	"	"	2.56	3.76
" ½x2 "	"	" "	"	"	"	"	3.16	4.62
" ½x3 "	"	" "	"	"	"	"	3.26	4.83
" ½x4 "	"	" "	"	"	"	"	3.60	5.12
" ½x5 "	"	" "	"	"	"	"	4.48	6.00
" ¾x1½ "	"	" "	"	"	"	"	2.51	3.60
" ¾x2 "	"	" "	"	"	"	"	2.72	3.68
" ¾x3 "	"	" "	"	"	"	"	4.04	5.10
" ¾x4 "	"	" "	"	"	"	"	3.76	5.52
" ¾x5 "	"	" "	"	"	"	"	4.96	7.26
" 1 x1½ "	"	" "	"	"	"	"	1.80	4.84
" 1 x2 "	"	" "	"	"	"	"	1.85	5.24
" 1 x3 "	"	" "	"	"	"	"	5.84	8.20
" 1 x4 "	"	" "	"	"	"	"	5.94	8.68
" 1¼x2 "	"	" "	"	"	"	"	4.64	6.56
" 1¼x3 "	"	" "	"	"	"	"	7.00	9.00
" 1x4 "	"	" "	"	"	"	"	7.68	9.72
" 1¼x5 "	"	" "	"	"	"	"	8.40	11.40
" 1¼x6 "	"	" "	"	"	"	"	10.00	14.50
" 2 x2 "	"	" "	"	"	"	"	7.60	10.73
" 2 x3 "	"	" "	"	"	"	"	10.12	15.80
" 2 x4 "	"	" "	"	"	"	"	11.12	16.90
" 2 x5 "	"	" "	"	"	"	"	13.47	18.93
Plugs, ¼-in	"	" "	"	"	"	"	1.40	2.00
" ½ "	"	" "	"	"	"	"	1.60	2.40
" ¾ "	"	" "	"	"	"	"	2.12	3.00
" 1 "	208	" "	"	"	"	"	3.00	4.00
" 1½ "	"	" "	"	"	"	"	5.00	7.00
" 2 "	"	" "	"	"	"	"	7.00	10.34
" 2½ "	"	" "	"	"	"	"	12.60	18.68
" 3 "	"	" "	"	"	"	"	16.60	24.60
" 4 "	"	" "	"	"	"	"	27.90	41.20
" 5 "	"	" "	"	"	"	1	0.61	1.15
" 6 "	63	Chicago	"	"	"	"	0.84	1.19
" 8 "	"	"	"	"	"	"	1.37	2.06
Reducers—2 to 2½	170	El Paso	"	"	"	"	0.50	0.69
" 4 to 3	63	Los Angeles	"	"	"	"	3.80	6.15
" 8 to 7	"	" "	"	"	"	"	4.86	7.50
Tees— ½-in.	"	" "	"	"	"	100	4.18	6.99
" ¾ "	"	" "	"	"	"	"	7.40	9.82
" 1 "	"	" "	"	"	"	"	10.80	18.64
" 1½ "	208	El Paso	"	"	"	"	20.00	28.00
" 2 "	"	" "	"	"	"	"	34.00	46.00
" 2½ "	"	" "	"	"	"	"	51.00	72.00
" 3 "	"	" "	"	"	"	1	0.99	1.43
" 4 "	63	Los Angeles	"	"	"	"	1.75	3.00
" 5 "	208	El Paso	"	"	"	"	2.16	4.00
" 6 "	"	" "	"	"	"	"	5.79	8.00
" 6 " flanged	63	Chicago	"	"	"	"	14.35	20.86
" 6 " to 3-in. reducing	63	Los Angeles	"	"	"	"	3.31	5.28
" 7 "	"	" "	"	"	"	"	6.20	8.80

Article.	Purchased from.	F.o.b.	Duties. Frac.	Duties. Amount.	Duties.	Unit.	F.o.b. cost.*	Delivered cost.*
Tees—8 in. flanged	63	Chicago	235	₱0.025	k.b.	1	₱14.36	₱21.60
" 8 " screwed	"	"	"	"	"	"	10.46	15.19
Unions, flanged, 1½-in.	97	El Paso	"	"	"	"	0.63	0.80
" " 2 "	63	Los Angeles	"	"	"	"	0.72	1.10
" " 3 "	"	" "	"	"	"	"	1.08	2.02
" " 4 "	"	" "	"	"	"	"	1.51	2.81
" " 6 "	"	" "	"	"	"	"	2.61	4.16
" " 8 "	"	" "	"	"	"	"	3.78	7.42
" malleable, ½ "	208	El Paso	"	"	"	"	0.14	0.18
" " 1 "	63	Los Angeles	"	"	"	"	0.22	0.26
" " 2 "	"	" "	"	"	"	"	0.50	0.62
" " 3 "	"	" "	"	"	"	"	1.40	1.79
Y bends, screwed, 4-in.	63	Chicago	"	"	"	"	4.60	6.80
" " " 8 "	"	"	"	"	"	"	12.15	23.25
Valves, ammonia, ¼-in.	208	El Paso	254	0.22	k.l.	"	8.25	8.71
" " ½ "	"	" "	"	"	"	"	8.75	9.32
" " 1 "	"	" "	"	"	"	"	10.00	11.82
" angle, ½ "	63	Chicago	"	"	"	"	1.00	1.21
" " 4 " standard F. & D.	"	"	253	0.12	k.l.	"	27.90	34.35
" Butterfly, all iron, 2-in.	208	El Paso	254	0.22	k.l.	"	6.00	7.35
" " " " 3 "	"	" "	"	"	"	"	7.92	9.24
" " " " 4 "	63	Los Angeles	253	0.12	k.l.	"	14.80	21.66
" check, Powell special vertical, ½-in.	170	El Paso	254	0.22	k.l.	"	4.80	5.20
" Vertical, ½-in.	208	" "	"	"	"	"	0.88	1.02
" " ⅜ "	"	" "	"	"	"	"	0.68	0.80
" " 1½ "	"	" "	"	"	"	"	3.08	3.80
" " 2 "	"	" "	"	"	"	"	4.67	5.64
" Cocks, all iron (Crane Co.):								
No. 320 ½-in.	63	Chicago	254	0.025	k.l.	"	0.51	0.70
No. 440 SSWay 1 "	"	"	"	"	"	"	1.42	4.02
No. 268 3-WBRS 1 "	"	"	254	0.22	k.l.	"	2.14	4.46
No. 324 All I 2 "	"	"	"	"	"	"	2.40	3.85
No. 324 3 "	"	"	253	0.12	k.l.	"	6.00	10.01
No. 325 F & D 5 "	"	"	"	"	"	"	18.16	33.80
No. 326 3-Way 5 "	"	"	"	"	"	"	16.00	30.00
No. 326 F & D 6 "	"	"	"	"	"	"	22.80	34.84
" Foot and Strainer, 2½-in.	170	El Paso	"	"	"	"	3.30	4.59
" " " " 4 "	"	" "	"	"	"	"	5.84	7.13
" Gate, All Iron:								
Powell-Pilot, ½-in.	"	" "	254	0.22	k.l.	"	1.30	1.60
" " ¾ "	"	" "	"	"	"	"	1.67	2.25
" " 1 "	"	" "	"	"	"	"	2.20	2.79
" " 1½ "	"	" "	"	"	"	"	4.40	5.90
" " 2 "	"	" "	"	"	"	"	6.60	8.54
" " 2½ "	"	" "	"	"	"	"	10.56	17.03
" " 3 "	"	" "	253	0.12	k.l.	"	13.20	20.25
Lunken, Clip, 4 "	208	" "	"	"	"	"	24.00	32.10
Crane Co., 4 "	63	Los Angeles	"	"	"	"	14.45	22.87
" " 6 "	"	" "	"	"	"	"	38.40	52.20
" Std. Brass Gate, ⅜-in.	"	" "	203	0.50	k.l.	"	0.75	0.97
" " " " ½ "	208	El Paso	"	"	"	"	0.85	1.13
" " " " ¾ "	63	Los Angeles	"	"	"	"	1.16	1.65
" " " " 1 "	170	El Paso	"	"	"	"	1.90	2.52
" " " " 1½ "	63	Los Angeles	"	"	"	"	3.50	5.27
" " " " 2 "	"	" "	"	"	"	"	5.25	7.20
" " " " 2½ "	"	" "	"	"	"	"	9.80	13.86
" " " " 3 " (Wt. over 10K)	"	" "	204	0.22	k.l.	"	14.00	23.64
" Special discharge valve, iron	97	El Paso	254	0.12	k.l.	"	150.00	197.78
" Globe, Std. Brass, ⅜-in.	208	" "	203	0.50	k.l.	"	0.60	0.94
" " " " ½ "	"	" "	"	"	"	"	0.80	1.22
" Homestead Air Cocks, 1-in.	143	Homestead	253	0.22	k.l.	"	4.80	7.61
" " " " 2 "	"	"	"	"	"	"	17.50	25.78
" Lubricating, B & C, 1-in.	170	El Paso	"	"	"	"	10.00	13.71
" Needle (See Ammonia Valve).								
Fuse—Bennet's Crown	17	Yzabal	644	0.033	k.b.	case	43.36	44.94
" Comet, Solid Core	137	San Fran.	"	"	"	"	31.80	42.00
" German Gutta Percha	209	Yzabal	"	"	"	"	44.00	45.70
" National, No. 6, 3 tape (single case lots)	170	Denver	"	"	"	"	52.00	80.14
" Rexall Gutta Percha	231	San Fran.	"	"	"	"	31.80	42.94
" Victor Gutta Percha	137	" "	"	"	"	"	36.00	46.16
Caps—3x Blasting	209	Yzabal				5000	40.00	40.87
" 6x "	"	"				"	50.00	50.85
Gaskets, C. I.—4x 6¾-in.	63	Chicago				1	0.14	0.15
" " 6x 8 "	"	"				"	0.56	0.63
" " 8x11 "	"	"				"	0.70	0.77
" " 9x12 "	"	"				"	0.80	0.92
Gages—Ammonia 5-in. ¼-in.	208	El Paso	612	0.0165	k.b.	"	15.00	15.95
" Boiler, No. 626 Crane	63	Chicago	"	"	"	"	1.72	2.39
" Bristol Recording, No. 9351-1000	32	Waterbury	"	"	"	"	56.50	64.43
" 0-60 lb. pressure, 5-in., Crane Co., No. 40	63	Los Angeles	"	"	"	"	2.70	3.32
" 0-200 pressure, 6-in.	"	" "	"	"	"	"	12.80	15.67
" Oil Gage, Fig. 802	170	El Paso	"	"	"	"	1.26	1.54
" Vacuum, 0-30, 2-in.								
Gage Glasses—½-in., No. 16	208	" "	"	"	"	"	0.12	0.15
" " Scotch, 1-in., No. 12	"	" "	"	"	"	"	0.55	0.64

Article	Purchased from.	F.o.b.	Duties Per.	Duties Amount.	Duties Unit	Unit	F.o.b. cost *	Delivered cost *
Gears—Bevel, solid iron, 1-in. P. 14 T. 4.49 Pd., 2¾-in. F. 1 15/16-in. B. standard keyseat	81	Mishawaka	612	$0.0165	k.b.	1	$11.06	$15.07
" 1-in. P. 35 T. 11.16 in. Pd., 2½-in. F. 1 15/16-in. B. standard keyseat	"	"	"	"	"	"	5.52	7.52
Glass—Window, SS 10x12	250	Los Angeles	711	0.07	k.b.	pane	0.14	0.25
" " " 10x16	"	" "	"	"	"	"	0.20	0.27
" " " 12x14	"	"	"	"	"	"	0.20	0.37
" " " 24x27	98	El Paso	"	"	"	"	0.70	4.44
" " DS 32x27	"	" "	"	"	"	"	6.60	14.53
" Skylight, wire inserted, ¼-in. thick, 10x48-in.	250	Los Angeles	"	"	"	"	1.27	2.24
Glue—Dry, bone-flake	277	St. Louis	17	0.05	k.b.	1 lb.	0.20	0.30
" Le Page's, pint cans	170	El Paso	684	0.50	k.l.	can	0.90	1.21
Graphite—Dixon's Flake 633	80	Jersey City	647	0.06	k.b.	100 lb	34.20	50.25
Grindstones 22x2½	97	El Paso	685	0.055	k.l.	1	4.00	5.74
" 36x3	"	" "	"	"	"	"	16.14	33.40
" 36x4½	"	" "	"	"	"	"	30.00	51.07
Grease (See Oils and Grease).								
Grease Cups—Powell, Bear No. 0	170	" "	612	0.0165	k.b.	"	1.35	1.43
" " " " No. 1	"	" "	"	"	"	"	1.45	1.64
" " " " No. 2	"	" "	"	"	"	"	1.50	1.91
" " " " No. 3	"	" "	"	"	"	"	3.00	4.01
" " Empress, ½-in.	208	" "	"	"	"	"	0.33	0.42
" " " ¼ "	"	" "	"	"	"	"	0.22	0.38
Hammers—Blacksmith, 16-lb.	"	" "	685	0.055	k.l.	"	2.16	3.53
" " 18 "	"	" "	"	"	"	"	2.43	3.95
" Carpenter, Nail	277	St. Louis	"	"	"	"	0.66	0.84
" Drilling, 4-lb.	170	El Paso	"	"	"	"	0.79	1.12
" " 8 "	277	St. Louis	"	"	"	"	0.80	1.26
" Farriers, K411	"	" "	"	"	"	"	0.87	1.11
" Machinist's, Ball P, 1¾-lb.	"	" "	"	"	"	"	0.83	1.03
" Prospecting 10-lb.	"	" "	"	"	"	"	1.00	1.42
" Sorting, 1¾-lb.	"	" "	"	"	"	"	0.83	1.03
" Swage, ⅞-in.	208	El Paso	"	"	"	"	3.24	4.04
Handles—Axe, 36-in.	303	Hope	152	0.06	k.b.	"	0.16	0.30
" Cant Hook	208	El Paso	"	"	"	"	0.54	0.85
" Hammer, 18-in.	303	Hope	"	"	"	"	0.076	0.16
" Hammer, 36-in.	"	"	"	"	"	"	0.18	0.35
" Pick, R.R., 36-in.	"	"	"	"	"	"	0.19	0.36
" Pick, Drift, 34-in.	"	"	"	"	"	"	0.19	0.36
Hanger, Barn Door—No. 2 Relia	170	El Paso	685	0.055	k.l.	1 pair	2.00	4.03
Track for above	"	" "	"	"	"	ft.	0.18	0.36
Harness—Bridle, Team, No. 17	277	St. Louis	59	2.00	k.l.	1	2.17	5.00
" Cinches, No. 319, 5 strand	170	El Paso	664	0.75	k.l.	"	0.30	0.58
" Chains, Trace, 6-8-2	277	St. Louis	254	0.22	k.l.	pair	0.74	1.82
" Collars, Mule, 15-in., No. 88	"	" "	59	2.00	k.l.	1	3.13	9.19
" " " 19-in., No. 605	170	El Paso	"	"	"	"	3.76	9.94
" Hames, Concord, No. 8501	277	St. Louis	153	0.15	k.l.	pair	2.00	3.35
" " Wood, No. 1 and 2	170	El Paso	"	"	"	"	0.71	1.28
" Packsaddles, Burro	"	" "	"	"	"	1	2.40	3.50
" Pads, Sweat, No. 141 N.	"	" "	667	0.80	k.l.	"	0.54	1.60
Hatchets—Cactus Claw No. 2	"	" "	685	0.055	k.l.	"	1.00	1.27
Hoists—Anaconda, complete with piping, etc.	135	Denver	612	0.0165	k.b.	"	.....	383.44
" Belted Friction, Fig. 6, 1865 lb.	86	"	"	"	"	..	299.20	396.00
" General Electric Co., No. 424; single friction drum; 12-in. dia.; 15-in. face; capacity, 1000 lb.; rope speed, 150 ft. per minute; bed plate 43½x34; weight, 1600 lb.	122	New York	"	"	"	..	755.00	920.00
" General Electric Co., No. 425; single friction drum; 12-in. dia.; 15-in. face; capacity, 1000 lb.; rope speed, 250 ft. per minute; bed plate, 45x34; wt., 2100 lb.	"	" "	"	"	"	..	825.00	1,010.00
" Ottumwa, single drum, double cylinder, complete; 4526 lb.	208	El Paso	"	"	"	1	1,002.00	1,233.28
" Vulcan No. 0; steel frame; single drum; electric; rope pull, 1200 lb. at 200 ft. p.m.; with 7½-hp., 3-ph., 440-v., 60-cyc., 1080 r.p.m., Fort Worth motor	135	Denver	"	"	"	"	918.00	1,065.33
Hooks—Cant, No. 4	277	St. Louis	685	0.055	k.l.	"	1.75	2.46
Hose—Air, Delhi, ½-in., 4-ply, with marlin cover	200	Passaic	661	0.12	k.l.	100 ft.	42.60	51.68
" " ¾-in., 5-ply	78	Akron	"	"	"	" "	62.62	74.48
" " 1-in., 5-ply	"	"	"	"	"	" "	77.04	88.88
" Mill, Fire, 2½-in. Python, CP	"	"	"	"	"	" "	80.00	91.45
" Suction, Harlem, 2 in. x 10 ft.	208	El Paso	"	"	"	length	14.30	20.02
" " " 2½ in. x 12 ft.	"	" "	"	"	"	"	30.36	42.41
" Water, Delhi, ¾-in., 2-ply	200	Passaic	"	"	"	100 ft.	16.20	20.51
" " " 1 " 2 "	"	"	"	"	"	" "	21.39	27.86
" " " 1¼ " 2 "	"	"	"	"	"	" "	27.22	34.32
" " " 1½ " 2 "	"	"	"	"	"	" "	32.40	41.90
" " Mulconroy, wire bound, 2½-in., 4-ply	349	Philadelphia	"	"	"	1 ft.	3.25	3.72
" " Delhi, 2-in., 3-ply	200	Passaic	"	"	"	100 ft.	53.20	62.74
" Garden, Ridgewood, ¾-in., 3-ply	170	El Paso	"	"	"	" "	26.00	32.91
" Sphinx, ¾-in., 3-ply	78	Akron	"	"	"	" "	16.20	27.60
I Beam—6-in.	97	El Paso	251	0.05	k.b.	100 ft.	84.12	140.48
Ice Plant—Complete; ½-ton capacity; weight, 8134 lb.	203	St. Louis	612	0.0165	k.b.	1	1,400.00	2,351.76
Tongs	97	El Paso	"	"	"	pair	1.50	1.87

Article.	Purchased from.	F.o.b.	Duties. Frac.	Duties. Amount.		Unit.	F.o.b. cost.*	Delivered cost.*
Iron and Steel:								
Iron—Bar Z, 3-in.	97	El Paso	251	P0 05	k.b.	1 lb.	P 0.08	P 0.13
" Angle, 3/16x1¼x1¼	"	" "	241	0.06	k.b.	" "	0.058	0.12
" " 1¼x1½x1½	"	" "	"	"	"	" "	0.055	0.12
" " 5/16x2 x2	"	" "	"	"	"	" "	0.05	0.11
" Flat, all sizes	"	" "	"	"	"	" "	0.05	0.11
" Round, ¼-in.	"	" "	"	"	"	" "	0.055	0.12
" " ½ to 1-in.	"	" "	"	"	"	" "	0.048	0.10
" Square, all sizes	"	" "	"	"	"	" "	0.045	0.09
" Sheet, No. 16 gage	"	" "	243	0.066	k.b.	" "	0.058	0.14
" " No. 18 "	"	" "	"	"	"	" "	0.066	0.15
" " No. 20 "	"	" "	"	"	"	" "	0.068	0.15
" " No. 24 "	"	" "	"	"	"	" "	0.07	0.16
Steel—Sheet, No. 3 gage	"	" "	"	"	"	" "	0.055	0.11
" " No. 7, 8, 10	"	" "	"	"	"	" "	0.057	0.12
" " No. 16	"	" "	"	"	"	" "	0.064	0.13
" Shafting, cold rolled, 7/16-in.	"	" "	241	0.06	k.b.	" "	0.105	0.16
" Spring, 3/16x1-in.	"	" "	"	"	"	" "	0.12	0.18
" Tool, common, 1½-in.	"	" "	"	"	"	" "	0.18	0.29
" " Rex A, 7/16-in.	"	" "	"	"	"	" "	1.30	1.60
" " Rex AA	"	" "	"	"	"	" "	1.50	1.80
" Drill (See Steel).								
Jacks—Car Screw, ½x14-in.	138	Chicago	612	0.0165	k.b.	1	3.50	6.00
" " " 1¾x14 "	"	"	"	"	"	"	3.90	6.75
" Claw type, hydraulic, 12-in., 10-ton	208	El Paso	"	"	"	"	117.68	124.97
Keyseater—Shaft, No. 2 Fairbanks	110	New York	685	0.055	k.l.	"	150.00	176.76
Lamps—Carbide, Baldwin No. 34, in lots of 500 (without extra containers)	208	El Paso	695	exempt		"	1.50	1.57
" Baldwin, No. 36, Supt's	"	" "	"	"		"	3.00	3.30
Burners for above	"	" "	"	"		gross	4.50	4.80
Gaskets for above	"	" "	"	"		1000	62.00	66.88
" Electric (See Elec. Supplies).								
" Justrite Carbide No. 85, in gross lots, without extra containers	164	Chicago	"	"		1	1.25	1.35
" Justrite, Supt's No. 95	"	"	"	"		"	2.25	2.40
" Ever-ready, Miners'	145	Cincinnati	"	"		"	1.50	1.75
Lanterns—Oil	277	St. Louis				"	0.55	0.82
Lead—Pig	208	El Paso	224	0.06	k b.	1 lb.	0.15	0.20
" Sheet	"	" "	"	"	"	" "	0.22	0.33
Lime—Native, delivered to mill						ton	....	31.00
Locks—Keen Kutter, No. k100	277	St. Louis	203	0.50	k.l.	1	0.67	0.82
" Miller Padlock No. 99	170	El Paso	"	"	"	"	0.69	0.84
" " " No. 899	"	" "	"	"	"	"	0.83	0.96
" Rim knob locks	277	St. Louis	"	"	"	"	0.45	0.72
" Yale Night Latch No. 42	"	" "	"	"	"	"	2.50	2.86
" " " " No. 90	"	" "	"	"	"	"	4.40	5.75
" " Padlock No. 8005	170	El Paso	"	"	"	"	1.09	1.51
" " " No. 805½	"	" "	"	"	"	"	1.20	1.65
" Miller Keyless	296	Pasadena	"	"	"	"	2.50	2.90
Lumber—Matched Oak Flooring	84	Douglas	147	0.001	k.b.	1000 ft.	140.00	200.00
" Native, delivered						" "	....	56.00
" Lagging, Rd., Oak						1 ft.	....	0.09
" " " Pine						" "	....	0.06
" " Split						" "	....	0.12
" Shingles (shakes)						1	....	0.02
" Stulls, 10-in. small end						1 ft.	....	0.11 to 0.25
" Ties						1	....	0.10
(Milling Machinery listed below in accordance with Tigre Mill flow-sheet.)								
Ore Bins—Steel, knocked down; 15x30 ft.; with rivets; total weight, 24,090 lb.	97	El Paso	612	0.0165	k.b.	"	1,820.00	2,695.65
Weighing Machines:								
Avery Automatic, No. 48; 100 lb. sand tailing per discharge of 4 tons per hour; 950 lb.	16	Milwaukee	"	"	"	"	460.00	530.00
Blake-Dennison Automatic; continuous; for 14-in. conveyor belt; 40 tons per hour maximum capacity; 2430 lb.	334	New York	"	"	"	"	2,450.00	2,648.00
Sampling Machinery:								
Hopper, 48-in. discharge, and distributer; 3498 lb.	97	El Paso	"	"	"	"	620.00	826.19
Scobey Tailing Sampler; 167 lb.	208	Denver	"	"	"	"	72.00	82.90
Snyder Automatic; 27-in. sampler, for 10% of 17 tons per day; ½-in.	5	Milwaukee	"	"	"	"	102.00	135.14
Rolls—Cananea type	"	"	"	"	"	"	....	2,591.78
Adjustable bearings	"	"	"	"	"	"	....	80.04
Adjusting collar	"	"	"	"	"	"	....	28.71
Shaft	"	"	"	"	"	"	....	405.48
Shells, chrome, 36x16; 1452 lb. each	51	Chrome	"	"	"	"	172.21	233.66
Tension rod, 4 in. x 8½ ft.	5	Milwaukee	"	"	"	"	....	86.32
Huntington Mills:								
5-ft. mill, complete; 15,000 lb.	97	El Paso	"	"	"	"	1,330.00	1,774.29
Screen, 10x30½; 1-mm. Rd.; No. 26 steel, 3/32-in. c.c., 1-in.	145	Chicago	"	"	"	"	0.65	0.74
Screen, 10x30½; ¾-mm. Rd.; No. 26 steel, 3/32-in. c. c., 1-in.	"	"	"	"	"	"	1.31	1.42

Article	Purchased from.	F.o.b.	Duties — Frac.	Duties — Amount.	Unit.	F.o.b. cost.*	Delivered cost.*
Huntington Mills							
Screen, 30x76, 2-mm Rd; No. 16 steel, 5/32-in. C No. 2, 1-in., rolled to 48x120	145	Chicago	612	P0.0165	k.b. 1	P 4.57	P 6.23
Muller centres; 155 lb.	97	El Paso	"	"	" "	15.00	21.78
" shoes; 42 lb.	"	" "	"	"	" "	11.00	12.82
" yokes; 76 lb.	"	" "	"	"	" "	10.00	13.36
Oil recess covers; 17 lb.	"	" "	"	"	" "	2.00	2.78
Ring dies, chrome; 766 lb., carload	51	Chrome	"	"	" "	79.12	107.65
Roller shells—Chrome, 154 lb. each, carload	"	"	"	"	" "	19.16	25.74
" " Midvale; 157 lb. each; less than carload	207	Chile	"	"	" "	15.30	23.38
Grinding Pan, 5-ft., complete with wooden frame, extended launder, single drive pulley; 7712 lb.	57	Denver	"	"	" "	1,100.00	1,636.10
Muller for above; 820 lb.	"	"	"	"	" "	150.00	187.14
Set of parts, 16 shoes and 16 dies; 130 lb. each	"	"	"	"	" "	10.30	17.50
Crushers:							
Austin crusher	15	Chicago	"	"	" "	....	825.95
Bevel gear for above	97	El Paso	"	"	" "	45.00	57.67
Concaves	15	Chicago	"	"	" "	6.98	9.10
Head; 460 lb.	"	"	"	"	" "	176.80	230.79
Spider, 2-armed, 4-hole; 1095 lb.	"	"	"	"	" "	110.90	203.40
Pinions for gears	97	El Paso	"	"	" "	7.00	14.52
Dodge crusher, 7x10-in.; 6314 lb.	"	" "	"	"	" "	470.00	694.70
Gates, Gyratory, No. 4 "K" No. 6584; 21,875 lb.	5	Milwaukee	"	"	" "	2,822.00	3,762.00
Head for above; 4554 lb.	"	"	"	"	" "	290.40	321.37
Sturtevant, 2x6-in. roll jaw, laboratory, ¼-in. and under.	293	Boston	"	"	" "	126.00	158.00
Revolving Ore Feeder; 1525 lb.	97	El Paso	"	"	" "	259.50	329.87
Conveying Machinery for 12-in., 14-in., and 32-in. belts; total weight, 13,200 lb.	254	New York	"	"	" "	2,270.00	3,458.60
Brush outfit for 14-in.	"	" "	"	"	" "	80.00	107.00
" " " 32 "	"	" "	"	"	" "	120.00	158.00
Sand conveyors, A & B, complete; 10,670 lb.	343	Kansas City	"	"	" "	2,800.00	3,790.00
Spiral ribbon conveyor, 47 ft. long 12 in. lb. complete; 4270 lb.	"	" "	"	"	" "	534.00	815.65
Batteries—Ironwork complete for 20 stamps (2 batteries), 1200-lb. stamps, with special mortars, cast in halves and 20 each extra shoes and dies; 4 suspended Simplex ore feeders; 4 rack and pinion ore-bin gates; 2 sliding battery belt tighteners; 6 c.i. battery post shoes; total weight, 100,060 lb.	5	Milwaukee	"	"	" all	10,640.00	16,054.72
Challenge Ore Feeders, complete	"	"	"	"	" 1	180.00	238.00
Pinions for above	"	"	"	"	" "	4.00	6.68
Bossheads, 9x20; 275 lb. each	"	"	"	"	" "	26.00	43.36
Cams, 6½-in.; 207 lb. each	"	"	"	"	" "	36.50	49.59
Camshaft, 6¼ in. x 15 ft. 9 in. long; 1730 lb.	"	"	"	"	" "	230.00	341.18
Camshaft box; 250 lb.	97	El Paso	"	"	" "	40.00	51.00
Dies—Chrome; 173 lb., carload	51	Chrome	"	"	" "	13.58	21.50
" El P. F. & M. Co.; 167 lb., less than carload	97	El Paso	"	"	" "	9.16	23.11
Liners; 42 lb.	"	" "	"	"	" "	2.54	4.84
Plates for liners, 4 to set; 367 lb.	"	" "	"	"	" set	22.04	36.10
Shoes—Chrome; 186 lb., carload	51	Chrome	"	"	" 1	14.61	25.11
" E. P. & S. M. Co.; 190 lb., less than carload	97	El Paso	"	"	" "	10.40	28.26
Screens—RekTang No. 205	189	St. Louis	253	0.12	k.l. sq. ft.	0.64	0.74
" " No. 40	"	" "	"	"	" " "	0.64	0.74
" " No. 51-52	"	" "	"	"	" " "	0.64	0.74
" No. 16 wire, 4 mesh	"	" "	"	"	" " "	0.21	0.34
" No. 18 " 4 "	"	" "	"	"	" " "	0.16	0.30
" No. 20 " 4 "	"	" "	"	"	" " "	0.12	0.25
" No. 20 " 10 " 36-in. wide, 0.035-in. D	"	" "	"	"	" " "	0.30	0.41
" No. 19 " 0.04-in.	"	" "	"	"	" " "	0.36	0.46
Stems, 3¾ in. x 14 ft.; 520 lb. each	5	Milwaukee	612	0.0165	k.b. 1	44.00	76.00
Split collar for cam shaft; 85 lb.	97	El Paso	"	"	" "	13.00	17.70
Tappets, 3 25/32-in. b.; 165 lb.	5	Milwaukee	"	"	" "	35.00	45.85
Wood battery pulley, 6 ft. x 19 in., 36-in. flange; 1480 lb.	"	"	"	"	" "	275.00	391.70
Wedges, with pins	"	"	"	"	" "	4.50	9.60
Hardinge Mill, 8 ft. x 22 in.; includes charge of P250 for drilling, nuts, bolts, and washers; weight, 11,623 lb.	132	New York	"	"	" "	4,250.00	4,978.61
Gear for above; 1840 lb.	"	" "	"	"	" "	270.00	405.00
Liners, hard iron, 4566 lb.; ribb. steel, 3600 lb. = 8166 lb.	"	" "	"	"	" set	800.00	1,125.00
" manganese steel; 10,449 lb.	92	Chicago	"	"	" "	1,842.00	2,540.00
Scoop feeder; 176 lb.	132	New York	"	"	" 1	32.00	48.00
Chain drive for Hardinge. Maximum "Silent"; 1208 lb.	185	Philadelphia	"	"	" "	506.00	608.67
120 pins, 240 bushings, and 250 leaf links for above	"	"	"	"	" "	65.60	73.63
Concentrating Tables:							
Wilfley No. 6; steel frame; 3540 lb.	308	Denver	"	"	" "	950.00	1,078.00
Parts for above as follows:							
No. 2 Thrust bars	"	"	"	"	" "	10.50	13.08
3 Eccentric shafts	"	"	"	"	" "	19.80	21.97
5 Pitmans	"	"	"	"	" "	7.00	7.62
6 Pitman caps	"	"	"	"	" "	1.00	2.03
8 Stroke adj. blocks	"	"	"	"	" "	2.20	2.76
16 Stroke adj. wheels	"	"	"	"	" "	1.70	1.98
25 Adjusting pinions	"	"	"	"	" "	1.00	1.64
43 Thimble	"	"	"	"	" "	1.10	1.32
44 Dies	"	"	"	"	" "	1.10	1.32
47 Loose pulley	"	"	"	"	" "	5.50	8.06
49 Coil springs	"	"	"	"	" "	5.00	6.57
Brass slippers	"	"	"	"	" "	4.00	4.28

Article.	Purchased from.	F.o.b.	Duties. Frac.	Duties. Amount.	Unit.	F.o.b. cost.*	Delivered cost.*
Concentrating Tables:							
Deister No. 3, LH, 1911 lb. each	74	Ft. Wayne	612	₱0.0165	k.b. 1	₱816.66	₱858.84
Parts for above as follows:							
No. 1-A Rocking end support	"	" "	"	"	" "	8.50	9.40
2 Roll brass bushings	"	" "	"	"	" "	9.60	11.40
4-a Ball-socket bearing	"	" "	"	"	" "	1.00	1.10
10 Yokes	"	" "	"	"	" "	7.20	8.09
11-a Wedges	"	" "	"	"	" "	1.80	2.09
13 Rocker arms shaft	"	" "	"	"	" "	2.40	2.80
13-a Wedge sockets	"	" "	"	"	" "	1.20	1.60
14-a Bases for wedges	"	" "	"	"	" "	12.00	14.17
20-a Spring seat	"	" "	"	"	" "	8.40	9.40
24 Oil guard	"	" "	"	"	" "	10.20	11.49
26-a Collar for hand wheel	"	" "	"	"	" "	1.20	1.44
Adjustable eccentric	"	" "	"	"	" "	24.00	28.38
Adjustable plates for crank-pin boxes	"	" "	"	"	" "	2.40	2.84
Bearings, 7-in.	"	" "	"	"	" "	4.60	5.44
Bearings, 7-in. brass bushings	"	" "	"	"	" "	7.80	9.23
Box cranks	"	" "	"	"	" "	14.40	17.02
Eccentric shafts and rollers	"	" "	"	"	" "	36.00	42.56
Fly-wheel crank-pin boxes	"	" "	"	"	" "	4.20	4.96
Fly-wheel with brass bushings	"	" "	"	"	" "	39.40	46.59
Loose pulleys	"	" "	"	"	" "	8.40	9.92
Rocker arms	"	" "	"	"	" "	15.60	18.44
Stroke adj. hand pieces	"	" "	"	"	" "	3.30	3.90
Yokes	"	" "	"	"	" "	5.20	6.30
Yoke crosshead brasses	"	" "	"	"	" "	6.60	7.80
Grinding Pan (See after Huntington Mills).							
Classifiers, Drag, Continuous, 42-in.; weight 3400 lb.	256	Nogales	"	"	" "	570.00	721.73
Vortex spigot for above	97	El Paso	"	"	" "	17.33	21.40
Sprocket wheels, 14 T, 4-in. P, D 18 in., 1 15/16 b.	185	Philadelphia	"	"	" "	9.90	14.85
Tube Mills, 5x14 ft.; 29,631 lb.	248	Cudahy	"	"	" "	2,486.00	3,967.05
Backing plates, 86 to set	97	El Paso	"	"	" set	117.26	194.93
Bed plate for bearings					" "	32.00	65.00
Discharge head; 2710 lb.	248	Cudahy	"	"	" 1	232.00	461.60
End refitting rings; 63 lb. each	97	El Paso	"	"	" "	3.80	7.00
Flexible link motor coupling drive	"	" "	"	"	" "	240.00	273.50
Gear, semi-steel, 89 T, 3½-in. P, 11-in. f.; 3830 lb.	248	Cudahy	"	"	" "	330.00	617.61
Liners, manganese steel, 86 to set, Forbes type; 10,990 lb.	"	"	"	"	" set	1,472.66	2,170 80
Long shafts; 485 lb.	97	El Paso	"	"	" 1	38.00	47.00
Pinions, spur, 17 T, 6-in. F., 3 15/16-in. bore, cast steel.	248	Cudahy	"	"	" "	45.00	49.71
Pinions, spur, 15 T, 11-in. F., 4 71/16-in. bore, semi-steel.	"	"	"	"	" "	45.00	53.16
Short shafts; 235 lb.	97	El Paso	"	"	" "	77.18	95.18
Elevators, 4 complete sets of bucket elevator shafting, pulleys, and gears; 12,530 lb	40	Chicago	"	"	" "	1,520.00	2,425.77
Buckets, 6x14, 16 gal.	290	St. Louis	"	"	" "	0.33	0.50
" 10x 6, 15 mal. iron	97	El Paso	"	"	" "	1.50	1.76
" 16x 8, 6½	"	" "	"	"	" "	3.16	4.00
Tanks:							
Agitating Storage Tank	146	Warren					
Agitating Storage Tank, 30x12 ft.; 17,870 lb.	240	San Fran.	"	"	" "	902.00	1,824.00
Air Agitation Tank, steel, 40 ft. tall x 15 ft.	146	Warren	"	"	" "	1,760.00	3,672.00
Agitating Storage Tank, 20x10 ft., steel	"	"	"	"	" "	604.00	1,303.00
Filter Tank, steel 26x10 ft; 7300 lb.	"	"	"	"	" "	410.00	878.00
Filter Tank, steel, 15x10 ft.	"	"	"	"	" "	231.00	377.20
Slime Thickener Tank, 24x12 ft.; 13,020 lb.	"	"	"	"	" "	788.00	1,510.00
Slime Thickener Tank, 24x12 ft., steel	"	"	"	"	" "	896.66	1,637.00
Slime Thickener Tank, 32x10 ft., steel; 21,140 lb.	97	El Paso	"	"	" "	1,640.00	2,354.26
Solution Tank, 15x10 ft.; 5130 lb.	146	Warren	"	"	" "	308.00	605.00
Solution circulating tank, 15x10 ft.	"	"	"	"	" "	338.00	711.00
Solution Steel Tank, 20x10 ft.	"	"	"	"	" "	495.00	1,024.50
Redwood, conical bottom, 16x10 ft.	240	San Fran.	"	"	" "	488.00	745.00
" SS tank, 24x14 ft., 3-in. redwood, patent nonshrinking; 11,700 lb.	"	" "	"	"	" "	734.00	1,459.46
" 9x8 ft., 2-in. redwood	"	" "	"	"	" "	165.50	248.22
" 10x8 ft., 4000 gal., plain; 1600 lb.	"	" "	"	"	" "	96.00	201.00
" 3-in., 18x5	259	Blk. Diam.	"	"	" "	430.00	751.67
" 3-in., 16x14, 40,000 gal.	"	" "	"	"	" "	792.00	1,391.00
" 2-in., 12x16	"	" "	"	"	" "	264.00	461.18
" 3-in., 16x6, conical; 4495 lb.	240	San Fran.	"	"	" "	470.00	804.04
Coco Matting for tanks	48	New York	392	0.28	sq. mt. sq. yd.	1.08	1.75
Stirring gear and transmission for bottom drive mechanical slime storage tank; 5482 lb.	97	El Paso	612	0.0165	k b. all	990.00	1,236.80
Thickener for Slime Tanks:							
Dorr, for 12X24; 2159 lb.	82	Denver	"	"	" 1	800.00	954.64
Dorr, for 32x10; 3600 lb.	"	"	"	"	" "	1,190.00	1,462.00
Spider, for 32x10 thickener	"	"	"	"	" "	28.60	39.00
Worm Gear for 32x10 thickener	"	"	"	"	" "	95.20	115.28
Filter Plant, Tigre type:							
Bags for above, No. 8 duck, 60-in. wide	9	San Fran.	"	"	" "	21.90	23.57
Filter Plant, Kelly type:							
Parral type; 19,600 lb. each	167	Salt Lake	"	"	" "	6,400.00	7,815.00
Bags for above, 13 to set	"	" "	"	"	" set	240.00	275.90
Bags for above, 13 to set	285	Yzabal	"	"	" "	171.62	181.63
Filter head; 4356 lb.	167	Salt Lake	"	"	" 1	265.00	430.00
Special tees, ¾-in.	"	" "	"	"	" "	0.20	0.25

Article	Purchased from	Duties Frac	Duties Amount	Duties	Unit	F.o.b. cost *	Delivered cost *
Filter Plant, Kelly type:							
Special unions, ¼ in.	167	Salt Lake	612	P0.0165	k.b.	1	P 2.70	P 3.71
Filter, Weidley continuous slime vacuum filter, with 50 sq. ft. filtering surface, complete, including 7½x7-in. vacuum pump of 50 cu. ft. per minute, 150 r.p.m., weight 8440 lb.	31	Yzabal	"	"	"	"	4,545.00	4,675.00
Presses:							
Shriver clarifying press, 500 sq. ft. filtering surface, 48 chambers, 1-in. cakes, Type B, No. 2639, wt. 12,235 lb.	274	Harrison	"	"	"	"	1,200.00	1,230.00
Merrill, 32-in., 30-chamber, precipitation press, complete, 35,820 lb.; includes also one 20-chamber press	205	"	"	"	"	2	16,000.00	18,000.00
Plates for above, 5 with air channel, 5 without, 10 frames, 3 in. thick	"	"	"	"	"	all	1,076.40	1,344.00
Distance piece for above	97	El Paso	"	"	"	1	17.10	21.80
Discharge cocks for above	205	Harrison	"	"	"	"	5.00	8.07
Refining:							
Steele-Harvey furnaces and appurtenances (See under Assaying and Chemical Supplies'- Furnaces).							
Bullion Molds, 2000 oz.	97	El Paso	"	"	"	"	4.62	8.34
Bullion Molds, 2000 oz.	221	Berkeley	"	"	"	"	7.21	14.60
Slag Pot, Tigre model	97	El Paso	"	"	"	"	24.00	34.59
Nails—Clout	277	St. Louis	257	0.12	k.l.	1 lb.	0.16	0.27
" Common, 1-in.	208	El Paso	"	"	"	100 lb.	6.80	16.24
" " 1¼ "	"	"	"	"	"	" "	5.90	15.94
" " 2 "	"	"	"	"	"	" "	5.80	14.80
" " 6 "	"	"	"	"	"	" "	5.40	14.21
" Finishing, 1-in.	"	"	"	"	"	" "	9.30	19.78
" " 2 "	"	"	"	"	"	" "	6.20	16.93
" " 3 "	"	"	"	"	"	" "	5.80	16.33
" Flat-head, wire, ⅝-in.	"	"	"	"	"	" "	17.12	27.56
" Rifle, ⅞-in.	"	"	"	"	"	1 lb.	0.50	0.71
" Nail Set	170	"	"	685	0.055	k.l.	1	0.50	0.77
Needles—Phonograph, Vict.	341	"	"	254	0.22	k.l.	1000	1.20	1.30
" Sail, Smith No. 13	277	St. Louis	"	"	"	"	gross	1.30	1.58
Netting—Poultry, 2-in.; 36 in. wide; 40 lb. to roll	"	"	"	253	0.13	k.l.	roll	9.60	10.25
Nuts—Tapped, ⅜-in.	208	El Paso	"	257	0.12	k.l.	100 lb.	13.50	22.71
" " ½ "	"	"	"	"	"	"	" "	13.80	24.56
" Threaded, hex., ⅜-in.	277	St. Louis	"	"	"	"	" "	19.50	37.80
" " ⅞ "	"	"	"	"	"	"	" "	9.30	27.29
Oakum—Plumber's	208	El Paso	"	88	0.022	k.b.	1 lb.	0.10	0.17
Office Furniture and Equipment:									
Brunsviga Machine	44	Canada					1	....	345.61
Flat-top desk, No. 752	220	Chicago	"	159	0.20	k.l.	"	55.40	107.08
Roll-top desk, No. 710	"	"	"	"	"	"	"	48.18	93.11
Roll-top desk, No. 726½	"	"	"	"	"	"	"	62.14	121.68
Standing desk, No. 790½	"	"	"	"	"	"	"	51.20	99.02
Typewriter desk, No. 828	"	"	"	"	"	"	"	33.20	64.18
Typewriter—Fox No. 24	115	Grand Rap.	"	254	0.22	k.l.	"	157.50	177.84
" Hammond No. 12	131	New York	"	"	"	"	"	153.00	170.95
" S. P. No. 4	220	Chicago	"	"	"	"	"	205.00	224.88
Oils and Greases:									
Ammonia Solution	122	Schenectady	528	0.01	k.b.	gal.	2.00	3.90
Black Oil—Aguila Cont.	54	Yzabal	277	0.09	k.l.	"	0.59	0.71
Black Oil—Waters-P. "	342	"	"	"	"	"	0.49	0.59
Coal Oil	54	"	"	"	"	"	0.65	0.76
Compressor Oil Cont.	342	"	"	"	"	"	0.83	0.93
Engine, Renown, W-P "	"	"	"	"	"	"	0.83	0.93
Gas Oil No. 3, Aguila, cases "	54	"	276	0.033	k.b.	"	0.35	0.45
Gas Oil, Special, Tank, St. O.	286	Los Angeles	"	"	"	"	0.055	0.37
Gas Oil, Tank Car Cont.	342	Yzabal	"	"	"	"	0.18	0.32
Gasoline, Nafta "	"	"	277	0.09	k.l.	"	0.87	0.94
Grease, Belt 10/10 "	"	"	14	0.08	k.b.	1 lb.	0.24	0.26
Grease, Cup No. 3-5 "	"	"	"	"	"	" "	0.152	0.16
Grease, Cog "	"	"	"	"	"	" "	0.135	0.15
Grease, Golden Axle "	"	"	"	"	"	" "	0.145	0.16
Ice Machine Oil "	"	"	277	0.09	k.l.	gal.	0.90	1.02
Lard Oil "	"	"	"	"	"	"	1.10	1.20
Linseed Oil "	208	El Paso	41	0.14	k.b.	"	1.34	1.97
Neatsfoot Oil	170	"	"	"	"	"	1.90	2.83
Red Oil, Atlantic, W-P Cont.	342	Yzabal	277	0.09	k.l.	"	0.65	0.75
Red Oil, Rubi, Aguila "	54	"	"	"	"	"	0.75	0.86
Transil Oil, Lightning Arr.	122	Schenectady	647	0.06	k.b.	"	0.50	1.15
Turpentine	54	Yzabal	140	0.10	k.b.	"	1.80	1.90
Calol, Red Engine	286	Douglas	647	0.06	k.b.	"	0.66	1.00
Gasoline, Red Crown	"	"	"	"	"	"	0.49	0.80
Cresylic Acid	38	Bayway	546	0.03	k.l.	"	1.20	2.10
Pine Oil—No. SD No. 5	127	New York	140	0.10	k.l.	"	0.58	1.18
" " SS No. 6	"	"	"	"	"	"	"	0.52	1.42
Packing:									
Fibrous Sheet	78	San Fran.	677	0.04	k.l.	1 lb.	0.90	0.96
Flax	97	El Paso	"	"	"	" "	0.50	0.57
Garlock's Packing:									
Asbestos board	120	San Fran.	"	"	"	" "	0.15	0.22
No. 2203 Combination coil	"	"	"	"	"	" "	2.80	3.03
110 Extra spiral	"	"	"	"	"	" "	2.20	2.35
53 Flax	"	"	"	"	"	" "	0.80	0.90

Article.	Purchased from.	F.o.b.	Duties Frac.	Duties Amount.	Unit.	F.o.b. cost.*	Delivered cost.*
Garlock's Packing:							
No. 52 Flax graphited	120	San Fran.	677	₱0.04	k.l.	1 lb.	₱ 0.70	₱ 0.82
273 Hydraulic coil	"	" "	"	"	"	" "	2.80	3.03
Hyd. white fric.	"	" "	"	"	"	" "	1.20	1.31
35 Lake Brand Flax	"	" "	"	"	"	" "	0.50	0.61
262 Special Hyd. Coil	"	" "	"	"	"	" "	2.00	2.27
90 W. P. H. coil	"	" "	"	"	"	" "	2.00	2.27
Plumbago, Manhatt.	97	El Paso	"	"	"	" "	1.10	1.20
Sheet Packing:								
Elbon Superheat	78	San Fran.	688	0.10	k.l.	" "	1.20	1.34
Rainbow Rubber	208	El Paso	"	"	"	" "	1.09	1.25
Red, Indian	78	San Fran.	"	"	"	" "	0.56	0.68
Red, Wire inserted	"	" "	"	"	"	" "	0.80	0.93
Paints, Stains, and Colors:								
Alabastine	170	El Paso	543	0.08	k.b.	" "	0.16	0.24
French zinc, Ivory	"	" "	544	0.15	k.b.	" "	0.44	0.66
Preservative Paints:								
Cyanide (Moran)	212	San Fran.	278	0.04	k.l.	gal.	1.60	2.37
P. & B., Bridge and roof	162	Los Angeles	"	"	"	"	0.98	1.85
P. & B., No. 2	"	" "	"	"	"	"	1.68	2.55
Red Oxide, paste	208	El Paso	543	0.08	k.b.	1 lb.	0.14	0.26
" " powder	"	" "	"	"	"	" "	0.06	0.15
Stains—Burned Umber	"	" "	544	0.15	k.b.	" "	0.40	0.67
" Cherry, Vermicol	"	" "	"	"	"	gal.	4.80	6.42
" Furniture Stain	"	" "	"	"	"	quart	1.00	1.44
" Van Dyke's Brown	"	" "	"	"	"	1 lb.	0.42	0.70
White Lead	"	" "	"	"	"	" "	0.18	0.30
Pebbles—Danish Flint	14	New York	298	exempt		2240 lb.	32.00	88.25
" French (Voigt)	332	Yzabal	"	"		" "	54.00	81.47
Picks—Drift, KO3	277	St. Louis	685	0.055	k.l.	1	0.83	1.23
" Prospector's, C-1	"	" "	"	"	"	"	1.25	1.69
" Railroad	"	" "	"	"	"	"	1.25	1.65
Pipe—Air, galvanized, 7-in.	97	El Paso	235	0.025	k.b.	1 ft.	2.22	2.73
" Standard wrought iron, ¼-in. (carload)	180	Steubenville	"	"	"	" "	0.026	0.05
" " " " ⅜ " "	"	"	"	"	"	" "	0.026	0.05
" " " " ½ " "	"	"	"	"	"	" "	0.036	0.07
" " " " ¾ " "	"	"	"	"	"	" "	0.045	0.09
" " " " 1 " "	"	"	"	"	"	" "	0.063	0.132
" " " " 1 " (less "	208	El Paso	"	"	"	" "	0.095	0.176
" " " " 1¼ " "	180	Steubenville	"	"	"	" "	0.086	0.182
" " " " 1¼ " (less "	208	El Paso	"	"	"	" "	0.129	0.235
" " " " 1½ " "	180	Steubenville	"	"	"	" "	0.101	0.229
" " " " 2 " "	"	"	"	"	"	" "	0.137	0.283
" " " " 2 " (less "	208	El Paso	"	"	"	" "	0.207	0.390
" " " " 2½ " "	180	Steubenville	"	"	"	" "	0.220	0.496
" " " " 3 " "	"	"	"	"	"	" "	0.295	0.625
" " " " 4 " "	"	"	"	"	"	" "	0.63	1.07
" " " " 5 " "	"	"	"	"	"	" "	0.84	1.21
" " " " 8 " "	"	"	"	"	"	" "	1.23	2.47
" " " " 8 " (less "	208	El Paso	"	"	"	" "	1.60	2.67
" " " " 9 " " "	"	" "	"	"	"	" "	2.99	4.59
" Spiral riveted, 16-in. (15 ft. long with flange)	"	" "	"	"	"	" "	5.23	7.00
Plaster of Paris	"	" "	268	0.007	k.b.	1 lb.	0.14	0.23
Pliers—Klein's side, 7-in.	135	Denver	685	0.055	k.l.	1	3.00	3.30
" " " 8 "	"	"	"	"	"	"	3.60	3.92
Pool Tables—Eclipse, 4½x9-ft.	33	El Paso	699	0.40	k.b.	"	400.00	610.25
Cloth cover	"	" "	"	"	"	"	16.50	19.80
Powder— ⅞-in., 40% Hercules	209	Yzabal	642	0.033	k.b.	case	17.00	17.86
" 1⅛ " "	"	"	"	"	"	"	17.00	17.86
" 1¼ " 60% Gelatine	"	"	"	"	"	"	20.00	20.86
" ⅞ " 40% No. 2 Gelatine	137	San Fran.	"	"	"	"	11.50	16.25
" 1⅛ " 40% No. 2 "	"	" "	"	"	"	"	11.50	16.25
" 1¼ " 60% No. 1 "	"	" "	"	"	"	"	13.90	18.70
See Fuse and Caps.								
Pulleys—Solid cast iron, 9x 6x2 7/16-in.	81	Mishawaka	612	0.0165	k.b.	1	2.08	3.60
" " " " 10x 3x1 7/16 "	170	El Paso	"	"	"	"	7.62	9.15
" " " " 10x 8x2 7/16 "	81	Mishawaka	"	"	"	"	2.38	4.11
" " " " 12x12x1 15/16 "	97	El Paso	"	"	"	"	19.00	23.98
" " " " 24x 6x1 15/16 "	81	Mishawaka	"	"	"	"	15.00	18.89
" Split steel, 10x 8x2 7/16-in.	97	El Paso	"	"	"	"	5.25	6.98
" " " 13x11x2 7/16 "	81	Mishawaka	"	"	"	"	6.16	10.64
" " " 14x 8x1 15/16 "	97	El Paso	"	"	"	"	7.06	9.46
" " " 14x11x2 7/16 "	81	Mishawaka	"	"	"	"	7.06	12.18
" " " 35x11x2 7/16 "	97	El Paso	"	"	"	"	65.00	82.88
" " " 42x20x4 7/16 "	40	Chicago	"	"	"	"	98.00	171.63
" " " 44x14x2 7/16 "	97	El Paso	"	"	"	"	54.00	59.51
Putty—5-lb. bladders	170	" "				1 lb.	0.075	0.23
Pumps:								
Aldrich, Vertical Triplex, 2x3-in., 12 gal. p. m., 50-ft. head; Fig. 133	4	Allentown	612	0.0165	k.b.	1	186.20	210.18
Aldrich Vertical Triplex, 4x9-in., 100 gal. p. m., 1100-ft. lift, all iron; Fig. 143; pot chamber; weight, 11,862 lb. (carload)	"	"	"	"	"	"	2,170.00	3,155.00
Aldrich Vertical Triplex, 5x6-in., 85 gal. p. m., 100-ft. lift	"	"	"	"	"	"	546.00	768.09

Article	Purchased from.	F.o.b	Duties Frac	Duties Amount	Unit	F.o.b cost *	Delivered cost *
Pumps							
Vidrich Vertical Triplex, 6x7-in., 140 gal. p. m., 175-ft. head; all iron. Fig. 150; weight, 4155 lb.	4	Allentown	612	P0.0165	k.b. 1	P 770.00	P1,000.00
Vidrich Vertical Triplex, 7x8-in., 250 gal. p. m., 120-ft. head; all iron; weight, 4719 lb.	"	"	"	"	" "	1,028.00	1,323.00
Vidrich Vertical Triplex, 9x10-in., Fig. 222	"	"	"	"	" "	.....	2,608.15
Vidrich Vertical Triplex, 9½x10-in., pot chamber, Fig. 28; weight, 12,400 lb.	"	"	"	"	" "	2,400.00	2,352.97
Peerless Centrifugal, 4-in., weight, 573 lb.	204	San Fran.	"	"	" "	480.00	527.71
Cyclone air displacement, 100 gal. p. m. of slime, 40-ft. head; weight, 400 lb.	123	Salt Lake	"	"	" "	650.00	691.60
Cameron, prospector's sinking pump, vertical plunger, 6x8x7; weight, 780 lb.	208	El Paso	"	"	" "	326.00	373.20
Cameron sinker No. 5; vertical plunger; 1275 lb.	"	"	"	"	" "	416.00	512.00
Deimler, centrifugal sand pump, 6x18-in.	288	Denver	"	"	" "	260.00	335.70
" " " " 6x54 " 1500 lb.	208	Rutland, Vt.	"	"	" "	280.00	376.44
" " " " 10x54 " 1664 lb.	"	"	"	"	" "	410.00	527.00
Gould, horizontal duplex, 8x10; vacuum; 342 gal. p. m.; side discharge; Fig. 1387; weight, 5225 lb.	47	Seneca	"	"	" "	1,116.00	1,622.60
Morris, bed plate, stand, and bearings; 356 lb.	5	Milwaukee	"	"	" "	102.00	138.23
Platt 2-stage, special No. 4; 2265 lb.	"	"	"	"	" "	950.00	1,172.95
Ramsey, 2½x4-in. triplex, Fig. 681; 389 lb.	170	El Paso	"	"	" "	173.00	193.86
Traylor, centrifugal, r.h., iron, sand pump; No. 304; wt., 450 lb.	208	" "	"	"	" "	171.39	192.30
Thresher Hand Force	"	" "	"	"	" "	15.00	19.00
Traylor centrifugal sand, 1½-in. LH; No. 304; 383 lb.	312	Salt Lake	"	"	" "	192.00	230.00
Rails— 8 lb. (carload lots)	322	Chicago	248	0.025	k.b. 1000 lb.	40.00	59.10
" 12 " " "	"	"	"	"	" " "	38.48	64.20
" 12 " " " C. F. & I.	65	Yzabal	"	"	" " "	41.97	60.00
" 16 " " "	"	"	"	"	" " "	41.08	59.06
Bolts for 12-lb. rail in carload with rails.	"	"	257	0.12	k.l. 100 lb.	9.50	16.28
Bolts, less than carload	170	El Paso	"	"	" " "	11.90	24.27
Spikes, 2½x⅜-in.	65	Yzabal	248	0.025	k.b. " "	6.80	8.59
" 3 x⅜ "	"	"	"	"	" " "	9.50	11.28
Splices, 12-lb. and 16-lb.	"	"	"	"	" " "	5.70	7.49
Rakes—Garden	277	St. Louis	685	0.055	k.l. 1	0.88	1.09
Rivets—Cone head boiler, ⅛x ⅜-in.	138	Chicago	257	0.12	k.b. 100 lb.	12.31	25.17
" " " " ¼x ¾ "	"	"	"	"	" " "	7.01	19.82
" " " " ⅜x1 "	"	"	"	"	" " "	6.38	19.23
" " " " ½x1½ "	"	"	"	"	" " "	6.58	19.11
" " " " ⅝x2½ "	"	"	"	"	" " "	5.58	18.11
" " " " ¾x2 "	"	"	"	"	" " "	5.28	17.80
" Flat head, 3/16x⅜-in.	208	El Paso	"	"	" " "	12.44	20.82
" " " 3/16x¾ "	"	" "	"	"	" " "	10.00	15.86
" Copper, with burrs	"	" "	203	0.50	k.l. 1 lb.	0.65	0.87
Roofing—Caps, tin, 1¼-in.	"	" "			" "	0.20	0.23
" Iron, corrugated, 26 gage, 26x 96-in.	"	" "	243	0.066	k.b. sheet	1.50	2.70
" " " " 26x 84 "	"	" "	"	"	" "	1.32	2.39
" " " " 26x108 "	"	" "	"	"	" "	1.71	2.98
" Ridge capping V	"	" "	"	"	" 1 ft.	0.11	0.17
Roofing Paper—"Texaco"	301	Douglas	694	0 04	k.b. roll	6.80	9.37
" " No. 1	"	"	"	"	" "	3.30	5.03
Rope—Manila, ¼-in.	208	El Paso	173	0.14	k.l. 1 lb.	0.36	0.51
" " ½ "	"	" "	174	0.09	k.l. " "	0.33	0.46
" " ¾ "	"	" "	"	"	" "	0.31	0.44
" " 1 "	"	" "	"	"	" "	0.28	0.41
Sacks—Coffee, gunny	9	San Fran.	169a	0.18	k.b. 1	0.44	0.80
" " "	201	Guaymas	"	"	" "	0.55	0.66
" Concentrate, Hessian Twill, 16-oz. jute, 28x16-in.	271	"	"	"	" "	0.40	0.45
" Mail Pouch, 30x40, 14-oz. duck	99	El Paso	"	"	" "	8.00	12.00
" Ore Sacks, 14x28 jute	170	Juarez	"	"	" "	0.23	0.28
" " " 17x28 twill	9	San Fran.	"	"	" "	0.15	0.32
" Sample ore sacks, 8½x14, 8-oz. duck	"	" "	"	"	" "	0.13	0.19
Salt Rock	291	Guaymas	557	0.02	k.b. 2240 lb	24.04	110.46
Sashes Window—10x16-in., 6-light	84	Douglas			1 pair	4.50	7.70
In 100 lots			319	0.45	k.b.		
Saws—No. 4 R.H., wood frame, Curtis, swing saw, complete with 1 mandrel, LHT 3; 1 46-in. s. t. circ. cross-c., No. 8 ga. saw, 1½-in. h.; 1 20-in. rip saw, No. 13 g., 1⅛-in. hole; 1 20-in. cross-c. saw, No. 13 gage, 1⅛-in. hole	208	St. Louis	612	0.0165	k.b. 1	231.08	275.26
" Circular, 48-in., No. 3 chisel tooth, 32 teeth, R.H., No. 8 gage; Atkins; 119 lb.	170	Indianap.	"	"	" "	113.00	121.22
Extra teeth for above	"	"	"	"	" 100	....	6.06
" Carpenter's (See Builders).							
Scale, Platform, No. 507	111	Los Angeles			1	30.00	48.60
" Grocer's, No. 1115	"	" "			"	33.60	58.05
Screens—Battery (See Machinery).							
Screens—Brass, 4 mesh, 12 wire	311	Cleveland	253	0.12	k.l. sq. ft.	2.72	3.40
" " 8 " 18 "	"	"	"	"	" " "	1.22	1.37
" " 10 " 22 "	"	"	"	"	" " "	0.54	0.60
" " 18 " 24 "	"	"	"	"	" " "	1.08	1.26
" " 22 " 27 "	"	"	"	"	" " "	0.76	0.89
" " 40 " 32 "	"	"	"	"	" " "	0.75	0.87
" Fly, 32-in.	170	El Paso	337	0.20	sq. mt. 100 ft.	8.00	11.57
" " 36 "	"	" "	"	"	" " " "	9.00	13.00

Article.	Purchased from.	F.o.b.	Duties Frac.	Duties Amount.	Duties Unit.	F.o.b. cost.*	Delivered cost.*
Screens—Fly, 12-in.	170	El Paso	337	₱0.20 sq. mt.	100 ft.	₱10.50	₱14.85
" Huntington (See Machinery).							
" Trommel:							
Steel. Size.							
5/16 76x30 5/8-in. o	253	Carbondale	612	0.0165 k.b.	1	11.43	22.50
No. 16 " 1½ mm.	"	"	"	" "	"	4.74	7.50
¼ " 3/8 " o	"	"	"	" "	"	10.40	22.10
3/16 " 3/16 " o	"	"	"	" "	"	9.70	18.68
No. 10 " 3/16 " o	145	Chicago	"	" "	"	6.60	11.89
5/8 " 5/16 " o	"	"	"	" "	"	11.26	20.64
Screws—Cap, hex. head, ¼x2½-in	170	El Paso	257	0.12 k.l.	100	2.88	3.75
" " " " 3/8x1 "	"	" "	"	" "	"	2.40	3.30
" " " " ½x3 "	"	" "	"	" "	"	5.88	8.20
" " " " 5/8x3 "	"	" "	"	" "	"	9.12	10.95
" " " " 5/8x4 "	"	" "	"	" "	"	11.92	13.20
" " " " ¾x1 "	"	" "	"	" "	"	6.88	8.60
" " " " ¾x2½ "	"	" "	"	" "	"	9.60	11.40
" " " " 7/8x1 "	"	" "	"	" "	"	10.12	12.85
" " " " 7/8x2½ "	"	" "	"	" "	"	13.04	16.10
" " " " 7/8x4 "	"	" "	"	" "	"	18.48	23.15
" " " " 1 x2½ "	"	" "	"	" "	"	16.00	22.30
" Flat hd. br. wood, ¾x 6-in	277	St. Louis	"	" "	gross	0.22	0.35
" " " " " 1 x 9 "	"	" "	"	" "	"	0.28	0.55
" " " " " 1 x11 "	"	" "	"	" "	"	0.33	0.70
" " " " " 2 x11 "	"	" "	"	" "	"	0.44	1.00
" " " " " 2½x11 "	"	" "	"	" "	"	0.64	1.15
" " " " " 2½x15 "	"	" "	"	" "	"	0.86	1.42
" " " " " 2½x20 "	"	" "	"	" "	"	1.48	2.23
" " " " " 3 x20 "	"	" "	"	" "	"	1.65	2.65
" " " " " 3½x20 "	"	" "	"	" "	"	1.88	2.83
" Lag screws, ½x3 -in	208	El Paso	"	" "	100	3.00	4.18
" " " ½x6½ "	63	" "	"	" "	"	4.41	6.48
" " " ½x9 "	208	" "	"	" "	"	4.76	6.45
" Set screws, 3/8x3-in	63	Los Angeles	"	" "	"	2.09	3.18
" " " 3/8x4 "	"	" "	"	" "	"	5.28	6.80
" " " 3/8x5 "	"	" "	"	" "	"	7.10	8.90
" " " 3/8x6 "	"	" "	"	" "	"	8.60	10.25
Seals—Lead safety, No. 15	246	Chicago	220	0.04 k.b.	1000	4.50	6.63
Solder—½ and ½	170	El Paso	217	0.10 k.l.	1 lb.	0.60	0.73
Soldering copper	135	Denver	197	0.13 k.l.	" "	0.30	0.48
Shovels—LHRP Plaza Bird	208	El Paso	232	0.0165 k.b.	1	1.25	1.59
" SHSP and LHSP	277	St. Louis	"	" "	"	1.33	2.00
Steel—Drill, Midvale, oct. and cruciform	207	Chila, Pa.	228	0.06 k.b.	1 lb.	0.09	0.18
" " Canton Buckeye	66	Pittsburgh	"	" "	" "	0.12	0.21
" " " extra drill	"	"	"	" "	" "	0.13	0.22
" " Crescent H. C	"	"	"	" "	" "	0.10	0.19
" " Acero Minero	"	"	"	" "	" "	0.08	0.17
" " Round hollow	208	El Paso	"	" "	" "	0.25	0.36
" Shafting, cold rolled, 2 7/16x20 ft	97	" "	"	" "	1	25.40	40.00
" " " " 2 15/16x20 "	"	" "	"	" "	"	36.84	57.63
" " " " 1 15/16x20 "	"	" "	"	" "	"	6.40	9.70
" " " " 3 7/16x20 "	"	" "	"	" "	"	53.54	129.10
Stocks and dies—Armstrong No. 2	170	" "	685	0.055 k.l.	set	8.00	9.08
" " " " 3	"	" "	"	" "	"	16.00	18.88
Tanks—Gas oil, No. 12 steel, 5x30-ft., Del. Yzabal	97	El Paso	612	0.0165 k.b.	1	321.50	818 16
" " " " 7x40 " mill, 3176 lb	"	" "	"	" "	"	513.50	1,229.95
" Mill (see Machinery).							
Taps—Machinists' hand, 3/8x16	277	St. Louis	685	0.055 k.l.	set	1.57	2.25
" " " 3/4x10	"	" "	"	" "	"	3.44	4.96
" " " 1 1/16x 7	"	" "	"	" "	"	6.30	7.66
" " " 1 1/2x 6	"	" "	"	" "	"	11.60	12.62
" " " 1 3/4x 5	"	" "	"	" "	"	17.00	18.75
Tents—10-oz., 12x14-ft. std	58	Denver	712	0.22 k.b.	1	18.26	27.50
Thread—Barbours 8 cord	21	New York	376	0.25 k.l.	1 lb.	2.09	2.46
" Lockstitch, 6 cord	181	New York	"	" "	" "	1.95	2.34
Trucks—R. R. No. 624, No. 4	170	El Paso	612	0.0165 k.b.	1	21.00	26.73
Twine—Sacking, jute, 3-ply	235	New York	376	0.25 k l.	1 lb.	0.255	0.46
Thermit outfit (see Welding).							
Torch, blow—Universal, brass (by exp.)	351	Houston	609	exempt	1	5.50	8 40
Washers—C. I., 45° beveled ¾-in. hole, 2¾-in	138	Chicago	257	0.12 k.l.	lb.	0.045	0.13
" Cut, ½-in	170	El Paso	"	" "	"	0.098	0.20
" " 5/8 "	"	" "	"	" "	"	0.094	0.19
" " ¾ "	"	" "	"	" "	"	0.092	0 19
" " 7/8 "	"	" "	"	" "	"	0.090	0.19
" Cast ½, 5/8, and ¾ in	97	" "	"	" "	"	.....	0.11
Welding outfit—Thermit, 200 lb. ready mixed	125	San Fran.	564	0.045 k.b.	"	0.56	0.63
" " 1 No. 6 crucible, including 1 cover, 5 plugs, 4 thimbles	"	" "	"	" "	all	40.40	57.00
" " Wax	"	" "	143	0.25 k.l.	lb.	0.70	0.90
" " Ignition powder	"	" "	239	0.02 k b.	"	1.00	1.50
" " Roasted steel punching	"	" "	"	" "	"	0.60	1.80
" " Preheating torch	"	" "	253	0.12 k.l.	1	116.50	129.50
Welding compound—Climax	170	El Paso	564	0.045 k.b.	lb.	0.16	0.24
Wheels, sheave—24-in. diam., solid rim, for ½-in. rope	97	" "	612	0.0165 k b.	1	26.00	38.62
Wheelbarrows—No. 7	170	" "	625	0.01 k.b.	"	11.00	14.50
Waste—Colored cotton	287	Douglas	87	0.022 k.b.	lb.	0.13	0.16
Whim, hoisting—Standard capacity, 500 lb.; 125 ft. per min. with safety brake	97	El Paso	612	0.0165 k.b	1	200.00	285.00
Wire, barbed—Glidden No. 12, 4 pt., 3-in. (carload)	322	Yzabal	231	0.025 k.b.	reel	7.20	8.25
Wrenches—Coe 6-in. (express)	138	Chicago	685	0.055 k.l	1	1.60	2.00
" " 10 " (freight)	170	El Paso	"	" "	"	1.14	1.28
" " 14 "	"	" "	"	" "	"	2.28	2 63
" " 18 "	"	" "	"	" "	"	2.85	3.37
" Monkey, black-jack, 8-in	277	St. Louis	"	" "	"	0.75	0.90
" " " 10 "	"	" "	"	" "	"	0.90	1.14
" " " 12 "	"	" "	"	" "	"	1.15	1.60
" Stillson, 10-in	170	El Paso	"	" "	"	1.48	1.60
" " 14 "	"	" "	"	" "	"	2 00	2.50
" " 18 "	"	" "	"	" "	"	2.68	3.00
" " 24 "	277	St. Louis			"	3.28	4.05
Zinc—Pig	97	El Paso			lb.	0.15	0.22
" dust (see Assaying and Chemical Supplies).							

*Values in Mexican currency at 2 for 1.

MINING AND SCIENTIFIC PRESS

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Volume 110 SAN FRANCISCO, APRIL 10, 1915 Number 15

CALIF. STATE

IT is not lack of appreciation that has debarred us from using this cover recently. On the contrary, we have traced more direct results from our advertisements on this front cover than from any other advertisement. But abnormal conditions caused by the war have temporarily abated our avidity for new customers—75% of our work comes from old customers.

We have recently received a large order for our **Cooper Roller Bearings, Neal's Discharge,** and **Komata Liners** from a group that six months ago fitted these adjuncts experimentally to one tube-mill. They are so well satisfied that, with the exception of two old spares, they are now fitting all their tube-mills with these power-saving appliances.

The Cyanide Plant Supply Company, Ltd.

1 BROAD STREET PLACE, LONDON, E. C.

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SAN FRANCISCO, APRIL 10, 1915

Buyers Directory—Page 28
Advertisers Index—Last Page

TABLE OF CONTENTS

EDITORIAL Page.

Notes 567
Life and Property in Mexico 567
The Price of Quicksilver 569
The Waste of Experience 570

ARTICLES

PROGRESS IN METALLURGY.
By James Douglas 570
The reminiscences of a veteran metallurgist.

THE MECHANICAL EFFICIENCY OF CRUSHING.
By Herman C. Kenney 572
Rittinger's law of the work required to crush ore was accepted for many years. Recently Kick has propounded an alternative and different law. Mr. Kenney considers various cases of the application of these laws and concludes that Rittinger's law appears to have a valid basis and cannot be discarded without further experimental evidence.

CONTINUOUS DECANTATION IN SOUTH DAKOTA.
By Jesse Simmons 575
Continuous decantation is becoming general practice in the smaller mills of this district. Ingenious appliances used at the Golden Reward mill are described.

WAYS THAT ARE DARK.
By John B. Farish 576
Attempts to mislead the engineer who examines a mine offered for sale are all too common, and the best means of prevention are care and a knowledge of what means may be adopted. An engineer of long and wide experience tells the details of some instances which have come under his personal observation.

SMOKE DILUTION AT MIDVALE.
By L. S. Austin 579
Legislation governing the operation of smelters commonly provides that the sulphur dioxide content of the escaping gases shall not exceed a fixed figure. To maintain this, air is blown into the stack in order to dilute the gas.

INFUSORIAL EARTH.
By Samuel H. Dolbear 580
Several different substances are included under the name of infusorial earth, and these are put to a great variety of uses. The material of the highest quality is imported from Germany, but deposits of good grade exist in California, and a large and increasing production is being maintained.

COST OF MINING AND MILLING AT TONOPAH.
By Jay A. Carpenter 583
The daily tonnage produced by the mines varies from 52 to 473 tons; the average content from $8.41 to $21.09 per ton, and the combined cost of mining and milling from $7.42 to $8.93. Net extraction ranges from 84 to 91.95%.

DEPARTMENTS Page.

DISCUSSION:
Milling Gold Ores in Cyanide.
By A. W. Allen 585
A correction of an error.
Valuation of Dredging Ground.
By R. T. Hancock and Edmund Bonella 585
A method of economizing in bush-cutting is pointed out, and the method proposed by E. J. Vallentine is commended.
Precision of Thought.
By Bernard MacDonald and F. H. Mason 586
One correspondent agrees with us, the other differs.
Utah University.
By Robert S. Lewis 586
A protest against reports which have been circulated in the public press.
Rhythmic Precipitation and Colloidal Ores.
By George E. Collins 586
A careful student points out that dynamic action could not produce the structures observed.

CONCENTRATES 587

MINING IN THE FAR NORTH.
Placer Mining on the Seward Peninsula.
By Emil Edward Hurja 588
Dredging for gold and tin is becoming increasingly important on the Seward Peninsula. Our special correspondent sends news of present operations.

REVIEW OF MINING: Special correspondence from Joplin, Missouri; Houghton, Michigan; Porcupine, Ontario; Toronto, Ontario; Tokyo, Japan; New York; Lordsburg, New Mexico 591

THE MINING SUMMARY 595

PERSONAL 599

SCHOOLS AND SOCIETIES 599

THE MARKET PLACE:
Metal Prices 600

COMPANY REPORTS 601
New Idria Quicksilver Mining Company; Seneca-Superior Silver Mines, Ltd.; American Smelting & Refining Company; Calumet & Arizona Mining Company and Superior & Pittsburg Copper Company; Crown Reserve Mining Co., Ltd., and Porcupine-Crown Mines, Ltd.

MINING DECISIONS 603

BOOK REVIEWS 603
'Methods in Metallurgical Analysis,' by Charles H. White. 'A Text-book of Practical Assaying,' by James Park.

NEW MACHINES AND DEVICES:
Ore Treatment Apparatus at the Exposition 604
Commercial Paragraphs 604

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EDITORIAL

T. A. RICKARD Editor
THOMAS T. READ Associate Editor

AFTER an absence of six years, and in response to a call from the staff of this paper, I resume the editorship. Assured of the loyalty of those with whom I shared the difficult days of the earthquake-fire, and hopeful of the continued support of the mining profession, I turn to a familiar task with pleasure. To my immediate predecessor, Mr. H. Foster Bain, the *Mining and Scientific Press* is indebted for devoted service; to him also I am grateful for personal loyalty in times of stress.

T. A. RICKARD.

OPTIMISM is speculative. The world needs a large measure of that cheerful tonic in these dark days.

TRULY the Panama-Pacific Exposition is a splendid show, but the chief exhibit is California.

ON April 3 the peso was selling at Monterey, Mexico, at 16 to 1, New York exchange. This sounds like the echo of an earlier day.

RESTORATION of the wage-scale in the Michigan copper region indicates the resumption of normal production and a return to ante-bellum conditions.

WAR teaches co-operation. The present world tragedy gives us a lesson in the efficiency of human solidarity as applied to destruction. It should point a way to the co-ordination of effort for beneficent purpose.

FOREIGN trade is abnormal—abnormally good. Imports are light; exports heavy. The domestic supply of gold is excessive, being about $1,800,000,000. This is far beyond our requirements and portends the granting of heavy credits to Europe.

WITH the abolishment of minimum prices, as established on December 15, 1914, the New York Stock Exchange returns to normal conditions. This marks a great improvement in domestic financial affairs and in foreign trade relations.

APPARENTLY the shipment of copper to neutral countries is now going forward under arrangements satisfactory to Washington and London. The greater demand for the metal in the manufacture of munitions is compensating for the decreased consumption in ordinary constructive work.

CARRANZA and Villa seem bent on killing mining in Mexico. The decrees relative to duties on metals exported, together with the land taxes promulgated at Vera Cruz, are supplemented by the new mining regulations published at Chihuahua. The miner may well exclaim: "A plague on both your houses."

THE council of the British Association and the local committee in charge of arrangements for the next annual meeting, to be held at Manchester, have decided that it is inexpedient under existing conditions to offer the elaborate local hospitalities usual to the meetings of the Association. It is planned therefore to restrict the meeting to purely scientific functions. War teaches many lessons; this is one that may be extended into times of peace.

WE note the passage of a resolution by the Senate, at Sacramento, enacting that the University of California shall assay gratuitously all samples coming from non-operating or undeveloped mining claims. We hope that the Committee on Mines and Mining will kill this proposal. It is an unwarrantable and unnecessary interference with an established business. The assayers in the State do such work efficiently and at a reasonable charge. The Mining Bureau makes qualitative determinations of ores without fee, leaving it to the proper persons to make quantitative or commercial tests. For the University, we hope that it may not be called to enter a business outside its educational functions and compete with its own graduates in the commercial field. The proposal is one that the mining profession will unite in condemning as an example of unprovoked paternalism not at all likely to advance the welfare of the State's mining industry.

Life and Property in Mexico

Two protests, one by the American residents in Mexico City and another by a committee of those operating mines in Mexico, have been addressed to the Secretary of State at Washington. The one deals mainly with the personal safety of Americans at the capital of our disorderly neighbor, while the other exposes the confiscatory character of a drastic decree issued in the North. In the one case it is the ineptitude and bad faith of Carranza that have excited expostulation; in the other it is the greed and tyranny of Villa that have evoked a remonstrance. Truly, affairs have come to a bad pass in Mexico. Making allowance for the personal prejudice of aliens subjected to the discomforts incidental to domestic political chaos, we still find ourselves moved by the complaint addressed by the American colony in Mexico City to the Secretary of State. After four years of fluctuating misrule and persistent disorder, of broken promises and disappointed hopes, they are entitled to protest. They recount their injuries, they describe their ignominy, they recite their indignation. The official reply may be that they ought to have left the country long ago, as they were warned to do; but that is easier

said at Washington than done in Mexico. They went thither under international guarantees and under the protection of our country's flag; we cannot blame them for trying to save their property by remaining on the spot, while expecting some measure of protection from our own Government. We agree with them that "American civilization is on trial," and that the struggle in Mexico "does not represent the efforts of a people to secure liberty and equal rights so much as the clash of personal ambition and revenge."

Our more immediate interest is engaged by the decree of Villa upsetting the regulations under which mining property is held. In the *Vida Nueva*, a paper published at Chihuahua, on March 25, we have the text of the latest pronunciamento on a subject that vitally concerns many of our readers. Title to mining claims is to be forfeited by reason of

1. Non-payment of taxes;
2. Suspension of work for more than 60 days;
3. Deficient exploitation.

As regards the first, many American owners of mining claims have paid the taxes imposed by more than one of the factions claiming to govern the country. The payment of taxes to one *de facto* government does not protect them as against the exactions of its successors. Suspension of work, it is true, involves forfeiture in other mining regions, but only where operations are rendered practicable by protection to life and property. At the present time most of the mines in Mexico are not only lacking in such protection, but the scarcity of labor and the interruption to railway traffic, both due to continued civil war, render continuous operations quite impossible. Moreover, this question of forfeiture on account of failure to operate is to be left to the judgment of the Secretary of Fomento (or Public Works), who is to be kept informed by the mineral agents delegated to act as inspectors in the various districts. Of course, this arrangement creates a veritable incubator of graft and furnishes unlimited opportunity for tyranny tempered by bribery. At the present time, even mines well established and well equipped are finding it hard to operate; what chance is there for isolated and undeveloped properties to escape forfeiture if they are to be at the mercy of individuals appointed by presidents whose term of office is less than a month, and by the various marauders posing as generals in command of revolutionary parties? But Villa's decree contains another proviso, even more pernicious. As our readers are aware, the owner of a mining claim in Mexico, as in South Africa and Australia, has no extralateral rights; his operations are delimited by four vertical planes; therefore, to assure his right to follow a lode on its dip, he locates or denounces enough ground to protect himself in depth. Hence a large part of his area covers the extension of his mine on the dip, without visible exploitation on the surface. Now comes a decree compelling the owner to have at least one active working in each contiguous 5-*pertinencia* (or 5-hectare) section. For every such sub-division there must be a stope, drift, adit, or other working contributory to the extraction of ore. This requirement is absurd technically, for it ignores the trend of the orebody, the distribution of the better portions of it, and the maintenance of any system of exploitation. It requires a hole to be dug whether ore is found thereby or not; it assumes that the entire area of a mining property covers productive ground; in short, it is blind to all the facts of the case and represents ignorant meddling of a most vicious character. Surely no Mexican mining engineer was consulted in the matter; for mining is an ancient industry in that distressful country, and it is not necessary to go outside to obtain advice in such simple matters of technology. Apparently the welfare of an established industry is to be sacrificed to the creation of opportunities for military requisitions. The decree is that of a dictator on horseback, not that of a national legislature. It is also questionable whether the decree is not unconstitutional by reason of the fact that it substitutes the decision of a Cabinet officer for the deliberate judgment of a duly constituted court of last resort in a matter involving rights of property. In any event, it is a deliberate violation of all the terms under which existing titles have been acquired, and it is retroactive. This may seem a small matter amid the unhappy conditions already obtaining in Mexico, but it is of vital importance to the mining industry, as destroying the confidence of both aliens and natives alike, rendering it hazardous to conduct mining operations of any kind, whether with domestic or foreign capital.

It is reported from Washington that the Government has suggested that the Mexican capital be declared neutral. This is a good idea. At the same time it would be well to place Juarez and Vera Cruz outside the zone of war and neutralize the railways connecting these commercial gateways with the City of Mexico. A precedent is afforded by the treaty ports in China, more particularly the international settlement at Shanghai and the foreign military guards along the railway from Peking to the sea. If next an American garrison were established at these focal points to assist in the maintenance of order, as between the unruly members of the rival factions, we might see some daylight in the darkness south of the Rio Grande. Undoubtedly some such effort to regulate indiscriminate brigandage is necessary. The United States is to Mexico at this time like a respectable householder who has a neighbor on the rampage. The peace of an orderly home is broken by the rough language, the midnight orgies, and the occasional shots across the fence. The disorderly behavior of his neighbor becomes insufferable to the man whose wife and children are exposed to the sights and sounds of a bagnio. If the police will not interfere in checking the revellers, then the householder asks his neighbors to assist him in putting an end to the nuisance. The United States is a country of advanced industrial civilization; it has a neighbor that is in a state of retrograde political disorder; the two are incompatible. No idealism can change the fact; no good nature can prevent the juxtaposition from becoming an intolerable irritation.

The Price of Quicksilver

Quicksilver is one of the metals that has benefited from the conditions created by the war, which has stimulated the consumption of mercury in the manufacture of explosives. Ordinarily the quicksilver industry of this country is a purely domestic one, in that the production and consumption are nearly equal. The price of the metal fluctuates between a level at which foreign metal can be imported and a minimum at which the domestic metal can be sold for export. As the total world's production is about five times the domestic output, this ordinarily would produce fairly stable market conditions, but the price of foreign metal is generally understood to be controlled by the Rothschilds, and this introduces a factor outside the ordinary laws of trade. It is not surprising, therefore, that occasionally the price shows quick and large fluctuations, though the average over a long period is governed by the conditions first stated. The increased buying of mercury by the manufacturers of explosives, both here and abroad, during the past few months has sent the price soaring upward from an average price during last year of $48 per flask to a present figure of about $80. Within the past few weeks there has arisen a good deal of discussion as to what is the real present price of the metal. On March 4 we quoted in our market pages $70 per flask, and on March 11 $80 per flask. On the same dates our junior contemporaries at New York and Chicago quoted figures of $59 and $61 per flask. Evidently someone was misinformed, and we have been called upon, quite properly, to justify the quotations for which we stand sponsor.

Before proceeding further it will be well to adduce more contemporary opinion. The New York *Journal of Commerce* on March 11 stated that quicksilver was in good demand, the price was strong, and moderate sales were being made at $80 per flask. On March 12 the New York *Commercial* said: "An order for 400 flasks of quicksilver was received here from Europe yesterday. Another advance has been named by the leading holder, who is now asking a minimum of $85 per flask of 75 pounds." On the following day the *Journal of Commerce* said that quicksilver was in small supply and the market firm at $85 to $90 per flask. The *Oil Paint & Drug Reporter* of March 15 said: "The steadily increasing export takings at this port [New York] have so reduced domestic supplies as to induce the leading manufacturers and other holders to raise their prices $5 to $10, making their revised quotations $85 to $90 per flask of 75 pounds in 100-flask lots." We were not alone therefore in our statement, that the market-price of quicksilver on March 11 was $80 per flask. Within the past week we had the pleasure of a call from the manager of a mine that is now producing at the rate of over 300 flasks per month; he made to us the statement that he had sold no metal in the past three weeks for less than $80 per flask and had recently refused an offer of $78 per flask for a considerable quantity. We have also asked those sellers who are willing to do so to show us the carbon copies of their bills of sale. While, of course, we can divulge neither names nor exact figures, we are in a position to state from exact knowledge that quicksilver was actually being sold at the figures named in our quotations. One dealer has recently quoted us a price of $67.50 per flask. This is interesting, but does not serve to modify the fact that other dealers have made sales at the higher figures, nor does it establish the market at the lower figure. When several commission dealers are selling potatoes at $4 per barrel a single dealer might quote a price of $3 per barrel, for a variety of reasons best known to himself, but that would not affect the fact that the general market-price was $4 per barrel.

The import of foreign metal is not now possible. Austria, which produced 855 metric tons of quicksilver in 1913, has, of course, been out of the market since the beginning of the War, as quicksilver is contraband of war. The Spanish output, about 1500 metric tons, is chiefly sold through London, and the export of quicksilver from Great Britain was prohibited by the military authorities months ago. The only other considerable source of the metal is Italy, which produced 988 metric tons in 1913. Export of quicksilver from Italy was recently prohibited by the government of that country. Domestic production therefore must meet our own consumption and supply foreign orders that are deflected here from the countries that cannot now export. Evidently domestic producers are justified in the belief that trade conditions entitle them to ask higher prices for their metal.

If the War continues long it seems likely that the price of quicksilver will continue to rise, unless the higher price serves to increase domestic production. This it will do to some extent, but it is questionable if any large increase can be made quickly. The output of quicksilver is not like the production of shingles, in which, to meet an increased demand, it is only necessary to put a larger force of men at work. Quicksilver deposits are characteristically irregular and a large part of the cost of production is the development work necessary to find the ore. No one knows how long the War may last; it is not impossible that hostilities may cease within a few months; producers, therefore, will be loath to spend large sums in development work in the face of the fact that prices may drop sharply before the desired ore-supply is found. This will tend inevitably to restrict increase of production, so that presumably the effect of the rise in price will be only a moderate increase of output. Production in California has been decreasing for the past few years, the United States Geological Survey figures having shown a decrease of 5000 flasks in 1913 and over 4000 in 1914. This decline will probably continue, for the New Idria mine, which produced 6550 flasks of the 11,500 credited to California by the Survey in 1914, is now almost exhausted, according to the report of the general manager for 1914, development work in depth only showing

low-grade ore. The mines in Nevada produced about 1700 flasks in 1914, and offer more possibility of increase under the stimulus of high prices. The only producer of importance outside these states is the Chisos mine, in the Terlingua district, Texas, which yields practically all of the 3000 flasks credited to states not shown separately. This property is now producing more than its normal output, rendering it safe to say that present domestic production is greater than the average for 1914, but less than the average for 1912.

The Waste of Experience

Nothing in human life is so pitiful as the waste of experience. Men come and go, they learn and they unlearn, leaving no record for those that follow. The omission to leave a legacy of information to their successors is due to the failure to appreciate the value of individual contributions to the common stock of knowledge, rather than the unwillingness to be helpful. In the technology of mining and metallurgy, we see a recurrent perpetration of old blunders, the repetition of useless experiments, and the falling of engineers into pitfalls that should have been marked by a red flag long ago. It is the function of the technical press to correct this omission: to invite engineers to record their experiences. A natural human weakness prompts men to make known their successful accomplishments rather than their failures, so that only the brighter half of the story is likely to get into print. Nevertheless the description of a blunder may prove more salutary than the advertisement of a feat. If we were altruistic we should not hesitate to tell our comrades of our mistakes so that they might be saved therefrom. Indeed, it is the mark of bigness in a man when he can stand up and acknowledge an error with the intention of helping his juniors in the profession.

The utilization of experience may be effected in a practical way by persuading the older practitioners, the men of unassailable repute, to record the technical happenings of an earlier day: in a word, to reminisce for the benefit of their sons and their friends' sons. In this issue we begin a series of such reminiscences. The first is by Mr. John B. Farish, a mining engineer who may claim to belong to both the old and the new schools of practice, for he was acknowledged as a leading practitioner fully thirty years ago and is one of those fortunate men who fail to outlive their reputations. His recollections deal mainly with the tampering with samples, or 'salting': a subject of perennial interest, for it combines both the humorous and the pathetic, while illustrating also that phase of business expressed by the old adage *caveat emptor*. We commend our friend's contribution to the younger engineers. It is better to be sure than sorry. Even if the iniquities he describes are not likely to be perpetrated in exactly the same way in these later days, it still remains true that vigilance is the price of safety. Most of us who have served our time in the field recognize that if those who tamper with samples were to take as much pains to effect their nefarious purpose as the engineer does to circumvent them, then 'salting' would be successful more often. In other words, if the trained intelligence of the engineer were available for such malignity, it would be difficult to defeat. We say it with crossed fingers and touching wood, for the idea is forbidding.

The composition of the material used in 'salting' suggests a question that we should like to see answered by some of our readers. In the old days the 'salt' used on gold ores was usually supposed to be gold chloride, while for silver samples the nitrate of silver was commonly employed. However, we hazard the suggestion that gold dust and brittle silver sulphide in the form of powder usually provided the artificial enrichment of samples. In districts where the gold existed in combination with tellurium and in other localities where it was so intimately associated with sulphides as not to be detectable by panning, it was practicable to use tellurides of the precious metals for 'salting.' On the whole, we believe that liquid chemicals were used rarely.

The two examples of deception quoted by Mr. Farish at the close of his reminiscences are peculiarly interesting. This kind of trick has been perpetrated more often than is generally supposed. The most celebrated case was that of the Chrysolite mine at Leadville. We can record one example from our own experience. The mine was in Boulder county; it contained a definite ore-shoot 300 feet long that had been worked for three levels and had been under-cut on the fourth level, leaving an apparent block of ground 300 by 100 feet. A rise from the bottom level had been started in ore. The sampling of the bottom of the third level was satisfactory and compared well with the sampling of the back of the fourth level. In the bottom of the third level there was a 10-ft. hole, which was explained as a sump for collecting the drainage from the stopes, previous to the water being pumped to the shaft. In order to test the block of ore between the levels, the rise was continued. Suddenly it broke into mud and water, which nearly drowned the men at work. Upon investigation it was ascertained that an incline had been extended from the bottom of the little sump on the third level and by means of it the heart of the ore-body had been extracted, without leaving any evidence of the fact along the two levels. If the miners had been drowned, the affair would have been exposed in the courts. As it was, the owners passed the blame to a subordinate, so that legal proceedings would have failed to punish the real culprits. That is the way also in most 'salting' cases: the responsibility cannot be traced except by inference. We quote this last case to supplement those given by Mr. Farish and to draw attention to one of the many pitfalls to be avoided by the younger members of the profession. Wise men may make a mistake, once; a fool, twice. The least that the older engineers can do is to give the benefit of their experience before it passes with them across that range from which the prospector ne'er returns.

Progress in Metallurgy

By JAMES DOUGLAS

*As life advances, one is inclined to look backward instead of forward, and the vista over which my memory carries me has been filled with such a shifting panorama of changes in metallurgy that the whole practice of the art seems to have been re-created.

The first cupola furnace that I saw in operation was at one of the group of mines at Capelton, Quebec, from which the Nichols company still draws some of its sulphur supply. At that time it was operated by a Hartford, Connecticut, company, under a General Adams. When its small brick furnaces made a campaign of a week and smelted 10 tons per day, the feat redounded to the credit of the operator.

The introduction of the water-jacketed cupola dates forward to the next decade. I was using one in Pennsylvania, making copper matte, to the horror of a noted metallurgist, who could not conceive it possible that you could bring fused sulphides into contact with steel without rapid corrosion. In our ignorance we were doing what seemed to be an impossibility, and it is just that recklessness and disregard for precedent which has characterized so much of the work of American metallurgists, and carried us forward at headlong speed.

Once the water-jacket was accepted as the type of the copper-cupola, its almost unlimited expansion in length, but not in width, was a matter of convenience rather than of skill. In Butte the cupolas have been enlarged by adding furnace to furnace.

The first reverberatories which I saw in operation were those in Hill's Black Hawk establishment, where the concentrate from the Gilpin County gold mills was run down into matte for separation in England. Smelting was done with wood as fuel, and the capacity of the furnace was about 10 tons per diem. Shortly after this, Hill formed an alliance with Richard Pearce, who was running what was called the Swansea Works, at the bend of the river approaching Georgetown.

Mr. Pearce had been engaged in the separation of precious metals from copper products in Wales, and applied his skill to the local separation of the Black Hawk matte. Soon the operations were shifted to the larger works at Argo, near Denver, where for many years the Ziervogel method was practised with much success. And to Pearce is due the credit of taking the lead and gradually expanding the size and capacity of the reverberatory, for at Argo and at the company's branch works at Butte this type of furnace grew rapidly in size to 35 by 16 ft., and a capacity of 50 tons.

Big as these were, they were pygmies compared with the huge reverberatories of the present day, heated by oil or coal, smelting as much as 660 tons of charge per day, and fulfilling what the old metallurgist dreamed of as a possibility, but failed always of securing as a reality: the recovery of the waste heat in the form of power.

The fate, however, of the Argo works, despite the science and experience which Pearce brought to bear upon his operations, was virtually sealed when the combined forces of the pneumatic method and electrolytic separation came almost simultaneously to the aid of the metallurgist. The converter brings the matte to metal in a space of time measured by minutes. Electricity at one operation refines the copper and separates the precious metals, simplifying the process and saving time and money. The Argo works had therefore to go out of blast, and the metallurgist retire before the engineer and the electrician.

The changes have not been confined to smelting, but have been conspicuous in the concentrating department. Isolated motors have in great measure abolished the counter-shafts; and grinding-mills of many different makes have competed for acceptance in rapid succession. The National riffle has even displaced the jig in some mills, and now flotation is claiming to supplant all other methods. Whatever invention may for the time being claim supremacy, the experience of the past compels one to admit that the construction of the mill of the future should be so elastic that it can be altered with the least expense and embarrassment to suit the many changes which will become imperative. It will probably consist of a large square structure, within which the devices temporarily employed will be erected upon platforms and scaffolding which can be readily shifted.

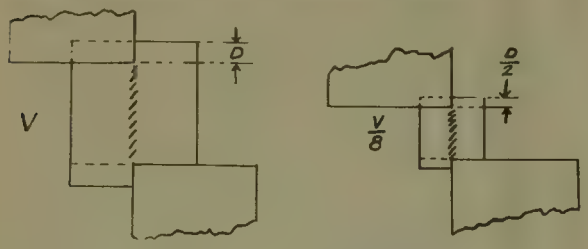
We have been recalling incidents in the history of copper metallurgy, but it is the growth of the iron industry which excites our imagination and wonderment. Its consumption is really the barometer by which we can gauge the world's activity and the demand for other articles; for there is an economic relation in the use of one metal and another. As the demand for iron is the controlling factor, not only in the metallurgical world, but in the industrial world at large, it is iron which fixes the rate of production of virtually all the other metals. I pointed out some years ago that the relation of the consumption of copper to iron in this country was as 1 to 83. That relation has been maintained ever since, and holds good approximately in the world's consumption of iron and copper. That being the case, the demand for the metals, and therefore, to a certain degree, the price which they will command in the market, depends upon economic laws, which will inevitably over-ride our attempts at interference. When these laws come to be better understood and submitted to as implicitly as we bow to the laws governing the forces of nature, the large groups of people who compose the industrial world, instead of engaging in rivalry, which is liable to degenerate into hostility, may possibly co-operate to advance the interests common to all. A world combine would be clumsy to handle, but a world's congress might pass international laws for the regulation of trade which would obviate some of the anomalies that exist today.

*Excerpt from address given recently before the New York section of the American Institute of Mining Engineers.

The Mechanical Efficiency of Crushing

By HERMAN C. KENNEY

Kick's law states that to produce similar alterations in the form of similar bodies requires work in proportion to the volumes of the bodies, according to my understanding of it. In an article by A. O. Gates[1] it is shown in his Fig. 1 how this law applies to cubes under stress. In Fig. 2 he has shown a cube subjected to shearing stress and has shown how the law is inapplicable in this case. It seems to me, however, that the law applies here also. Take the following figure:



100 Mesh Cube
Area one Section = A
Average resistance to shear per square inch = F
Energy = F A D
Energy Proportional to Volume.
200 Mesh Cube

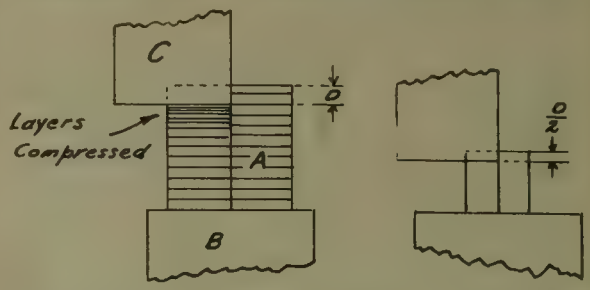
$$\text{Area one Section} = \frac{A}{4}$$

$$\text{Energy} = F \frac{A}{4} \frac{D}{2}$$

(In Mr. Gates' Fig. 2 he assumed that D and D 2 shown above were identical when fracture occurred.)

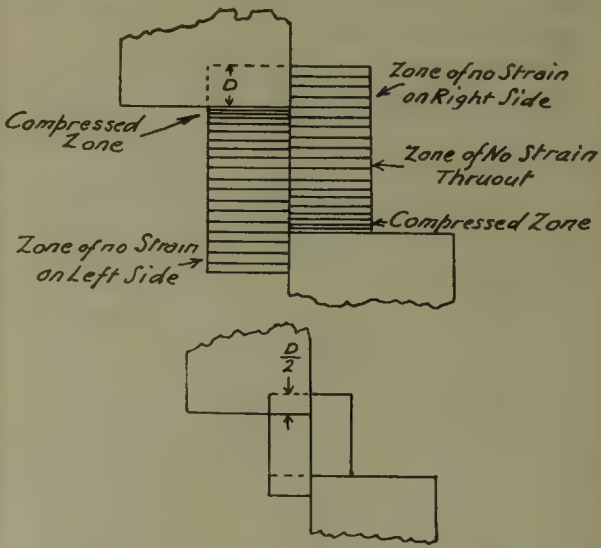
Here analogous changes of configuration have taken place and the work done is proportional to the volumes, as shown and as Kick's law states. This is assuming that the cubes have not been ruptured; that is, that they have not been strained beyond the elastic limit. This, it seems, is all Kick's law implies, as 'configuration' in itself signifies form or shape and not state of division, and the law is essentially a re-statement of the laws of elasticity. Make the assumption that any body is perfectly elastic to a certain degree, however slight, and that up to the elastic limit stress varies as strain. From this point to the yield point, at which the first visible break occurs, the stress is no longer proportional to the strain, and small latent breaks are occurring whose extent cannot be determined.

Now, does Kick's law hold beyond the elastic limit? In Mr. Gates' Fig. 2 it was assumed that the shearing distance would be the same irrespective of the diameter of the cube. That is, if cube V required the force to pass through distance D, cube V 8 would require the force to pass through this distance also, whereas to obey Kick's law D 2 would be required as shown. If the blocks were perfectly inelastic the former would, no doubt, be true, but consider the following case:



The cube A is supported on the anvil B, and C is a distorting force. The left side of A would be compressed, the upper layers more than the lower, and in time these would tend to separate from the upper layers of the right side. In a block of half the diameter the same relative effect would be produced by the force moving through half the distance as before, even though rupture may have taken place. In this case Kick's law seems to be in force even beyond the elastic limit.

Applying this form of reasoning to Mr. Gates' Fig. 2 we have



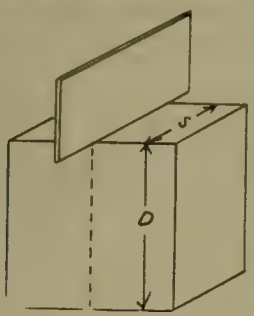
Compression takes place on each side owing to the elasticity of the block, and finally to break it the central portions must have slid past each other far enough to cause rupture, as stated by Mr. Gates in his article.

Obviously, the greater the diameter of the block, the greater would be the distance necessary to produce the same relative effect, and it can be shown that this distance will vary as the diameter of the cube and will not be a constant quantity as stated in the article re-

[1] *The Engineering and Mining Journal*, May 24, 1913, p. 1039.

ferred to. So Kick's law seems to apply here also, and it seems as though it would apply beyond the elastic limit in all cases.

Take the simplest case of all. Suppose a soft chalky material that can be cut with a knife, and that a cube one inch on a side be taken for experiment. Then suppose the cube be cut into two equal parts. If the knife were sharp enough and strong enough, in short, a theoretical knife (since we are dealing in theories), that would sever the molecular bonds without causing compression or distortion, the work done can be expressed easily enough. The distance passed through must equal the diameter of the block, and the force must be the product of the length of the knife-blade in the cut, by the resistance offered to it per linear inch. In other words, the work would vary as the area of the cut.



F = Resistance per inch
Work = F D S

This work would be required if the cube were cracked or broken in the same place by any other means, as it is the net amount of work required to sever the bonds holding the halves of the block together.

Call the unit of work the force necessary to make a cut an inch wide acting through a distance of one inch, and equal to W. To cut a cube one inch on a side into eight equal cubes would require three cuts, or work equal to 3 W. If the original cube already had work expended on it equal to A, the total work in the eight small cubes would be 3 W + A, but since the surface of the original cube was six square inches, equal to fractures of three square inches, A = 3 W, the work in the eight cubes would be 6 W and each would have had work expended on it equal to $\frac{6\,W}{8}$ or ¾ W.

To tabulate:

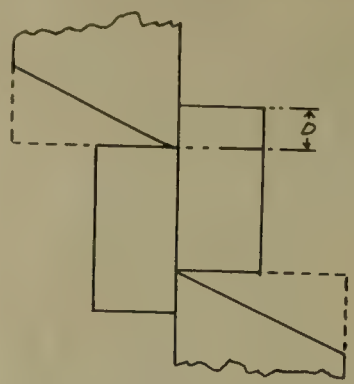
		Unit				
Side of cube, inches.	S	1	1/2	1/4	1/8	1/16
Number of pieces from unit	$P = \frac{1}{(s)^3}$	1	8	64	512	4096
Volume of each piece, cu. inches	$V = \frac{1}{P}$	1	1/8	1/64	1/512	1/4096
Number of unit cuts to reduce from unit cube		0	3	9	21	45
Total work	$\frac{S}{3W}$	*3W	*6W	12W	24W	48W
(For comparison....– 10 log 1/s	†0	3	6	9	12)	

*See above.
†Proposed by C. A. Stadler.

So the series derived agrees with Rittinger's, and not Stadler's series. Rittinger's law states that the work of crushing is proportional to the surface exposed in crushing or to the reciprocal of the diameter crushed to.

There must be a loop-hole some place, and since I have previously shown that the distance the crushing force, or shearing force, passes through must be proportional to the diameter, there can be only two possibilities for the discrepancy in the two cases. Either (1) the force is not proportional to the surface of fracture, as claimed by Mr. Stadler, or (2) the area of application of the force is not equal to the area of the cube-face. Let us go back to Mr. Gates' Fig. 2.

Suppose the jaws of the shear were not square set, as assumed before, but beveled as shears usually are.



The force to cut the block could not have changed if, as given above, it is equal to the area of fracture, but the area of application of this force has changed from a surface to a line, and the work becomes

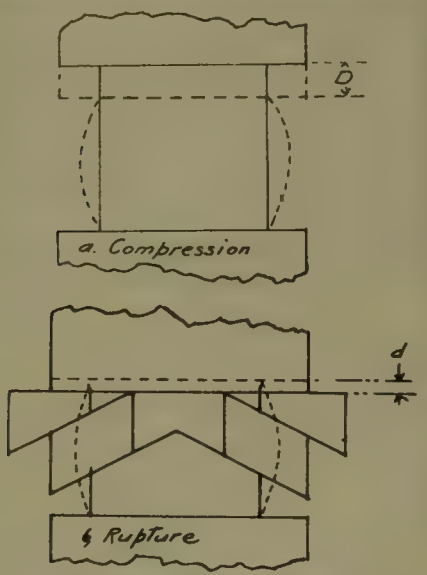
$$W = F\,D\,S \text{ for a one-inch cube}$$

$$\text{and } W = F\,\frac{D}{2}\,\frac{S}{2} \text{ for a cube } \tfrac{1}{2} \text{ in. on a side.}$$

This is not then a volume relation, but a surface relation, since F is constant, D varies as the diameter, and S equals the diameter. So W varies as S^2, as does the surface exposed in this operation. Of course it would be impossible, or nearly so, to shear a cube in this way, and this action might never occur in any commercial crushing operation. Theoretically, however, it is easy and it involves the use of an ideal machine when assuming a 100% efficient one. A steam-engine could never approach 100% thermal efficiency, and this may also be true of crushing devices.

To return to Kick's law. I have shown that it holds in all cases when the elastic limit has not been passed, just as it was intended to, but that in one case, at least, it does not apply thereafter. In my last figure it is evident that for every compression, however slight, there is a corresponding amount of fracture, and that there is added to the work of compression, which is proportional to the volume, the work of fracture in turn proportional to the surface of fracture. As the cut becomes nearly complete, the potential energy of compression changes to work of fracture and the work of compression is lost,

as such, and drops from both sides of the equation. In the case of straight compression, as in a testing machine or stamp, the work done divides into: (1) the work of compression, and (2) the work of fracture. The



PROCESS OF CRUSHING A CUBE.

work of compression will operate up to the yield point and is proportional to the volume, as Kick's law shows. The work of fracture is proportional to the surface of fracture, being simply the work to sever the molecular bonds, as I have shown in the case of cutting the cube where this work acts alone. Now at the yield point the work of compression changes to work of rupture and the parts tend to assume their original shape. To obtain 100% efficiency there should be a complete transfer of work of compression into work of rupture.

Then

$$\text{Work input} = W_c + W_f$$
$$\text{Work recovered} = W_c$$
$$\text{Total work} = W_c + W_f - W_c = W_f$$

But W_c varies as volume and W_f varies as surface exposed. If no further work is put into the rupture W_f must equal W_c, so surface exposed varies as volume.

Here is the agreement between the laws of Kick and Rittinger, showing how the work necessary to break cubes of the same material is at once proportional both to the volumes and the surface exposed by the break.

That the work required to rupture cubes of rock of various sizes is proportional to the volumes of the cubes has been shown by many tests. R. H. Richards in his 'Ore Dressing,' Volume I, page 300, gives the data for tests made at the Watertown arsenal in which it was demonstrated that the force to rupture cubes of the same material was a constant, independent of the size of the cube. From this it is easily shown that the work ($= F A D$) varies as the volume. No measurements of surface exposed were made in this case. Tests made at the same time on similar prisms showed that the work was a volume relation, but that it was not in any way related to the work to rupture a cube.

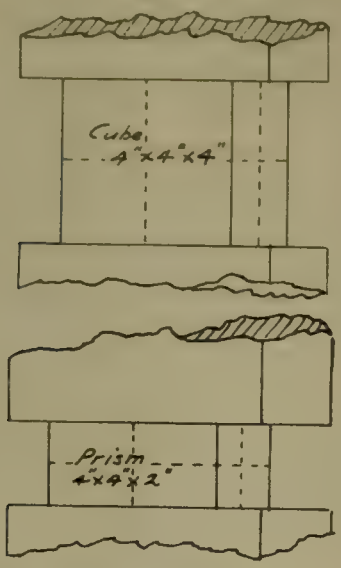
Rittinger's law in no way states that the work to rupture a cube is not proportional to the volume of the cube, neither does the law state that the work done is proportional to the diameter, or the square of the diameter, of the cube ruptured. The law states first of all that the work done is proportional to the surface exposed in the operation and that this surface is, to all intents and purposes, proportional to the reduction in diameter. It is difficult to understand what is implied by the word 'configuration' in the English version of Kick's law, but from the foregoing reasoning it seems that the law holds always within the elastic range and, in cases of straight compression, just up to the breaking point. Rittinger's law does not apply up to the elastic limit, since no surface is exposed. Between the elastic limit and the breaking point small breaks occur, but these cannot be measured; however, if the work is continued so that these breaks are developed they can be measured, so we must consider that the law is in force from the elastic limit on.

Mr. Stadler's version of Kick's law is that it applies always. He assumes that the work of compression in changing to work of fracture is sufficient, and just sufficient, to break the cube into eight similar cubes and that a like amount of work would break these eight into eight more each, yielding in each case surfaces proportional to the square of the diameter of the large cube. It is shown in Kent's handbook that suddenly applied forces are more destructive than slowly applied forces exerting the same amount of work. Kick's law explains this by saying that suddenly applied forces acting similarly will produce alterations in proportion to the volume, just as slowly applied ones do, but that for the same amount of work done the alterations need not be equal for equal cubes. Rittinger's law explains it by saying that when rupture occurs the surface of rupture is proportional to the work done in all cases. A rapidly applied force would require less work to rupture a block, and consequently would produce less surface. This is natural enough, for a sudden blow usually makes a cleaner break than a slow one. Mr. Stadler's theory is at a loss to explain this case, for he has made the assumption that a definite amount of force will divide a block into eight parts, regardless of the way it is applied.

Take the case of a prism. I have mentioned the Watertown Arsenal tests and how Kick's law applied for prisms as well as cubes. Rittinger's law, of course, does not consider the shape of the material, but applies in all cases. Stadler's theory, on the other hand, has nothing to do with prisms. Suppose a prism occurred in a lot of material to be crushed, I believe Mr. Stadler would divide it into eight parts as he does a cube with a unit expenditure of energy. Taking for comparison a prism 4 by 4 by 2 in. and a cube 4 by 4 by 4 in., they can be divided into eighths as shown in the figures on the next page.

According to Mr. Stadler, the force, and not the work, varies as the surface of fracture. In the case of the cube,

the surface exposed is 3 by 4 by 4 in. = 48 square inches. In the case of the prism the surface is 2 by 2 by 4 + 4 by 4 = 32 square inches. So the force to crush the cube would be greater than the force to crush the prism. The Watertown Arsenal tests showed just the opposite, the force to crush the cube being 5962 lb.,



and the force to crush the prism being 8028 pounds.

In case the unit cube does not break up into smaller cubes, Kick's law does not apply further, for the geometrical similarity has disappeared. Cutter (Richards' 'Ore Dressing,' Volume I, page 302) has shown that for blocks of nearly the same volume but slightly irregular in shape, the crushing force is not only not a constant but varied within wide limits, so that the work could not be proportional to the volume of the block. Mr. Richards explains this by the statement that in the cases where the force was greatest, the work done being also great, the blocks were shattered, while in the cases where it was least they were simply split, showing in this way the surface relation.

Referring again to Richards' 'Ore Dressing,' Volume I, page 305-310, tests made by Von Reytt on an ore consisting mainly of quartz, calcite, argentiferous galena, and blende, by crushing in various machines, show that the increase in surface per horse-power varied between 20 and 40 square metres. This was considering, of course, that the machines were 100% efficient. These limits in themselves are very reasonable and are not nearly as wide as the variation between Rittinger's law and Stadler's theory. He adds that in the finer sizes the increase in surface was greater than the law called for. This is very natural under the circumstances, since the ore was heterogeneous and the more easily broken constituents tend to accumulate in the fine.. Then, too, if latent breaks had occurred these would tend to show more in the finer sizes. Mr. Richards sounds a warning note against assuming that all the constituents of an ore have the same specific gravity and tensile strength, citing the case of quartz and galena. He shows that the power to crush a given weight of quartz is to that to crush the same weight of galena as 15 is to 1.

Von Reytt, moreover, adds a table of results showing his energy calculations. This table, although not exactly according to Rittinger's law, is certainly far from being in accord with Stadler's theory. I hope that these observations may serve to show that Rittinger's law is not founded on fiction and should not be dropped as fallacious without direct experimental proof. Further argument without such proof seems to be but beating about the bush.

Continuous Decantation in South Dakota

By JESSE SIMMONS

Increasing popularity of continuous decantation, with counter-current circulation of the cyanide solution, as applied to the treatment of slime, is evidenced by the manner in which it is being solved and adopted by Black Hills operators. Following the example of the New Reliance, the first plant in the district to be equipped for this work, the newly constructed Black Moon mill of the Mogul company was constructed on similar lines. Now comes the Golden Reward, where, after considerable testing, the process is to be applied, and the Moore filter dispensed with. In preparation for the new process there have been installed in this mill a 24 by 16-ft. tank, with Dorr thickeners; a 24 by 16-ft. tank, with Trent equipment; a 12 by 16-ft. tank with Dorr agitator, and a similar sized tank equipped with a pipe agitator made on the premises. Tanks for the slime department as now arranged consist of four 20 by 16-ft., equipped with Dorr thickeners (two of these are steel, recently installed to replace wooden tanks), the two agitators as above, the Trent tank and the large thickener. As the slime at this plant amounts to less than 100 and over 75 tons daily, it is calculated that the equipment will be ample to fill the requirements. To handle the slime between the various tanks, diaphragm pumps are used, and in order to overcome the excessive wear on the driving gear, an objection to the pumps as delivered by the manufacturers, at this mill a new scheme of transferring the energy has been adopted. A frame of ½ by 3-in. angle iron is fastened to a small platform, at one end of which is the pump and at the opposite end, 5 ft. distant, is the drive shaft to which a pulley is attached. An eccentric on this shaft is connected by a rod to a walking beam, which in turn drives the pump. It makes a smooth-running rig, does away with the gears and pinions often used, and appears admirably suited to the purpose.

OPERATIONS of the Broken Hill South during the six weeks ended February 6 were as follows: ore treated, 20,230 tons, assaying 15.4% lead, 7.3 oz. silver, and 14.7% zinc; concentrate produced, 4025 tons, assaying 60.1% lead, 21.6 oz. silver, and 10% zinc. The mine and mill was only at 50% capacity during this period.

Ways That are Dark

By JOHN B. FARISH

From earliest history, deceptions in all kinds of trade and commerce have been practised; mining has not escaped its share. While I stood at the collar of one of the old circular shafts sunk by the Romans in Transylvania during the first century, a shaft that began on nothing, went down on nothing, and ended in nothing, I could easily picture to myself the professional mine-promoter of that day walking up the streets of Rome with his hands full of specimens of the rich gold ores of Transylvania, inducing his friends to invest in the bonanza he was developing in that far-off country.

And so, even if there is nothing new in the following rambling reminiscences, I submit them in the hope that they may serve as beacons to warn the younger engineers of the dangers and temptations they may have to overcome along the road they must travel to win their spurs.

In the early '80s I was engaged to examine a mine in southwestern Nevada, something over 100 miles from Candelaria, the nearest railroad point. I had been cautioned by my employers that while the persons offering the mine were excellent practical miners and judges of mines, they were at the same time not to be trusted, and they might, in order to make assurance doubly sure that their representations would be confirmed, attempt to salt my samples.

With this warning in mind, I took with me to the mine a strong box which I had had made, of sufficient size to hold my sampling outfit. I also took with me several rolls of tape of a peculiar green color, and sealing-wax of a shade which I thought could not be found in such an out-of-the-way place. I was accompanied by two assistants.

On reaching the property, we took the box and entire outfit into the mine, and never for one moment was it out of our sight, night or day, except at the meal-hours, and then the tape was passed around the box and securely sealed with the wax. No one was near us during the time that the samples were being taken, and I, as was always my custom, watched every sample cut, and took part in cutting many of them, and also assisted in the work of breaking down and quartering the samples to convenient size and placing them in the ordinary sample-bags I had taken with me, which in turn were carefully sealed and put inside the box.

After a week of such constant work and vigilance, we finished, and the box was taken with us in the open wagon back over the desert roads to Candelaria. The box was the kind of baggage that the Pullman company refused to allow in a sleeping-car. Consequently, we sat in the last seat of the day-coach with the box next to us. The owners of the mine and the men of whom we were suspicious accompanied us from the mine to the railroad station at Candelaria, and there bade us good-bye. We felt a sense of relief when we had parted from them finally and were at last in the train homeward bound.

In the evening we stopped at a little out-of-the-way station for supper. There were only three or four houses, and as we had our reservations for the sleeper for the night, I determined that we were far enough away from the 'scene of hostilities' to permit me to safely trust the box to the express company and have it sent forward to the assayers. I, therefore, took the box, which was sealed with the same green tape and sealing-wax, into the express-office, and after marking it with my name in care of the assayer at San Francisco, I delivered it to the express messenger. He objected that the rules of the express company did not permit him to accept a box sealed as that was, so we got some screws and fastened the cover down securely with them, removing the tape and wax.

A day or two after I arrived at San Francisco the box showed up at the assayer's, and the samples were duly assayed, but to my surprise they ran about double what I had thought they would from the appearance of the ore as I was breaking the samples. This led me to take a few specimens which I had picked out as being extra good, and which I had carried in my grip, to the assayers. Much to my surprise, these selected samples did not run any higher than did the average samples that were cut. To my mind, this was a suspicious circumstance, and I posted back to the mine and took check samples, which never left me for a moment, as I carried them back with me in my grip to San Francisco. These samples ran about as I judged the ore should from its appearance in the mine, and were too low-grade to pay, economic and physical conditions considered.

It was many months afterward before I learned that of all the people between Candelaria and San Francisco, the only one who was in any way interested in salting my samples was the express messenger at the little out-of-the-way station in Nevada. He probably opened the box after it had been entrusted to him and applied the 'salt' to the samples before expressing it to its destination.

A few years after that I was in Colorado in the interest of George D. Roberts, at that time a well known and prominent mining man of New York, one who, thirty years or more ago, was known all over the West. He had written asking me to find him a large body of ore on which there would be a regular margin of profit. My attention had been called to the Mud Sill mine, not far from Fairplay, in Park county, Colo-

rado. It was owned by certain persons resident in Detroit, and associated with them were two brothers who lived in Colorado. The older brother was the manager for the mine and the younger was his assistant. The older brother was as pleasant, affable, and convincing a man as I had ever met, and it was on his representations that I went to the mine and made what I told him was a preliminary examination. The mine itself was said to be an impregnation of limestone carrying from 18 to 24 oz. of silver. Milling ore of that grade at that time was profitable under the usual mining conditions.

On the day after my arrival at Fairplay I went with the brothers to the mine. After going through it with them, I spent the rest of the day and the following day in taking a number of samples. The formation did not appeal to me, nor did the so-called ore appear to be of commercial value. I did not, however, for one moment think that my samples would be tampered with, though I took the ordinary precaution of putting them in special bags, well sealed with a seal-ring bearing an Old English 'F'; these in turn were put into a canvas sack which was securely sewed, and were delivered by me to the express company at Fairplay. I had, as was my custom, picked out a few specimens of the ore and these I put into my grip under lock and key without the knowledge of anyone.

The older brother accompanied me to the express office, and the samples were addressed to a well known assayer at Denver. The next day, we all went fishing in the South Park river and had a pleasant outing. That night I left for Denver, and my samples showed up on the day after my arrival in that city.

The results of the assays were received in due time and confirmed the statements made to me by the older brother as to the value of the ore. The average, as I now recall, was between 17 and 18 oz. I had one of the specimens I picked out assayed and the result was only 12 oz. I did nothing further with the property; for, as already stated, the formation did not please me, and when the New York mining man came through Denver I told him that it was nothing I cared to present to him and that I had dropped it.

Some little time afterward, the property was taken over by an English company at a price which I understood to be $300,000. An experienced English mining engineer had examined it, and I was informed that on his report the purchase was made. A small mill was erected for testing purposes and to determine what recovery could be effected. It was only run a short time when operations ceased and the entire proposition was abandoned.

Some months had passed when I received a note from the Hon. Charles S. Thomas, the well-known lawyer of Denver, who is now United States Senator from Colorado, asking me to call at his office. I did so, and after the usual greetings he asked me if I had not at one time examined the Mud Sill mine. I told him that I made a preliminary examination. He asked me why I had not gone further and made a second examination and taken the property. I told him that while my samples of the ore averaged up to the grade that had been represented to me, I did not like the formation, and therefore I had advised my client not to proceed with it. He then gave me one of the surprises of my life by asking me if I knew that my samples were 'salted.' I told him I did not; that I had no idea of it, though I had always wondered, in a disinterested kind of way, why the specimen had not run as high as the average of the samples of ore, and that if I had gone back to make a fuller examination that would have been one of the things I should have looked into first. He then said, "Well, your samples were salted," and in answer to my inquiry as to how it was done, he told me this story:

On the evening that I finished sampling and gave the sack of samples to the express messenger—the evening before we went fishing—the younger brother had at midnight gone with the express messenger to the station, where they secured the sack of samples, and carried them some 300 or 400 yards to an old deserted and vacant cabin. They hung blankets over the windows of the cabin and then by the light of a candle they opened the sack. They found, to their surprise, that the sample-bags were sealed with the seal-ring bearing the initial 'F.' In this plight, they carefully opened a small hole in the bottom of each bag and through that administered the 'salt' as a liquid, from some glass instrument. The younger brother told the express messenger that this was only a preliminary examination and that he wanted to get an impression of the seal so that he could be better prepared when I came back to make a fuller examination. So he left the express messenger in the cabin and went up to Fairplay between two and three o'clock in the morning and returned with some wax and plaster of paris. With these he took an impression of the seal on the bags, and having finished this work, replaced the bags of samples in the sack, carefully sewed it up and took it back to the express-office, from which it went forward to Denver by the morning train the next day.

He further stated that the younger brother went to Denver and hunted through the jewelry shops there for a ring with a seal that corresponded with the one I used in sealing the bags. Failing to find one, he sent the impressions to his brother at Chicago, who made a search there, and not finding a seal that would answer the purpose, he had one cut. On the return of the younger brother to Fairplay, he showed the seal to the express messenger and told him he would be ready for me when I came to make the final examination.

I asked the Senator how he knew all this, and he replied that the English company, which had purchased the mine on the report of the English engineer, had brought suit in the Circuit Court of the United States, at Detroit, against the two brothers and their associates, and that the express-agent, who had been promised some of the 'swag,' had told the story of salting the samples

of the different engineers, including my own, because the brother had failed to 'divvy' with him. I watched the trial of the case with interest, and was somewhat disappointed when the verdict was rendered in favor of the defendants. An appeal was taken to the Court of Appeals, where on February 5, 1894, the Circuit Court was reversed and a decision rendered giving the complainants judgment for all they asked. The title of the case is Mudville Mining Company, Limited, *et al. v.* Watrous *et al.* The decision is reported in full in 61st Federal 163, and affords interesting reading.

The third instance occurred at Breckenridge, Colorado. Those engineers who know the veins in that district know that in many of them the ore is contained in an altered and often very clayey porphyry rock occurring in dikes in the general formation. I was one of several who were engaged to examine and make separate reports on one of the prominent mines of that district, famous for its specimens of leaf-gold.

The mine was opened with five levels driven from a central well-equipped shaft. It was stated that the development disclosed an ore-shoot widening from some 300 ft. on the upper level to some 600 ft. on the lower level, and filling the full width of all of the drifts with ore that would assay from $8 to $10 per ton in gold. I began cutting large and systematic samples as carefully as possible, and these samples were broken and quartered in the usual way and assayed by one of my assistants in the assay-office at the mine. We occupied the adjoining room to the assay-office as sleeping quarters and as a convenience for working out our details. No one came near the office during the time of the examination and we felt ourselves quite safe. As I was bred among the gold mines of California, I had learned to use the old Mexican horn-spoon, and so I never examined any free-gold mine without making numerous hornings of the ore. In the different tests of different samples of this ore, I noticed that there was quite a difference in the character of the gold, both in its color and in the density of the particles. It was moderately fine gold, and the samples assayed quite regularly within very limited extremes. So marked was the difference in the appearance of the gold that I saved the hornings until I had accumulated a fair sample. About the time I finished the sampling, with the result that the assays apparently confirmed the statement made as to the length and value of the ore-shoot, some business called me to Denver. I took my samples of hornings with me, and while there visited Professor Van Diest, who was the happy possessor of one of the best microscopes at that time in Denver. Under this instrument, the different qualities of the gold showed up very plainly, and some of it certainly had the appearance of filings or grindings from the old brassy-looking $5 gold-pieces that were coined many many years ago in New Orleans and are now regarded as curiosities.

While on this trip to Denver I determined to inquire into the antecedents of the owner of the property, and with this object I interviewed J. A. Thatcher, at that time president of one of the most important local banks. His answer to my inquiry as to the honesty and integrity of the owner of the mine was one that I shall never forget. He said: "Well, I have known him since 1860 and he is an honest and honorable man, but he made a fortune in Leadville and so has had a taste of the luxury of wealth; and now he has lost about all of his money. Under those circumstances, you cannot tell what an honest man might do."

Upon my return to the mine I took with me two trusted miners who had only reached Colorado within two or three days and who had no personal acquaintances anywhere in the state. With them I began a check sampling of the mine. I took thorough possession of it, much to the annoyance of the manager, and for three days kept everyone out of the property. During these three days we cut back into the walls of the drifts at different points, from one to two feet. In other places, we put in shots that extended into the walls as far as the cuts. The samples taken from the back end of these cuts and from the bottoms of the shots returned only $2 to $3 in gold, and in all cases this gold was uniform in its appearance and character. This satisfied me that something was wrong, and I notified the head assistant of one of the other engineers who was examining the property, a well-known professor in one of the schools of mines, that I had become suspicious of salting and I would advise him to resample the property. Word came back from the professor that every care had been taken and he was personally satisfied with the sampling he had already made. To test the matter further, I determined upon a mill-run upon the property—there being a mill on it—though we all know how easy it is to salt a mill-run even where extreme care is used.

As the ore was broken in the mine we sampled each place as it was blasted, sampled the ore as it was hoisted in the buckets, sampled it as it went through the crusher and from the self-feeders into the batteries, and sampled the tailing. With all of this sampling, there was little chance for deception and the mill-run showed that the gold contents of the ore were very much lower than had been represented and much too low to pay. We paid no attention to the bullion.

Years afterward, a report reached me that when the manager of the property was on his death-bed, he told how the salting was done and that it cost several thousand dollars. Personally, I have been puzzled to know and can imagine no other way than the use of a shot-gun. Even with this, the particles were so small and so light that it would seem a difficult operation, especially to distribute the gold as evenly as it was. On the other hand, it must not be forgotten that the ore itself was of clayey character and that the gold would readily attach itself to it.

But 'salting' is not the only means of deception in mining. An interesting case came under my observation in the examination of a property many years ago

in Clear Creek county, Colorado. A two-compartment incline shaft, one compartment for hoisting and the other with a ladder-way, had been sunk on the vein to a depth of something over 400 ft. Four levels had been run at approximate depths of 100 ft. below each other. A definite ore-shoot had been practically worked-out from the third level to the surface, but good ore showed in the bottom of the third level under the stopes and along the roof of the fourth level. My samples were taken carefully in the floor of the third level and along the roof of the fourth to determine the tonnage and value of the ore blocked-out between the third and fourth levels.

While engaged in this sampling I was delayed one noon until after the engineer had gone to his lunch, and so had to climb out of the mine on the ladders. A few feet, perhaps twenty, above the roof of the fourth level I noticed that some of the lagging on the end of the shaft had fallen back at the top but was caught at the bottom. I did not think much of it at the time, but later determined to see why this lagging should hang in such a peculiar way. On making an examination, my candle disclosed the fact that back of the lagging a small drift had been driven into the block of ground that was supposed to be standing intact. Tearing the lagging away, I went into the drift and found that in a short distance it opened into a stope large enough to demonstrate that the heart of the block of ore that was supposed to be in reserve had been extracted. The ore had probably been wheeled out to the shaft through the little drift that I had accidentally discovered.

Quite a number of years ago, Alfred Wartenweiler and Henry Bratnober, two of the best known engineers of their day in the United States, had an option on a large property near Red Cliff in Colorado. The option was not exercised. Long afterward when talking the matter over with Wartenweiler, he told me that the principal ore reserves appeared to be in one large block that had been exposed by drifts on four sides. During the sampling he found that one of the shift-bosses was an old miner who had worked for him a number of years when he was manager of the famous Lexington mine at Butte; that one day he met the miner in a drift, and the miner whispered to him not to finish the examination of the mine without taking out a certain lot of cribbing at one corner of the block of ground. This Wartenweiler said he did and found to his astonishment that the heart of the block of ground had been taken out. At that time, a firm doing a very big packing business in a large city on the Atlantic coast was interested in the property, but whether the members of the firm knew of the attempted deception, my informant did not know.

A number of other instances of attempted deception that have come under my personal observation could be mentioned, but I think these are sufficient to show that in mine-examination work good-fellowship with the miners is apt to be useful and that, above all else, "eternal vigilance is the price of safety."

Smoke Dilution at Midvale

By L. S. AUSTIN

The bag-house at this lead-smelting plant of the United States Smelting, Refining & Mining Co., at Midvale, Utah, is divided into two parts, which receive respectively the gases from the blast-furnaces and from the roasting-sintering machines. The former gases contain less than 0.1% of sulphur dioxide, and hence may be freely emitted into the atmosphere without possible detriment to vegetation. The gases from the roasting division, however, must, by order of the Court, be kept below the limit of 0.75% in sulphur dioxide, it being then considered sufficiently diluted to permit escape without detriment to life, either vegetal or animal, in the surrounding country. Also, by order of the Court, the limit of 10% sulphur was not to be exceeded for the ores treated at these works.

Of late, however, the proportion of sulphide ore has been increasing, so that at present 80% of the ore on the blast-furnace charge is composed of sintered (that is, roasted) sulphides. To remove all possible chance of complaint on the part of the neighboring farmers, the Company brings the percentage of sulphur dioxide in the escaping gases from the sulphide division safely below the permissible limit by admixture with air.

From near the roof and at the end of the bag-house a down-take comes off, 11 by 11 ft. in sectional area. This branches near the ground, each branch entering a No. 20 Sorocco suction-fan. These fans are narrower than the regular No. 20 Sorocco fan in order to insure greater efficiency. Estimating the temperature of the bag-house gases at 135°F. and the maximum air-temperature at 100°, both fans will discharge 350,000 cu. ft. per minute. The diameter of the fan is 10 ft. and it will run at 100 r.p.m. Both fans require 70 hp. against a resistance of 0.54 in. of water. The two fans are on a common shaft and are driven by a 150-hp. electric motor. In the down-take are regulated openings into which air is drawn, and a further supply can also be obtained by opening the lower doors of the upper chamber of the bag-house. In this way any desired dilution with fresh air can be obtained to keep the sulphur dioxide below the proposed limit. The stack is 16 ft. diam. and the diluted gas mixture escapes through it at the rate of one-third of a mile per minute.

It will be seen that, owing to the entrance of fresh air before the fans, and to the action of the fan-blades, there is a thorough mixing of the air with the filtered gases. When in addition, we remember the high velocity with which the mixture is shot upward, its superiority over the older way of discharge is evident.

It certainly appears that any chance of damage to the farmer is now eliminated and that complaints and damage suits initiated by him should cease. The Murray plant of the American Smelting & Refining Co. is putting in a similar installation, except that the fresh air is supplied in known quantity by a separate fan.

Infusorial Earth

By SAMUEL H. DOLBEAR

Introductory.—Infusorial earth, called also kieselguhr, diatomaceous earth and known by various trade names, is generally described as a variety of opal. Chemically, this designation is correct, but physically it possesses characteristics about as different from opal, in the sense in which the word is generally taken, as can be imagined. The classification is a most unsatisfactory one, and there is really no more justification for referring to infusorial earth as a variety of opal than there is for calling diamond a variety of coal. As there has been much confusion and a good deal of difference of opinion as to the correct designation for this material, a few words on this subject seem timely.

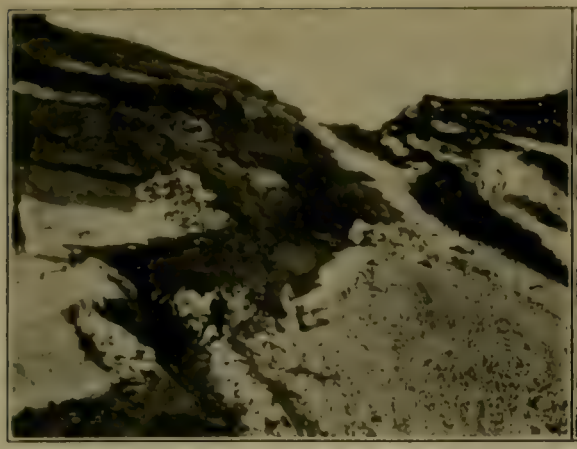
Diatomaceous earth is essentially the silicious remnants of diatoms, an aquatic form of plant life. Infusorial earth, then, would be similarly derived from infusoria, a low order of animal life. Most deposits of this material, if not all of them, are made up of both diatomaceous and infusorial earth, and either name may be applied with equal justification, unless one is willing to go to the pains of determining in each sample which of the two is in the majority. If more diatoms be found than infusoria, then diatomaceous earth would properly describe it. The name 'kieselguhr' is of German origin, being a combination of the German *kiesel*, meaning flint, and *guhr*, an earthy deposit or sediment in water. Tripoli takes its name from Tripoli in Africa, where large quantities of the earth are quarried. While in this country it is used to some extent interchangeably with diatomaceous and infusorial earth, it is commonly employed to designate a light porous variety of chert mined in Missouri and other places. This chert is supposed to have originally contained much lime which has been dissolved out, leaving a cellular structure chiefly consisting of silica. The uses of tripoli are very much the same as those of kieselguhr, although the latter is finding a wider variety of applications, owing to its lighter weight. It is a soft, chalk-like substance, extremely light, and when pure, almost white. Diatoms are so small that 40,000,000 may be easily placed in the space of a cubic inch.

Few substances are more widely distributed than this. It is found in nearly every country on earth, and in North America its occurrence is noted from Alaska to the Panama Canal. It is by far most abundant in the eastern portion of the United States, where in Delaware, Maryland, Virginia, and North Carolina it has been deposited over thousands of square miles and subsequently covered by alluvium of variable depth. Considerable amounts are mined in Maine and Nova Scotia. Much of this is shipped to England, in which country none is produced. Small quantities of high-grade material are found in Scotland. Very good earth, close to tidewater, is found in Alaska. Large shipments have been made from the gulf ports of Mexico to New York, this earth being white and resembling that mined in Africa. Algiers and Tripoli are the sources of the cheapest infusorial earth reaching the markets of the eastern United States. In spite of the fact that long overland hauls are necessary, the cost of production is very low. The product weighs 35 to 60 lb. per cubic foot, and requires careful sorting upon arrival at American ports. Upon distribution into three grades—light, medium, and heavy—it is then put into the market, selling at an average price of about $9 per long ton. This price prevails for lots of 200 tons or more.

The deposits of Germany are one of the most important factors in this industry, and the owners, who also control the African sources, dominate much of the world's trade. Owing to the boggy nature of some of the ground, hydraulic dredges are used in many instances. The earth is classified by flotation, dried, calcined, and ground. The exact method of treatment is held secret, and competitors have been unable to duplicate these products. This accounts for the demand for the German earth at relatively high prices. Outside of the United States, Germany is one of the principal producers of infusorial earth. English manufacturers, however, have heretofore purchased infusorial earth from Germany, and as the channels of trade are closed in that direction, they are now looking to American producers for a supply.

There are many deposits of this earth on the Pacific coast. Its occurrence is by no means limited to the Coast range, for it is found far inland in Nevada, Utah, Arizona, and New Mexico. Among the states which have produced this commodity are California, Missouri, Illinois, New York, Maryland, Virginia, New Hampshire, Massachusetts, Connecticut, and Nevada. In the Government reports, it is customary to give statistics combining the output of infusorial earth and tripoli, designating both as abrasives. While these two products resemble one another in some respects, and their industrial uses are much the same, there seems to be abundance of reason for keeping separate records of each. Through the practice mentioned, much confusion has resulted, and I find a constant tendency to confound the two by purchasers, many of whom have regarded tripoli simply as another name for infusorial earth. The structure, origin, and some of the physical properties are quite different. Its classification as an abrasive is correct, of course, but there are now many other uses for this material; in fact, its application as an abrasive is perhaps not as important now as its use as an absorbent and filler.

So many deposits of infusorial earth have come to my attention in the past few years, some good and some bad, that I have come to wonder if one of its principal uses was not to afford a pastime for mining promoters. This is accounted for, of course, by the increased demand,



THE QUARRIES ARE WORKED IN LAYERS 12 FT. DEEP.

QUARRY WORK AT LOMPOC.

new uses that have been discovered, and the fact that it occurs abundantly in California. In order to compete with producers who are now operating, it is absolutely essential that the deposits be large, of easy access to rail, and capable of yielding the best quality of earth. There are a number of factors to be taken into consideration in determining whether or not the earth is of a character to be valuable. Density is one of these. I believe in all deposits the density will be found to vary considerably. Where extreme lightness is required, the material is selected, the denser portion being kept separate and used for other purposes.

The lightest earth found in the Lompoc deposits, when air-dried for a month or six weeks, will not exceed 30 lb. per cubic foot. As the earth is capable of absorbing water in an amount equal to as high as 200% of its original weight, no judgment of its real weight should be passed until the sample is first dried. For most purposes color is a determining factor, a white or nearly white product being preferred. The sample should always be dried before determining the color. When taken from the ground the material invariably contains a good deal of uncombined water which may impart a gray, brown, or yellowish color. Much of this disappears as the moisture evaporates. According to Percy A. Boeck, the Lompoc earth contains 25 to 45% free moisture as well as 5 to 10% combined water.

Uses.—Those to which the earth is put are so numerous and varied that it is not possible to classify them completely. The two principal applications are dependent upon its abrasive qualities and its ability to absorb moisture readily. Almost equally important is its non-conduction of heat, which has resulted in extending its use to insulating of boilers, steam-pipes, safes, and refrigerating-plants. It is used quite extensively in metal-polishes, scouring-soaps, and in the preparation of some tooth-powders.

The chemical composition of the earth is not important in many of its applications. On the other hand, where the material is to be subjected to any high degree of heat, the presence of too much lime or magnesia will tend to reduce its point of fusion. In the following table I give analyses of infusorial earth from various places.

	I.	II.	III.	IV.	V.	VI.
	Per cent					
Silica	88.78	77.78	80.53	84.15	91.43	81.53
Alumina	2.68	2.96	5.89	1.40	2.89	3.43
Iron oxide	trace	0.00	1.03	0.70	0.66	3.34
Titanium oxide	0.10	....	.....	....	....	....
Lime	1.61	0.88	0.35	1.75	0.36	2.61
Magnesia	1.30	0.37	....	1.10	0.25	....
Soda	...	....	....	....	0.95	1.43
Potash	...	....	....	....		1.16
Loss on ignition	5.54	17.03	12.03	10.40	3.80	6.04

Localities: I, Lompoc, California; II, Sonoma county, California; III, New Hampshire; IV, Germany; V, Nevada; VI, Maryland.

As an absorptive, it is used to some extent in the manufacture of dynamite, and in Europe it has been used as a carrier of liquids. This is done for convenience in shipping bromine and other liquid chemicals, the earth being allowed to take up as much fluid as it will, and is then packed in wooden containers. In the same way it may be utilized as an absorptive of liquid manures. The sugar refineries in California alone use several hundred tons per year for filtering syrups.

Among its miscellaneous applications are the manufacture of papier-maché, Swedish matches, sealing-wax, sodium silicate, ultramarine and other pigments, analine and alizarine colors, gutta-percha products, artificial stone, composition flooring, ceramic products in glazing; as a filler in paints, as whiting, in plaster wallboards for lightening their weight and increasing their fire-proofing qualities, in electric stoves and fireless cookers; in the manufacture of phonographic records, in preserving timbers, and in portland cement, the addition of infusorial earth having been found to increase the resistance of the concrete to salt water. It is sometimes dusted over freshly laid asphalt surfaces to prevent adhesion. Introduced between the floors and partitions of buildings, it acts as a sound deadener. Experiments have recently been made in San Francisco in the manufacture of crayons from this substance. A

binder is added and the mass subjected to pressure in molds. Sawed into blocks, infusorial earth is made up into filter-stones, and the use of sawed blocks as building stone has been suggested. Refractory fire-brick having a fusion point of 1610 C. (2930 F.) is also manufactured.

California Deposits.—This state has become the leading producer of infusorial earth through the operations of the Kieselguhr Company of America at Lompoc in Santa Barbara county. These deposits have been worked for over fourteen years, increasing rapidly during recent years. According to the figures of the California State Mining Bureau, 6895 tons was mined here in 1913. The same authority gives a total production in California since 1889, of 38,442 tons, most of which came from the Lompoc quarries. The increase in demand for this material has been largely due to the intensive advertising and instructive campaign conducted by the Kieselguhr company. The engineers of this Company devote much of their time to instructing manufacturers in the application of the Lompoc product, and through this service and the fact that it owns forty or more patents covering as many uses, it is able largely to control the market. This has required a heavy investment, and aside from the extensive equipment at the quarry, the technical investigations and educational work alone have cost over $100,000. Here we have an example of high technical and business efficiency; manufacturers of other mineral or chemical products could well afford to study this Company as a model for their own organization to follow in building up a demand for the products they have to market.

From the point of transportation, the Kieselguhr company's mines are well situated. It has direct connection with the Southern Pacific company's railroad, and it is easily feasible to load directly into ships, tidewater being about four miles distant. Shipments by water have never been made from here, but the Company is now considering construction that will enable it to ship by water both to local markets as well as to the Atlantic seaboard and Europe. The Lompoc deposit is described by A. H. Krieger, general manager for the Company, as being several square miles in extent and having an average thickness, without any overburden, of 960 ft. The accompanying illustrations will convey to the reader something of the extent of the deposit.

The earth is extremely light, averaging 28 lb. per cubic foot or a little more than half the weight of the same volume of water. This is the lightest earth found, and as its usefulness is dependent in a large measure on its volume or bulkiness, it follows that this light product is more valuable than that weighing 35, 40, or 50 lb., as in the case of similar earth elsewhere.

The old methods of quarrying the earth have recently been abandoned and new equipment provided by which long narrow strips are sliced in the quarry face. These strips are 3 ft. wide, 500 or 600 ft. long, and 40 or 50 ft. deep. As soon as they are loosened, they are split into large flat blocks, and hauled to the sawmill. The function of the sawmill is to produce various shapes, the largest part of the output being bricks. This portion of the equipment has been completed quite recently, and is operated electrically. Power is transmitted over a recently built line, 26 miles in length. Where the earth is to be shipped in bulk or ground, it is accumulated in long winrows and allowed to dry by exposure to wind and sun for about six weeks.

The earth found at Lompoc is classified by the Kieselguhr company into three grades, the following being characteristic analyses of each:

	(1)	(2)	(3)
		Per cent	
Silica (SiO_2)	88.78	85.28	94.59
Alumina (Al_2O_3)	2.68	5.35	1.87
Iron oxide (FeO)	trace	1.12	0.76
Titanium oxide (TiO_2)	0.10	0.21	0.10
Lime (CaO)	1.61	1.12	0.83
Magnesia (MgO)	1.30	1.30	trace
Loss on ignition	5.54	5.57	2.22
Color	white	ivory	white
Color after ignition	white	pink	white

Sample (1) Very light-weight pure white kieselguhr.
(2) Light-weight brownish kieselguhr.
(3) Compact diatomaceous shale.

The crushing and grinding equipment, provided with air separators, is designed to prepare the various grades demanded by the trade. The ground product is packed in bags. Motor trucks are used to convey the material along the mountain roads, twelve miles of such roads being maintained by the Company on its own property connecting quarry workings with the various mills.

The deposits of J. C. Jens are seven miles from Bradley, in Monterey county, and from a point of reported production, are next in importance to those of Lompoc. According to Mr. Jens, 1700 tons was shipped in 1913, and about 1100 tons in 1914. Most of the material shipped was used for insulating purposes. Work is carried on during the summer months only; only enough earth is mined to fill contracts for lots of several carloads or more. The deposit covers 120 acres, and test-holes show a thickness of 240 ft. The earth is broken by the use of plows and scrapers, and only crude earth is sold, there being no grinding or sawing machinery on the ground.

The following analysis is given as characteristic:

	Per cent.
SiO_2	84.00
Al_2O_3	5.00
Fe_2O_3	0.00
H_2O	11.00
	100.00

The Los Banos deposit is 12 miles southeast of Los Banos, a town on the Southern Pacific railroad in Merced county. There are no heavy grades between the mine and railroad, but, as is the case of many California roads, no hauling can be done during the rainy season. The owner, George B. McDevitt, states that analyses show an average of 90% silica and an aggregate of 2.5% alumina, iron oxide, lime, and magnesia.

What is probably one of the largest deposits of this earth in California is found along the banks of the Pitt river, in Shasta county, California. It is reported to be 16 miles long and several hundred feet thick. Unfortunately, it is too inaccessible and too far from rail to be commercially important. In the Owens River valley, Inyo county, California, a little has been mined by John Black in the vicinity of Aberdeen, six miles from the Owenyo narrow-gage railroad. A shaft sunk on this claim shows the earth for a depth of 40 ft. It can be followed for many miles along the foothills of the eastern slope of the Sierra Nevada in Inyo county. In Los Angeles county there are a number of beds of diatomaceous earth, and attempts are now being made to explore these. In Sonoma county, two carloads were mined and shipped in 1913 from a point about five miles from Mark West station. The deposits are small and the earth is somewhat discolored. In Nevada, a few carloads are occasionally shipped from points along the Tonopah Goldfield railroad, and some has been produced from deposits 12 or 15 miles from Miller. The wide distribution of infusorial earth is fairly indicated by the fact that deposits have been noted in 16 counties of California.

MINERALS EXPORTED from Broken Hill in January were only worth $720,000, against about three times that amount in normal times.

Cost of Mining and Milling at Tonopah

By JAY A. CARPENTER

*At some future time when the United States Bureau of Corporations requires a fixed form of detailed report from all metal-mining companies, and such reports are given by the companies to their stockholders, such a compact statement as given in this article will be accurate in detail and easily secured. At present, to illustrate the contrast, the Tonopah Extension divides all operating expenses under the four headings, 'mining,' 'milling,' 'general expenses,' and 'administration expenses,' while the Montana-Tonopah divides its disbursements into 48 items, and a table on the cost of operations has eight headings, as follows: 'mining,' 'development,' 'milling,' 'general expense,' 'maintenance,' 'marketing,' 'indirect costs,' and 'depreciation.' In most of the reports the total costs of operations per ton of ore include only the Tonopah office vouchers, and to get the total cost per ton the financial statements must be studied to find the head or Eastern office expenses; but this is not the case with the Montana or Nevada Hills companies, with head offices at the mines. This contrast exists through all the reports. In one report the total information given concerning mill costs is in the one item 'milling'; in a second, the annual cost of 61 items under the head of 'milling' is given; and in others, complete milling costs for every month of the year are to be found.

After a careful study of these many different reports, table No. 2 is a conscientious attempt to take all these varying methods of cost-accounting and group them under a few definite heads for a direct and fair comparison of cost data for the year 1913.

It will be noted that the Nevada Wonder and Nevada Hills companies are also included, since these companies treat ores similar to the Tonopah ores and the wagon haul per ton to these properties from Fallon is no greater than the Hazen-to-Tonopah railroad freight rates.

*From *The Tonopah Miner*, March 27, 1915.

In table No. 1 is given a description of the reduction plants of the mining companies at the time the cost figures in table No. 2 were obtained. The data for table No. 1 were taken from articles in the technical press and from my personal knowledge of these plants. The tables are given on the next page.

The following general observations on table No. 2 bring out points of special interest. The grade of ore milled varies from $8.41 to $21.09, the daily tonnage produced from 52 to 473 tons, yet the gross cost per ton of those mines having reduction-plants varies only from $7.42 to $8.93.

The gross extraction varies within the limits of 87.2% and 94.45%, while the net extraction, which is the important extraction figure since marketing costs are not included in the total working costs and must be deducted from the gross extraction, varies from 84 to 91.95%. The variation in the cost of marketing depends upon whether bullion is the only product made, in which case about 1.6% is the cost of marketing, while if any concentrate is shipped out, with its heavy freight and smelter charges, the cost of marketing goes up in proportion to the tonnage shipped.

The book charge of depreciation, varying from nothing to $4.65 per ton, illustrates the varying importance attached to this charge by the different companies. The tons of ore for one foot of development work is an indication of the progress made in blocking out ore reserves, or the search for some to block out, and has a direct effect upon the total cost of mining.

If the "total of all costs" be divided into the two heads 'mining' and 'milling', and the important factor of net extraction be considered, a summary of table No. 2 would be as follows:

No.:	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Mining	4.68	3.58	5.87	4.19	4.46	0.00	4.20	4.62	4.35	5.57
Milling	2.92	3.84	3.06	3.26	3.59	3.94	3.24	3.53	3.32	7.27
Net ext., %	92.0	85.8	86.8	88.6	87.5	84.4	84.0	91.9	91.1	90.0

TABLE NO. 1. REDUCTION PLANTS OF THE MINING COMPANIES

Company.	Year Built	Crushers.	Grinders.	Regrinders.	Type.	Concentration	Classification.	Agitators.	Filters.	Precipitation.	Daily Tonnage.
Desert Power & Mill Co. Tonopah Mining Co.	1906	Gyratories 1 No 7½ 2 No. 4's	100 Stamps 1050-lb.	2 Huntingtons 2 Chileans 2 Tube Mills 1 5-ft x18-ft. 1 5-ft x20-ft.	Changing to All-Sliming	Wilfleys	Dorr Classifier and Thickener	Arm Agitators and Dorr Agitators	190-leaf Butters	Zinc Thread	400
Tonopah Belmont D Co 1 Millers Plant	1906	Gyratories 1 No 6 2 No 4's	60 Stamps 1050-lb.	2 Tube Mills 1 4-ft x16-ft. 1 5-ft x18-ft	Mostly Sliming Some Leaching	Wilfleys	Dorr Classifiers and Thickeners	Arm Agitators	120-leaf Butters	Zinc Thread	Custom Mill about 150
2 Tonopah Plant	1912	1 No. 7½ 2 No 4's	60 Stamps 1250-lb.	8 Tube Mills 5-ft x18ft	All-Sliming	Wilfleys	Dorr Classifiers and Thickeners	Pachucas	200-leaf Butters	Zinc Dust	500
Montana-Tonopah M. Co.	1907	1 No 5 2 No 3	40 Stamps 1050-lb.	2 Tube Mills 5-ft x22-ft	All-Sliming	Wilfleys	Dorr Classifier Cone Settlers	Hendryx & Trent	144-leaf Butters	Zinc Dust	150
West End Con M Co..	1911	10x20 Blake 1 No 3 Gyratory	20 Stamps 1250-lb	2 Tube Mills 5-ft x18-ft	All-Sliming	Deister	Dorr Clas'r, Dorr & Trent Thick'nrs	Trent	100-leaf Butters	Zinc Thread	150
Tonopah Ex M Co	1909	Gyratories 1 No 4	30 Stamps 1050-lb	2 Tube Mills 5-ft x18-ft	All-Sliming	No Concentration	Dorr Classifier Cone Thickeners	Trent	100-leaf Butters	Zinc Thread	160
MacNamara M Co	1912	Gyratories 1 No 3	10 Stamps 1350-lb.	1 Tube Mill 5-ft x16-ft	All-Sliming	No Concentration	Dorr Classifier and Thickener	Trent	50-leaf Butters	Zinc Thread	70
Nevada Wonder M Co	1911	Blake 10-in x16-in	10 Stamps 1400-lb.	1 Chilean 1 Tube Mill 5-ft x22-ft	All-Sliming	No Concentration	Dorr Classifier and Thickener	Pachuca	2 12-ft.x8-ft. Olivers	Zinc Thread	110
Nevada Hills M Co	1911	Blake 12-in x20-in	20 Stamps 1250-lb.	2 Tube Mills 5-ft x18-ft.	All-Sliming	Deisters	Dorr Classifier and Thickener	Pachuca	2 12-ft x12-ft. Olivers	Zinc Dust	120

TABLE NO. 2. MINING AND MILLING COSTS IN 1913

Company.	TONNAGE. Year: Dry Tons Ore	TONNAGE. Year: Value Per Ton	TONNAGE. Month	TONNAGE. Day	MINING Without Depreciation Charges: Without Development	MINING: Development	MINING: Including Development	MILLING Without Depreciation Charges: Indirect Charges	MILLING: Total Mining	MILLING: Direct	MILLING: Indirect	MILLING: Total Milling	Depreciation: Mining	Depreciation: Milling	Depreciation: Total	Total Mining and Milling Costs at Local Office Without Depreciation.	Eastern or Head Office.	Total of All Costs Without Marketing Depreciation or Exploration.	Extraction of Values: Gross	Extraction of Values: Marketing Cost	Extraction of Values: Net	Tons of Ore for 1 ft. Development.
(1) Tonopah Belmont Tonopah Plant	172,398	$21.09	14,360	473	$3.01	$1.10	$4 11	$0 407	$4.517	$2 56	$0 20	$2.76	$.087	$0 29	$0.377	$7 367†	$0.318‡	7.685	% 94.45	% 2.5§	% 91.95	6.7
(2) Tonopah Mining	163,387	$17.79	13,615	448			2 96	312	3 28	2 59	(22 *(74	3.55	00	.00	.00	6.83	.59†	7.42†	89.00	3.26	85.75	9.1
(3) Tonopah Extension	58,022	$12 00	4,835	159			5 40	38	5.78	2 58	40	2.98			.30	8.76	.17	8.93	88.4	1.6	86 8	3.6
(4) West End	52,838	$18.70	4,403	145			3 47	.64	4.11	2 97	21	3.18	138	.35	.488	7.29	.15	7.44	91.3	2.6	88.6	7.7
(5) Montana-Tonopah	52,362	$12.70	4,363	143	2 62	1.36	3.98	.47	4.46	3 12	47	3.59			.757	8.056	.00	8.05	91.15	3.62	87.52	5.1
(6) Tonopah Belmont Millers Plant	48,088	$18 90	4,007	132						3 67	27	3.94			.00		.00		87.2	2.85	84.35	00
(7) Nevada Hills	41,919	$13 78	3,493	116	2 45	1 35	3.80	40	4.20	2 84	40	3.24			4.65	7.44	.00	7.44	88.4	4.46	84.00	?
(8) Nevada Wonder	39,118	$14 63	3,260	107			4 10†	22	4.32	3 09	16	3 25‡			1.06	7.57	.58§	8.15§	93.6‡	1.67	91.93	5.2
(9) MacNamara	28,098	$ 8.41	2,341	77			3 93	42	4.35	2.96	36	3.32			00	7.67‡	00†	7.67	92.7	1.60	91.1	8.5
(10) Jim Butler	18,900	$19.80	1,575	52			5 20	37	5.57	6 23	*1 04	7.27			00	12.84	.08	12.92			90 00	?

(1†) Checks total on page 7 of the annual report, minus depreciation and marketing costs, and "total direct mining" of page 26

(1‡) Checks from page 20 includes U S corporation tax

(1§) Includes from page 7 " marketing bullion," "marketing concentrates and slag," and "smelting losses in concentrates"

(2) All figures except those marked (†) taken from "costs per ton" table page 12

(2†) The figure $7.44 is derived from page 19 by adding all disbursements for the year except that of $12,549 for patent litigation, $75,007 for exploration, and those for capital investments. The difference between this $7 44 and the $6 33 shown on page 19, is here shown as eastern office expense However in the "income and surplus account," page 20, the total expense per ton of ore figures $7 50, thus including the patent litigation but not exploration, and is divided into mining, shaft sinking and general expenses, $3 68, milling costs and general expenses $3 08, and freight $0 74 This throws all eastern office expense directly into mining and milling

(2*) Freight.

(3) All figures taken from cost per ton and "profit and loss account" statements The figure $8 93 does not include construction account which totaled 29 2 ct a ton.

(4) All figures taken from mining and milling operation tables. The item "marketing costs" shown in the table as a percentage figure is in most all of the reports shown as a money item in the cost per ton statement but does not show as an expense in cash receipts and disbursements because the freight, express and treatment is all deducted by the smelting and refining companies before remitting to the companies

(5) Figures taken from cost of operation table in which the items "general expenses," "maintenance," and "indirect costs" are divided equally between mining and milling as the total indirect charges. This leaves nothing for eastern or main office as this is at the mine in Tonopah.

(6) Operated as a custom plant on Jim Butler, Tonopah Merger and other ores and on sweepings and tailings

(7) As in the case of the Montana-Tonopah all expenditures outside those given for direct mining and milling are divided equally between mining and milling as indirect charges. Current construction of 2 1 ct. is not included.

(8†) Includes item "Ore on Dump at Cost of Mining" from "assets" table as 3,517 tons dump ore was milled.

(8‡) From mill supt. report.

(8§) The figure $8 15 is from cash receipts and disbursements table, page 25. The difference of 58 ct. thus falls to main office expense. It probably contains considerable mine construction expense, but this item does not show anywhere in the report. It is not in plant and betterments for that asset shows a decrease for the year greater than the depreciation charged off.

(9†) All indirect expenses, including San Francisco office, are given as one item which is divided into mining and milling

(9‡) This total does not include interest payments on loans.

(10) This company has no railroad spur or reduction plant of its own, but sends it ore to the Belmont's Millers plant.

(10*) Transportation

DISCUSSION

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Milling Gold Ores in Cyanide

The Editor:

Sir—Permit me to correct a slip which I notice I have made in my letter on the above subject in your February 20 issue. "On the Rand, where milling in cyanide is usual * * *" should, of course, read: "On the Rand, where milling in water is usual * * *"

London, March 8. A. W. ALLEN.

Valuation of Dredging Ground

The Editor:

Sir—The equilateral triangle arrangement of holes that forms the subject of E. J. Vallentine's communication in your issue of February 6 has already been mentioned by C. S. Herzig during this discussion. Its advantages are so obvious that it is a wonder any other system is ever used. To mention one, the amount of bush-cutting is only about 75% of that required for the square arrangement, assuming the holes to be developed on parallel lines in each case. Some years ago I pointed out in the *India Rubber Journal* how the entire cost of bringing an estate into bearing could be covered by adopting this method of setting the trees, as against the customary square system. To arrange the triangles it is only necessary to run parallel lines at a distance apart equal to the sine of 60° multiplied by the distance apart of the holes along each line, the holes in alternate rows 'breaking joint,' that is, falling opposite the central point of the line between two holes on an adjoining line. Two lines 194.2 ft. apart laterally, with the holes spaced 224.3 ft. apart along the lines, would give a series of equilateral triangles each half an acre in extent, the acreage varying as the square of the distance between the holes. It may be pointed out, however, that this means only one hole per acre, each hole standing at the centre of a hexagon of that size. If no ground can be considered developed unless it lies within the equilateral triangle formed by three holes, the amount of ground actually developed per hole will depend on the shape and extent of the property. Thus 3 holes may develop half an acre, 7 holes three acres, and 19 holes twelve acres, and so on to the limit case of one hole per acre covering the whole earth.

The causes and effects of the ambiguous results of sampling on the square system do not appear to have been very clearly stated by any of your contributors. If a square is sampled by a hole at each corner and calculated by dividing it into two right-angled triangles, the value of the square will differ ('value' is used in its material sense) according to which diagonal is used in dividing the square, except in the case where the sums of diagonally opposite values are equal. If the value is calculated by treating the square as such, that is, averaging the four holes, the result is the mean of the two possible results obtained by dividing into triangles. Given a sufficient number of holes, from the law of averages the final result would tend to be the same, whether the diagonals were drawn consistently on one bearing or the other, or drawn haphazard but without prejudice, and this result would be the same as obtained by calculating in squares. If the initial assumption is that ground can be sampled by dividing it into squares with a hole at each corner, the obvious proceeding is then to compute it by squares, and disregard any holes that do not define a square, and any areas that are not square, and therefore do not conform to the initial assumption. However, as those rejected holes define triangles in such a way as to exclude bias, the values of the remaining triangular areas can be computed with practically the same degree of accuracy if the work is extensive and the marginal values fairly uniform. In this way I obtain 39 as the average within the lines of the figure that has so often appeared in your columns, as against Mr. Hohl's figures of 35.8 and 37, and Mr. Herzig's 34.96, but I hope it will be understood that this is merely a note, submitted with diffidence.

R. T. HANCOCK.

Jemaa, Northern Nigeria, March 13.

The Editor:

Sir—The system of boring advocated by E. J. Vallentine in your issue of February 13 has already the sanction of first-class practice. W. A. Prichard, in his report upon the properties of the Pato and Nechi mines (Colombia), refers to his adoption of a series of polygons formed by joining the points of intersection of interlacing circles. The balanced effect produced, as pointed out by Mr. Vallentine, is an ideal condition for the calculation of the value of units and the subsequent summation of results.

But this balance is a matter of care, time, and money, and its absence is not covered but rather confounded by calculations based upon ideal principles that have not been respected. A small company will not pay for first-class work and cannot expect first-class results; but it is an open question whether an engineer who is re-

stricted in his examination may not obtain better results by abandoning the idea of valuation by individual units.

Surely a series of well-tested sections running across a property at convenient intervals will give a fairer estimate of both value and depth than an ill-considered geometrical arrangement (probably adopted to economize boring operations) in which the holes are not representative of the units employed in subsequent calculations. If one standard of computation be adopted, it should, I submit, be based upon one standard of boring, namely, the system producing the greatest balance, which is undoubtedly that demonstrated by Mr. Vallentine.

London, March 17. EDMUND BONELLA.

Precision of Thought

The Editor:

Sir—Under this caption, in your issue of March 20, the use of the singular or plural form of the verb in the sentence, "Of the tonnage hoisted, 626,000 tons *was* crushed," is interestingly discussed.

I do not have the original article before me, but from the expression referred to, standing alone, it would appear that the intention of the writer was to make a clear separation of the tonnage crushed from the tonnage hoisted, and, to do so, he was obliged to subdivide the tonnage crushed into 626,000 separate tons, the common weight units. Thus separated from the tonnage hoisted, these 626,000 tons *were* crushed. By way of further explanation, the sense, in my opinion, that was sought to be conveyed might be expressed as follows: "Of the tonnage hoisted (1,000,000 tons), 626,000 *were* crushed, or $\frac{626}{1000}$ of the tonnage hoisted *were* crushed."

BERNARD MACDONALD.

Los Angeles, March 26, 1915.

[We have evidently failed to make clear the vital point that the ore was not at any time divided into separate tons; the quantity was not subdivided, but the writer was endeavoring to distinguish between a total quantity that was hoisted and a part of the whole that was crushed.—EDITOR.]

The Editor:

Sir—Your articles on 'Precision of Thought' and the letters they bring forth are always interesting, and Mr. Shockley's letter and your reply are by no means exceptions. It seems to me, however, that a slight re-casting of the sentence from "Of the tonnage hoisted, 626,000 tons was crushed" to "Of the tonnage hoisted, a large quantity—626,000 tons, to be exact—was crushed" (Editor, please don't spell it crusht) would put the matter beyond controversy.

The value of perspicuity was impressed forcefully on me recently, while wading through a book on metallurgy. The author had a valuable message to deliver to his coworkers, but he couched it in such ambiguous language that, in places, it was difficult to reconcile the text with what, from my knowledge of the subject, I knew to be the author's meaning.

San Francisco, February 23. F. H. MASON.

Utah University

The Editor:

Sir—In your issue of March 27 there appears, under the caption 'Schools and Societies,' on page 497, a statement regarding conditions at the University of Utah. This information has evidently been taken from the newspaper reports that have spread over the country, and does not represent the true state of affairs. For this reason I would greatly appreciate your giving space to the following remarks:

(1) The report that I have resigned is not true.

(2) The board of regents of the University consists of 14 members, 7 of whom are Mormons and 7 of whom are non-Mormons.

(3) The matter of bringing suit for the forfeiture of the charter of the University was dropped almost as soon as it was suggested.

(4) Careful investigation has shown that the Mormon question has nothing to do with the present difficulty at the University. The responsibility for such a statement rests upon the sensational newspapers of the country, which were quick to add this coloring to their reports.

Salt Lake City, March 30. ROBERT S. LEWIS.

P. S.—I might add by way of explanation that I am a native of Connecticut, a graduate of Stanford, and a non-Mormon.—R. S. L.

Rhythmic Precipitation of Colloidal Ores

The Editor:

Sir—With reference to Mr. Tays' letter on this subject in your issue of March 13: an insuperable difficulty, to my mind, to the acceptance of this hypothesis is the fact that in banded structures we often find every gradation from straight vertical layers, parallel with the walls, to successive banding with sinuous outlines, following the irregular shape of nuclei, or included fragments of country-rock. In the latter case, thin concentric layers of quartz, calcite, rhodonite, metallic sulphides, etc., will often follow the minutest irregularities of the nucleus, in such a way as to render it virtually impossible that successive shattering could have resulted in precisely similar successive exposures. Moreover, when we have bands of quite dissimilar composition, Mr. Tays' explanation still requires us to assume abrupt changes in the composition of the solutions that deposited them. The hypothesis of rhythmic precipitation from a gel is attractive in that it offers the only satisfactory explanation of such concentric banded structures.

The banding of mechanical origin, often marked by slickensides or gouge between the bands, is obviously different in character.

Denver, March 28. GEORGE E. COLLINS.

CONCENTRATES

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Converter slag is poured directly on to the ore beds at Douglas, Arizona, giving excellent results.

Antimony causes its lead alloy to expand slightly on solidification, a property that is used to great advantage in type metal.

In February 92 vessels, carrying 424,606 tons of freight, passed through the Panama Canal. Of this traffic, 41% consisted of coastwise cargoes.

The platinum being washed out of alluvial deposits in Colombia is associated with ultra-basic rocks and is derived probably from a rock rich in olivine, resembling dunite.

The copper mineral characteristic of the celebrated Chuquicamata mine, in Chile, is brochantite, the basic sulphate of copper, named after its French discoverer, Brochant de Villiers.

The celebrated Vielle Montagne zinc mine is situated in the little tract of neutral territory called Moresnet. This covers an area of 1½ square miles and is governed by a joint Belgian-German municipality.

The second delivery of radium from the plant of the National Radium Institute, being operated by the U. S. Bureau of Mines at Denver, was recently made. It consisted of 300 milligrams of radium bromide, having a market value of $19,000. This delivery of radium bromide is a small fraction of the radium extracted from the first 240 tons of ore treated in the experimental plant first erected. The crystallization of the radium itself has not kept pace with the extraction from the ore, owing to the impossibility to obtain certain special apparatus from abroad which is not manufactured in this country. Deliveries will gradually increase until they are equal to the capacity of the combined plants, which is approximately three tons of ore per day.

No. 5 reverberatory furnace, at the Washoe reduction works, Montana, has recently been remodeled for the purpose of using coal-dust firing in the place of grate firing, and the size of the furnace has also been increased from 19 ft. wide by 112 ft. long, to 25 ft. wide by 144 ft. long. This makes it the largest furnace of its kind in the world, according to the Anaconda company's safety-first publication, *The Anode*. Several valuable improvements in operating features have also been made. Thus, the charge, which was formerly dropped from hoppers discharging into the centre of the furnace, is now dropped from hoppers above each side of the furnace so that it forms a protecting pile against each side wall along its whole length except at the skimming end of the furnace, where a settling well is maintained to settle matte from the slag. This practice eliminates all necessity for fettling except at the settling well in front of the skimming bay. Slag is allowed to flow continuously from the skimming bay in the same manner that it does from the blast-furnace settler. Under ordinary operating conditions this furnace is now smelting an average of about 650 tons of charge per day, against an average smelting rate of 240 tons for the old furnace, and each ton of coal burned in the new furnace smelts about 7 tons of charge, while in the old furnace only about 4¼ tons was smelted for each ton of coal burned. Work on the construction of the furnace was started on December 10, 1914, and in spite of a delay of about three weeks, due to lack of materials, the furnace was ready for firing by February 5, 1915. This was accomplished without the occurrence of a single accident causing an incapacitating injury to any man on the job.

Water-supply for the Kalgoorlie and other eastern goldfields of the state of Western Australia is pumped 353 miles from the Helena reservoir, of 4,650,000,000-gal. capacity, through a 30-in. main conduit. While the water is of excellent quality for all purposes, and the pipes were coated before being laid down, there has been considerable internal corrosion, both by pitting and by incrustation. This had increased the friction and power used by the eight pumping stations, and decreased the capacity of the main. For some time past lime has been added to the water at No. 1 station near the reservoir to the amount of 6 grains per gallon. In the year 1913-14 a total of 1,194,591,000 gal. was consumed from the system, including the distributing pipes of 1175 miles. The crude lime contains from 55 to 70% of calcium oxide, and the amount of free lime in the water, which is equivalent to 2.5 gr. per gallon at No. 2 pumping station, becomes less as it travels toward Kalgoorlie, being 1.75 gr. per gallon at Northam, 1.5 gr. at No. 3, 0.5 gr. at No. 4, and 0.25 gr. at Kalgoorlie, 353 miles. Inspections made late in 1914 showed that a continuous coating of lime has been formed inside the 30-in. main along the greater part of its length, diminishing gradually in thickness from Mundaring (the reservoir) till traces only are found at Kalgoorlie. The corrosion and consequent formation of nodules in the main which were going on rapidly a few years ago appear, from the inspection made and from tests of friction in the main, to have been brought almost to an end.

Mining in the Far North

Placer Mining on the Seward Peninsula

By EMIL EDWARD HURJA

There were 42 dredges operating on the Seward Peninsula during 1914. A number of these have proved successful ventures from the very beginning. Three new dredges commenced operations during the year, and a fourth one is proposed as soon as the ground has been sufficiently proved.

One of the new dredges was built by the Union Construction Co., San Francisco, California, on Bangor creek a tributary of Snake river, for the Bangor Creek Dredging Co., composed of Cole, Mitchell & Brower. This dredge has buckets of 3½-cu. ft. capacity, in close-connected line. Power is furnished by two Bolinder crude-oil engines, of 60 and 80 hp. respectively. A plant is being constructed to refine asphaltum oil for use by the Bolinder engines. The crude oil, landed at Nome, costs $2.50 per barrel. It will be refined to a 24 degree gravity at the plant, which will have a daily capacity of 500 gal. One of the new dredges is operating on Arctic creek, a tributary of Cripple river, 14 miles northwest of Nome, and was built by the Flume Dredge Co. The third new dredge was constructed by the American Dredge Building & Construction Co. It has 2-cu. ft. buckets and is operating on leased ground on Anocovick river, Cape York. The Plein Dredging Co. closed down its dredge on Otter creek, four miles from Nome. Dredging operations in other parts of the Nome district are generally reported to have been successful, demonstrating the success of the type of dredge developed for the shallow placers of Seward Peninsula. There are six dredges working within a few miles of the city of Nome, but the more promising dredging fields are Candle, Council, Kougarok, and Inmachuk.

Dredging costs in general on Seward Peninsula are not thought to be excessive, considering the remoteness of the district and the unusual conditions encountered. Operating costs in Seward Peninsula dredging are said to run from 15c. per cubic yard up. One dredge, a 3-cu. ft. close-connected U. C. Co. type, operated on the Kugruk river this summer, is reported to have operated at a cost of 9c. per cubic yard, without counting depreciation. This was possible because of ideal conditions, such as thawed ground, no hard bedrock, easy digging, etc. The dredge is owned by Coffin and Johnson.

The most important company operating on Seward Peninsula is the Pioneer Mining Co. Its work is conducted under the supervision of Jafet Lindeberg, president and manager. Though considerably hindered by lack of water for sluicing, the Pioneer Mining Co. operated successfully during the 1914 season. The Company maintains six hydraulic elevators in the Nome district, but operations during the past summer were confined to three lifts for a greater part of the time. Water is supplied through a system of ditches costing approximately $500,000. The principal ditch is 40 miles long, 6 ft. deep, and 16 ft. wide at the bottom. There are several tunnels through solid rock on the ditch line, and there is also a siphon at Hobson creek which is 6 ft. in diameter and 3100 ft. in length.

Dredges operating in the immediate vicinity of Nome, not included above, are the Saunders Creek dredge, the Julien dredge, the Middaugh dredge, the Wonder Creek dredge, the Nome Gold Gravel Co. dredge, the Hastings Creek dredge, and the Ernst-Alaska dredge.

The dredge of the Arctic Gold Dredging Co., of which Frank Middaugh is manager, operated part of the season on Hobson creek. The Hastings Creek dredge, formerly on Moss gulch, worked on Hastings creek during the summer. A. N. Hansen is manager of this dredge. The Julien Gold Dredging & Mining Co., of which Victor Julien is manager, worked with success on Osborn creek during the sluicing season. The Saunders Creek dredge, owned by Andy Anderson will probably be moved to the Snyder group at the mouth of Center creek during the winter, as it has worked out the available ground on Saunders. The Wonder Creek dredge is working on the E. W. Johnston ground. E. E. Powell is manager of the Company.

Hydraulic operations in the vicinity of Nome, as elsewhere in the district, form quite an important part in gold production. On Center creek eight different outfits have worked during the summer, on a scale varying from a hydraulic elevator to minor hoisting operations. There are two outfits on Anvil creek, one on Lindblom creek, and others on Oregon creek, Newton gulch, Gold Bottom, and Banner creeks. Eight plants operated on Dexter creek and two on Boulder creek. Stewart and associates, on Sledge creek, have driven a drainage tunnel 1100 ft. long. The same men also intend to operate on Monument creek.

Council City District

The largest operator in the Council district is the Wild Goose company. Others are the Blue Goose Dredging Co., Saupe & Kimball, Oro Dredging Co., Warm Creek Gold Dredging Co., Nome-Montana-New Mexico company, Flume Dredging Co., Willow Dredging Co., and Ruby Gold Dredging Company.

In the Council district the first discovery of gold was made in 1866, by D. B. Libby, a member of a party which was attempting to build a telegraph land line around the world. In 1897, H. L. Blake, A. P. Mordant, L. F. Melsing, and Libby left San Francisco for that district, and in April 1898 located rich ground on Ophir creek. A stampede followed. The 1914 output of the Council district was encouraging. It was placed in excess of one million dollars.

The Wild Goose Mining & Trading Co. was organized in 1899, with a capital stock of $1,000,000. J. Dennis Arnold is president of the Company and Fred M. Ayer is resident manager. The home office is in San Francisco.

In 1911 a dredge was built by the Wild Goose company on No. 27, Ophir creek, a tributary of the Neukluk, 90 miles from Nome. The dredge has worked down the creek until it is now on No. 22 Above, Ophir. The dredge was built by the Yuba Construction Co., and is equipped with buckets of 3½-ft. capacity and has a daily capacity of 2000 cu. yd. The motive power of the dredge is furnished by a 125-hp. vertical type four-cylinder engine designed by L. F. Washburne, dredgemaster of the Wild Goose company. It was built in San Francisco, and is stated to have given satisfaction in the operation of the dredge and effected a saving of one-third in the fuel bills. The Wild Goose dredge, according to Mr. Ayer, has eight seasons' work ahead of it, the average Nome season being from June 20 to October 27, or 129 days. The Company also operates a Joshua Hendy hydraulic elevator with a 3¾-in. nozzle on 2 Above, Ophir creek. Water is supplied by a system of ditches 16 miles long. The intake is at the cañon on Ophir creek. In the dry season, additional water is obtained from the Paragon ditch, 10 miles long, with its intake at Helen creek. The operation is on the benches of the creek, where the ground is from 8 to 14 ft. deep. Operations of the Wild Goose company in the vicinity of Nome are confined to Cooper gulch, 4½ miles from Nome, a 2½-in. nozzle being used. Here lessees are operating in a small way. The Company also owns

the Seward ditch, 36 miles long, which supplies water for the Company's needs as well as for some independent operators.

A pipe-line which has been under construction for a number of years will increase the flow of water in the Seward ditch. The pipe-line will take water from the Crater Lake reservoir at the head of the Grand Central river, and its outlet will be the Nome river, which feeds the Seward ditch.

The Wild Goose company owns 110 claims on Seward Peninsula. Fifty of them are on Ophir creek, and the rest are in different parts of the Nome and Council districts.

The Blue Goose dredge is owned by the Blue Goose company, of which A. N. Kittleson is manager. It was on 8 Above last season and has four years' work ahead of it. The dredge is in its twelfth season. Operation in 1914 started on May 28. It is said that clean-ups for a part of the summer showed an output as high as $3000 per day. The Blue Goose company also worked a hydraulic elevator on Ophir creek during a part of the season. The dredge of the Warm Creek Dredging Co. started work early in July and is said to have had a successful season. It is managed by A. E. Wellington.

A 1½-cu. ft. flume-type dredge was built last season and installed by the Oro Dredging Co. on No. 1, Elkhorn creek. Although a little trouble was encountered early in the spring, better results were reported later in the season. Charles Spencer is manager of the Company. The dredge of the Ruby Dredging Co, under the management of Claude Scott, on Casadepaga, is reported to have had a successful season. The flume dredge operated by the Nome-Montana-New Mexico company on Goose creek started work late in June. G. F. Ramsay is manager for the Company. The Willow Creek and Gaylord dredges also operated last season with success. The Flume Dredge Co. owns two 3½-ft. dredges of its own manufacture which are operating in the Council district. One is on No. 1 Crooked creek, a tributary of Ophir, and the other is on Melsing creek, a tributary of Neukluk river. The dredge on Crooked digs across the whole stream and to a depth of from 8 to 11 ft. The Melsing dredge has a 90-ft. swing and digs to an average depth of 10 ft. Distillate is used for fuel. It costs 35c. per gallon delivered in 55-gal. tanks at Council City.

There has been some hydraulic work in a small way in the Council district. Trolsen & Streifeld, working No. 1 and No. 2 Above Discovery on Ophir creek under lease from the Wild Goose company, have used hydraulic elevators successfully. Kenna & Elms, leasing from the Northern Light Mining Co., had a good season on the Ophir benches where they worked. W. K. Taylor & Co. used scrapers on No. 23, Ophir. Vallentine & Peterson and T. J. O'Shaughnessy & Co. have been carrying on open-cut work on Dutch creek. Stitch & Roberts had a successful summer on Crooked creek. Gawiler & Gloor operated a steam scraper on Melsing Creek bench last summer. William Brookins & Co. used a hydraulic elevator on Camp creek. The Uplift Mining Co. is said to have made plans for a flume-type dredge on Camp creek next year. They prospected some ground for a few months last year.

Solomon River District

Dredging in the Solomon River district has been an important factor in the history of the Seward Peninsula gold production. The first dredges in the district commenced operations in 1905 and have been operating ever since that time. At present there are nine dredges at work and another may be built next year. Several companies are conducting prospecting operations in the district and expect to build boats as soon as the ground has been proved. If the experiment of the Seward Dredging Co. with Diesel engines during the fall is successful and develops a lower working cost than was possible under the old system, it means that ground which heretofore would not pay to dredge will become available for dredging purposes. In the same district the Nome-Montana-New Mexico company's dredge uses coal for fuel.

The Flodin Mining & Dredging Co. operates a Risdon dredge on Solomon river. A flume dredge with buckets of 3-cu. ft. capacity, operated by the Flodin company, shows a low working cost; power is furnished by a 60-hp. gasoline engine. The Solomon dredge, operated by the Solomon Gold Dredging Co., of which J. A. Mallock is manager, has worked out all of its ground and probably will move to new claims during the winter. It is stated that this dredge has averaged 60,000 cu. yd. per month. It is driven by steam, with crude oil for fuel.

The Sievertson-Johnson dredge on Solomon river, in charge of Charles Sievertson, experienced some trouble during the season past because of bedrock encountered. The Shovel Creek dredge, owned by the Shovel Creek Dredging Co., of which C. C. Brayton is manager, operated successfully throughout the season.

C. E. Kimball operates two dredges of the Flume Dredge Co.'s manufacture. One is on 18 Above, Shovel creek, a tributary of Solomon river, 41 miles northeast of Nome. The buckets have a capacity of 2½ ft. and the dredge a capacity of 1000 yd. per day. Power for the dredges is furnished by 60-hp. Western gasoline engines. The dirt is dumped by the buckets on a grizzly. From the grizzly it goes into the main flume, 75 ft. long and 48 in. wide. Another Flume dredge, on Adams creek, a tributary of Shovel creek, 47 miles from Nome, is digging to a depth of 7 ft. and only requires 18 in. of water for flotation.

The Behring Dredging Co. operated a hydraulic lift last season on the Kougarok below the mouth of Taylor creek. The Company plans to build a dredge on its ground near Henry creek next spring. The dredge which is being constructed by the Union Construction Co., of San Francisco, is at Davidson's landing and will be freighted overland to Kougarok during the winter. It has a close-connected line of buckets of

BOURBON DREDGE SNOWED IN.

KIMBALL No. 2, FLUME DREDGE.

3-cu. ft. capacity. Its capacity will be about 1500 yd. per day. Motive power will be derived from two 50-hp. Webster gasoline engines. Hutton & Flodin, old-timers in the North, prospected all summer on their Kougarok river holdings, with a view to installing a 2½-ft. Union Construction dredge which was brought to Nome for them in 1913.

The White Bear Dredging & Hydraulic Mining Co. is having a survey made of its claims in the Kougarok and expects to construct a dredge on the ground soon. Charles Flodin is planning to build a dredge on Serpentine creek on the upper half of the Halpin ground, below the mouth of Artic creek. A dredge for the Taylor Creek Ditch Co. will be built on Taylor creek during the winter. The dredge machinery was transported from Teller to Davidson's Landing last summer and will be freighted to its destination over the snow. The Company has extensive property holdings in the Kougarok. John Mathews is manager for the Company. Because of difficulty in transportation, the new dredge of the Kougarok Dredge Co., J. Halpin, manager, has failed to reach its destination on Iron creek. A caterpillar automobile was used during the summer, but without success. The Company owns 200 acres of placer ground in the district. The dredge will be operated by two gasoline engines having 125 combined hp. The maximum dredging depth is 35 feet.

The Kelliher dredge, owned by James Kelliher, operated spasmodically during the summer, due to difficulty encountered at bedrock. Uneven thawing probably will be eliminated after stripping operations now under way are finished. A seven-mile ditch has been built for hydraulic operations and three nozzles are being used to strip ground ahead of the dredge. Operations in the Kougarok have been retarded somewhat by the European war, and foreign capitalists who were becoming interested in the district have called off their plans indefinitely. Considerable mining on a small scale has been going on, five outfits being engaged on the upper Kougarok gravels and several small prospecting parties worked during the summer on Sherrett creek. The Nome Gold Mining Co. is considering a dredge for its property on Sherrett. The Company has spent three years in prospecting the ground. Grant Laiblin is Nome agent of the Company. Two outfits worked on Willow creek, in the Pilgrim River district.

Operators in the Candle district, which is included in the Fairhaven mining precinct, report a successful summer. The Keewalik Mining Co. operated on Johnny Bull hill. Elmer Rydeen operated a hydraulic elevator on Bear creek during the summer. The Candle Creek Mining Co. owns a number of claims on Candle creek on which work was done last season. The Kugruk River district is near the Inmachuk watershed, both heading into the same district. A Union Construction Co. dredge was built last summer on the holdings of Henry Coffin and Iver Johnson. This boat has a close-connected bucket line, with buckets of 3 cu. ft. capacity. Prospecting work with a drill was carried on throughout the summer. The Dearborn Investment Co., which owns considerable ground on the same creek, has been conducting a thorough investigation of the merits of its claims. A dredge is a possibility. George Wallin prospected his Kugruk ground with a drill last summer. Operations of the Candle Gold Dredging Co., of which E. E. Pierce is manager, proceeded satisfactorily on Candle creek.

In the Teller district the American Dredge Building & Construction Co. added another dredge to the one already operating on the Anacovick river, Cape York section. Both dredges are of 800 cu. yd. daily capacity. The Company is managed by B. Bernard. J. A. Pidduck, manager of the Pidduck dredge on Sunset creek, across the bay from Teller, reports that his operations have been satisfactory. New pay is said to have been found in the benches. The dredge of the Johnstone company has been taken over by Sullivan & Dorn. The new owners are said to be contemplating building another dredge next season. They had several drills at work the greater part of the summer. The dredge Windy Creek, owned by the Pasadena Dredging Co., had a fair season. Considerable prospecting has been going on in different parts of the Teller district.

Throughout the Inmachuk district, there was a lot of new work during the summer. The Union Construction Co. 3-ft. dredge, owned by the Inmachuck Dredging Co., reports successful operations in the upper Inmachuck during the summer. The Fairhaven Mining Co. is operating several hydraulic plants in connection with a 40-mile ditch from Lake Imuruk. The 2-ft. dredge owned by the Deering Mining & Dredging Co. operated on lower Inmuchuck to the satisfaction of Henry Fries, president of the Company. There is a lot of small work going on in the district, the output of which adds to the annual production of the Inmuchuck.

Kobuk District

The mining in the Kobuk district is centered largely about Klery creek. The Kobuk is tributary to Kotzebue sound, north of Nome, and most of the producing streams are tributary to its watershed. Supplies are landed at the mouth of Squirrel river, in Kotzebue sound, at a cost of $22 per ton from Seattle. The goods are then taken by launch up the river. Klery creek was discovered in 1909. It is 18 miles long and flows into the Kobuk 60 miles from its mouth. Andy Garbin and 'Spanish Jack' are the original discoverers of Klery creek. Their claim, the Oregon association, has produced $45,000 since its discovery. The lower 600 ft. of 1 Above Discovery has yielded $60,000 since discovery. The paystreak is 50 ft. wide. The men still conduct summer work on their claim. Theodore Westlake, Steve Ryan and Leo Jeffe are working on 1 Above, Klery creek. They took out a $10,000 dump last winter. The ground on Klery is frozen and has a depth of from 12 to 14 ft. On Klery No. 8 Above, Joe Quillan is prospecting. Paul Xavier, Josh Devine, Albert A. Ryan, and E. R. Burden are working on 5 Above Discovery, first tier, left limit, of Klery creek. They are shoveling in after having ground-sluiced off the overburden. The ground is from 12 to 15 ft. deep. The men manage to make from $8 to $10 a day.

Tin Prospects

The average content of tin in the concentrates of the York Tin Dredging Co. is 68%. The tin in veins so far discovered ranges from 3%. The known tin area of Seward Peninsula is about 200 square miles, terminating at Cape Prince of Wales. Ear mountain, on the Arctic side of the cape, is reported to contain large quantities of tin ore. In the Lost River region, farther south, tin is also found. The York Tin Dredging Co. has a 2½-ft. Union Construction Co.'s dredge in operation on Buck creek, which flows into Grouse creek. Grouse creek flows into Mint river, which, in turn, empties into the Arctic ocean. The dredge is operated by two 40-hp. Union gasoline engines. Operations in 1914 started July 15. An average season is 115 days long. The 1914 output is estimated at 75 tons of stream tin. The ground worked is from 5 to 8 ft. deep. Considerable money is said to have been spent in the search for a tin vein on Cape Prince of Wales mountain. It is reported that a ledge 2 ft. wide has been discovered.

The Lost River mines are being operated by the Lost River Tin Mining Co. George Jamme is manager. The vein on the property is said to be 12 ft. wide and contains 3 to 4% of tin. It is reported that a 60-stamp mill will be built on the property in 1915. A gasoline-operated sampler comprises the present equipment. The Bartels Tin Mining Co. owns 32 patented claims in the district. A three-stamp mill has tested 300 tons of ore and, it is stated, found an average content of 3%. Twelve hundred tons of tin ore are on the dump. The United States Tin Mining Co. owns four patented claims adjoining the Bartels property. A 10-stamp mill has recently been erected. The main adit has a length of 400 ft. and must be driven about 100 ft. more to cut the ledge. T. Winfield has a crew of men prospecting a tin vein in the Ear Mountain district and there are a number of other properties that have attracted attention.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

JOPLIN, MISSOURI

Re-opening West Joplin Sheet-Ground Mines.—Large Production from Webb City Sheet-Ground District.—Important Development at Granby, Missouri.—Notes.

Four mines in the West Joplin sheet-ground district that have been idle for more than a year are to resume operation, while another company is contemplating the erection of a 500-ton concentrating plant in that field. The former are the Martha Ball Zinc & Lead Co., now known as the Bradley No. 2, the Falls City Lead & Zinc Co., the Muskingum Lead & Zinc Co., and the Samson Mining Co. The new plant is to be constructed by the S. Y. Ramage Mining Co., at present a large operator in the Webb City district. The Ramage company for more than a year has been drilling on a 120-acre lease to the south of the Samson and the other mines mentioned, and it is reported that 18 drill-holes out of 20 are into sheet ore at a depth varying from 175 to 200 ft. Virtually all of the mines of the West Joplin sheet-ground district suspended operations about a year ago when ore prices reached a low level. The present high price of zinc ore has stimulated mining, and the reopening of these properties should mean a large tonnage added to the weekly production. The Samson mine will be under operation of W. J. Briggle, who formerly operated this property. Work was conducted at a depth of 175 ft., but the stope will be taken up as there is about 8 ft. of ore beneath the present drifts. The Muskingum mine is under the supervision of Charles U. Porter, and work is being conducted at a depth of 200 ft. The Falls City is under the management of George Bayless. Production has not yet begun, as the Company has experienced some difficulty in draining the ground, and larger pumps are being installed. W. S. Pate is in charge of operations at the Martha Ball, or Bradley No. 2, the work here also being at 200 ft. The ore in the West Joplin sheet-ground area is extensive in formation, but does not carry a high percentage of either zinc or lead. The zinc-blende recovery is about 3%, with a much smaller percentage of lead. The cleaned concentrate, however, runs high in metallic zinc, and commands a high settlement. On the Ramage lease, an old shaft is already down more than 100 ft., but it did not reach the orebody. This shaft is to be sunk deeper.

The Webb City-Carterville, Missouri, district is, as has been the case for the past six or seven years, leading all other fields of the Missouri-Kansas-Oklahoma district in the output of both zinc and lead ores. For the first quarter of 1915 the Webb City-Carterville district has shipped zinc and lead ores valued at $1,341,237, compared with the Joplin production of $660,264, which is the next largest producer, and $445,162 from Miami, Oklahoma, the third. Duenweg, Missouri, comes fourth; Alba, Missouri, fifth; Galena, Kansas, sixth; and a number of other minor camps with smaller production. The aggregate value of zinc-blende shipped from the district for the first quarter is $3,460,000, calamine $180,000, and galena $444,000.

A concentrating plant of 1000-ton capacity per 24 hours, embodying several new features in milling practice, is being constructed by the Granby Mining & Smelting Co. on its own property at Granby, Missouri. Shaking-screens will be placed at the heads of all jigs, and the fine removed before passing over the jigs. Special jigs will be installed for treating the fine ores. Electric power will be used. The shell-work of the mill will be of galvanized iron. A separate unit, also of galvanized-iron construction, will be erected for treatment of sludge ores. The initial equipment will consist of 15 tables. Later, three double-deck sliming-tables will be installed. This work will be the second active mining venture of the Granby company, which, in the past, has adhered closely to the leasing end of the business. About a year ago the Company constructed a 350-ton concentrating-plant on its property at Joplin, and this was the first time the Company had engaged in active mining. The success of this undertaking caused the Company to launch out on a broader scale at Granby. A lease of 40 acres has been reserved by the Company for these operations. A number of drill-holes are into disseminated zinc ore at a depth of 185 to 230 ft. One shaft is already down into ore, and driving has been started. A second shaft is now being sunk. The mill is being constructed at the completed shaft, and a tramway will connect with the other.

WEBB CITY SHEET-GROUND DISTRICT, MISSOURI.

The Carl Junction, Missouri, district, eight miles northwest of Joplin, is having a revival of activities as a result of higher ore prices. The Chicago-Lehigh Mining Co. is driving east into virgin ground, in sheet formation, at a depth of 125 ft. The mill is now producing two carloads of concentrates per week.——The Webb City-Lehigh Mining Co.'s plant is being overhauled by David Gilmore and associates, and this property will soon be running.——A new prospect is being opened at a depth of 105 ft.——The Joplin-Lehigh mine is running steadily, and producing on an average of six carloads of blende concentrate per month.——Marshall & Co. are sinking a new shaft on the Baby Kitty lease of the

Knight land, and contemplate the erection of a mill on this property.——The old Jay shaft ground is being drained to a depth of 132 ft. by Tom Raddish & Co.——Lightburn & Co. are opening the old R. C. Johnson Mining Co. some distance to the east of the main Carl Junction camp.

At a depth of 125 ft., driving has been started in the Louis Stevison mine on his own land, two miles north of Oronogo, Missouri. This work is in a new district, the nearest mines being the heavy-producing Oronogo Circle properties. Mr. Stevison has 18 drill-holes in ore, four or five of which were rich enough to warrant development. A larger derrick has been erected and steam equipment installed.

Noe & Elliott, operating on a 10-acre lease of the D. O. Witmer land, southwest of Joplin, have extended an old drift into new ground at a depth of 125 ft., and are taking out zinc ore which yields 12% concentrate over hand jigs. Much of the ore occurs in large chunks, and can only be cleaned satisfactorily in a mill. Only the finer 'dirt' is being cleaned over hand jigs. The mine has not been worked for nine years. Formerly it produced some ore, but operations were abandoned because of low ore-prices that prevailed. The present operators found no trouble in removing the water from the mine with a 3-in. pump. They have installed a 40-hp. boiler, and are now making a steady production of ore, and at the same time are developing their land to such an extent that it appears to be a good mill property.

NEW YORK

NEW MINING REGULATIONS IN MEXICO.—FEDERAL MINING & SMELTING AND AMERICAN ZINC, LEAD & SMELTING COMPANIES.—COPPER.—UNITED STATES SMELTING, REFINING & MINING CO. AND NEW PROPERTIES.

The troubles of mining men in Mexico have been augmented by a recent promulgation of Villa. The edict provides that work must be resumed on all mining properties within territory under the dictator's control within 120 days, or confiscation will ensue. Since transport is practically impossible, such resumption is out of the question in many cases. Other provisions of the new mining law provide for restriction of ownership. No individual can hold more than 15 contiguous *pertinencias*; no mining company more than 150 *pertinencias*, and every five *pertinencias* so held must be developed by two shafts. A large number of operators interested across the border held a meeting at El Paso this week, and endeavored to institute some concerted action, hoping to move the State Department at Washington and avert complete chaos. The statement is freely made that this is but the first of moves to drive all foreign capital invested in the mining industry in Mexico out of that country. It seems incomprehensible, but these are days when our comprehension must get used to the high hurdles. There is no reason to anticipate any action by our own State Department, since there has already been such an accumulation of reasons for action and none taken.

A group of insurgents in the United States Reduction & Refining Co., a concern that at one time operated profitably at Cripple Creek, is trying to organize opposition to the present management, with a view to renewing the company's activities. This company's securities are listed on the New York Stock Exchange, and are largely held in the East.

The Federal Mining & Smelting Co. shows a deficit of $46,908 as the net result of its operations in 1914, compared with $29,150 in 1913. With lead and zinc both advancing, and buyers taking everything for near-by deliveries, the outlook for these companies that have not been quite able to break even ought to improve materially. This viewpoint has nothing to do with mining problems, but is all-important for the investor who has nerve and judgment enough to come in when things look blue.——The American Smelting & Refining Co. has advanced the price of lead to 4.20c.——One of the lead-mining companies in the northern Illinois districts is reported to be filling an order for 1,000,000 lb. sheet lead. ——The sudden reversal of conditions in the market for lead and spelter has affected the American Zinc, Lead & Smelting Co. as sharply as any concern in the business. From a deficit of $169,000 in 1913 to an earning of $2,000,000 or more in 1915 is something to make stockholders and managers catch their breath. If present prices hold, this company can reckon on earnings for the year of more than $3,000,000. The two smelting plants at Caney and Dearing, Kansas, are being operated largely on Butte & Superior ores. The combined capacity of these plants is about 65,000 to 75,000 tons of zinc ore annually. Of the 12 blocks of furnaces, 9 are devoted to Butte & Superior ores, 2 on other contract ores, and the remaining block is devoted to refining, turning out a special grade of metal that sells at a premium. The amount derived from the extra price for this product is stated to be from $750 to $1000 daily above what would otherwise be received for ordinary metal. The great danger arising from prevailing abnormal conditions will lie in the temptation to expand unduly in order to take care of business offering, with the possibility of having too much plant and too much overhead expense on hand when the slow-down comes, as it must come, after peace is restored and the painful work of repairing waste and re-building destroyed property begins. Our own fertile South, with its great staple crop of cotton and its cheap negro labor, after having poured itself into the struggle of the Civil War, faced a long period of slow re-construction from which it took years to emerge. We suffered in our own land something of a shock, a terrific shock, financially, when war was declared; we must be prepared to undergo a further strain when the European struggle is over and the emergency business comes to an end.

Copper producers are getting back into full stride as rapidly as possible. Michigan especially is feeling the effect of war orders, and Lake copper continues to hold its premium of approximately one cent per pound above electrolytic. Rush shipments are being made from all the smelter yards in the northern peninsula. The copper people are all optimistic. The uses for copper have so multiplied that it is not likely to feel the cessation of abnormal demand in anything like the same degree as some other commodities. It has for some years been evident that the world can take all of the copper that can be turned out, if prices are kept within reasonable bounds.

The United States Smelting, Refining & Mining Co.'s report for 1914 shows $1.75 per share earned on the common stock after payment of the preferred dividend, compared with $5.35 per share earned in 1913. The decrease, of course, is due largely to the distressing conditions in Mexico; the Real del Monte and the Pachuca have had troubles of their own during the year, and from present indications are likely to find them increased rather than otherwise, especially if the various rivals for leadership in Mexico begin to make it fashionable to impose impossible and outrageous conditions on mining companies controlled in this country or abroad. As usual, not the least interesting part of the report of the company relates to its attempts to find new ventures worthy of exploitation. During 1913 some 639 properties were submitted to the engineering staff, all but 101 were rejected on examination of data and reports, 82 of the remainder failed to pass preliminary field-examination; and out of the remaining 19, two oil properties were taken over, and a long-time option secured on an interest in a third. Evidently the complete answer to 'What Is the Matter with Prospecting?', the interesting symposium published in the *Press* in 1914, has not yet been found, when out of 639 properties there is not discovered a single metal prospect worthy of development. It is undoubtedly true that there has grown up a disposition to eliminate the natural mining risk in taking up new ven-

tures. Just what is the reason for the attitude of our development companies it is hard to state. Is it not possibly because geological conditions are so well known? The possibilities and probabilities in almost every mining district are perhaps so well classified and card-indexed that it is an exceedingly difficult matter for the prospector, or group of claim-owners, to bring in anything that is really new. Whatever it may be, there hardly exists anywhere a more hopeless task than lies before the owner of undeveloped ground seeking to raise capital in Eastern financial centres.

The Calumet & Hecla is just bringing its subsidiary, the White Pine, into the producing list. The property is on the western extension of the copper belt, is expected to turn out 18,000,000 lb. per annum, and to be a low-cost mine.

TOKYO, JAPAN

Coal-Mine Explosions.—Kosaka Mine Output Declines.—Gold, Silver, and Copper Production of Certain Mines.—New Ironworks.—New Smelter in Korea.—Oil Refining.

The problem of coal-mine explosions is a serious question in the Japanese mining industry. On December 13, 1914, two weeks after the big explosion in the Wakanabe Shin-Yubari coal mines, Hokkaido, resulting in the death of 422 employees, another still greater explosion took place in the Hojo-Tanko colliery, a mine in Kyushyu, 35 miles southwest of Moji, belonging to the Mitsu-Bishi-Kaisha. The total number, including engineers and officers, killed by the explosion was 670, being the greatest disaster that has occurred in the history of Japan. Special attention has been given to save the mine, and also take care of the families of the dead. On January 31, 1915, a small gas explosion took place in the Koyaki coal mine, Nagasaki-Ken, by which two miners were instantly killed and 15 were seriously injured. It is supposed that this was caused by a defect in a safety lamp.

The Kosaka mine, owned by Fujita-gumi, of Osaka, which for a time stood foremost in its production of copper, silver, and gold, is now declining, and it has recently been decided to reduce the scale of the working to one-half. In its production of copper it ranks third among the Japanese copper mines, the Ashio mine coming first and the Hidachi next.

The production of metals in the important mines of Japan till the end of November 1914 (11 months), was as follows:

Gold—Hidachi, 75,048 oz.; Sado, 14,900 oz.; Yamagano, 12,152 oz.; Kosaka, 10,200 oz.; Kushikino (Kagoshima-Ken), 10,206 oz.; Kamaishi, 6085 oz.; and 19 other mines, 44,286 ounces.

Silver—Kosaka, 887,817 oz.; Hidachi, 670,043 oz.; Tsubaki (closed in September 1914), 453,320 oz.; Ashio, 297,044 oz.; Kamioks (Gifn-Ken), 254,862 oz.; Ikuno, 206,412 oz.; Abeshiro (Awomori-Ken), 198,123 oz.; Sado, 135,032 oz.; and 20 other mines, 980,457 ounces.

Copper—Ashio, 22,227,561 lb.; Hidachi, 20,647,052 lb.; Kosaka, 15,413,720 lb.; Betshi, 15,023,456 lb.; and 38 other mines, 52,081,869 pounds.

The Mitsu-Bishi Co., last year planned to erect ironworks in Kenjiho, Korea, but on account of the war the construction of the plant has been suspended for a time, as it is now impossible to get the machinery, all of which has been ordered from Germany. The net profit of the Mitsui Mining Co. in 1914 was 1,405,226 yen ($702,000).

The Kuhara Mining Co., the owner of the Kidachi mine and smelters, is going to erect a new smelting plant in Chinnampo, Korea. Chinnampo is a well situated seaport on the southernmost coast of the peninsula, with good communication both on land and sea. The Company possesses a number of copper-bearing iron pyrite mines on Skikokn island. These basic ores will be smelted together with gold quartz from Korea, which occurs abundantly throughout the peninsula. It is expected, after the completion of this smelter, that the yield of gold from Korea will be considerably increased.

The Nippon Oil Co. intends to construct open and shut retorts of the Russian type for refining oil in Akita, where

PART OF HOKKAIDO.

large quantities of oil in flowing wells was struck last autumn, in drilling with rotary drills of American make. An engineer of the Company is now in Russia to get the retorts.

HOUGHTON, MICHIGAN

Operations Returning to Full Capacity.—Copper Prices.—Calumet & Hecla Smelter.—Hancock and Ahmeek.

Conditions in the Lake Superior copper region continue to improve and to profit from the continuation of the deplorable European war. Each week records the re-opening of some mine or mill, an increase in working force, or an increase in wages to the men. With all the producing mines back to normal production, a spirit of optimism prevails, and all are looking forward to a most prosperous and productive spring and summer.

This revival of mining operations is due directly to the advance in the price of copper. Operating costs at some of the Michigan copper mines are so high that when copper drops much below 15c. per pound the margin of profit is small. But with Lake copper selling between 16 and 17c., every Michigan mine will take full advantage of the unusual opportunity offered. Another reason for the present increasing production of the Michigan mines is that Lake copper is specified in contracts, and foreign governments are specifying in their ammunition orders that Calumet & Hecla or Quincy copper, and none other, be used. Never before has Lake copper commanded such a high premium per pound over elec-

tiolytic copper. The high premium for Lake brands has naturally resulted in a revival of interest in Lake copper shares. Notable advances have been made, and in some cases shares have doubled in price in the past two months.

It now seems that the present copper prices are due directly to the war, and that the higher price can be maintained only by a continuation of the war. It is reported that Lake Superior copper is being specified in contracts for ammunition, and that contracts for Lake copper are being made at prices above 16c. for July and August deliveries. It is also pointed out, however, that these contracts are subject to cancellation before the time of delivery, and if the European war should end before that time, it is probable that these contracts would not be filled. The report comes from Boston that copper sales as high as 17c. have been made by the Calumet & Hecla selling agency. The sales consisted of small lots of highest-grade copper, and were contracted for August delivery. This is the first time since November 1913 that Lake copper has sold above 16 cents.

As evidence of the faith of the Michigan managers in the copper market, several important announcements were made during the past week. The Tamarack mine of the Calumet & Hecla will resume mining operations at shafts No. 3 and No. 5 as soon as possible. When copper dropped to 11c. soon after the beginning of the War, this mine was forced to close. It has the highest producing-cost of the Calumet & Hecla subsidiaries, and its re-opening certainly shows confidence in the copper market and is most pleasing to the people of the locality. A great many of the best Tamarack miners were given work in other Calumet & Hecla mines following the suspension of operations, so that they are now available for their old positions. Plans for the immediate re-opening of the Calumet & Hecla No. 18 shaft have been completed. Both of these increases in operations mean an increase of several hundred men to the working force at Calumet.

One or two of the mines in the Michigan district cannot increase their present output because their mills are now running at full capacity. The Quincy has not as yet made any large increase in operations, and apparently has not as much faith as others in the stability of the copper market. However, a slight daily increase in production is reported, costs are being lowered, and a ready market is being found for its copper. Isle Royale will no doubt show a marked increase in production this year. Costs will correspondingly be reduced. The surface work at the No. 1 shaft is nearing completion and retimbering of the shaft below the eighth level has been resumed. It is reported that production of copper from the Baltic and Champion mines of the Copper Range Consolidated will be 15% above normal for the month of March. Trimountain is preparing to increase its output. Baltic has been making better than 30 lb. of copper per ton several months and Champion is showing a remarkable yield of over 30 lb. per ton on a tonnage twice as large.

The working force at the Calumet & Hecla smelting plant has been greatly increased during the past month. Two additional furnaces went into commission at the smelter last week. Unusually large rail shipments of copper are being made each week and the opening of navigation on the Great Lakes will find little copper on hand in the smelter yards. A great deal of the copper now being shipped from the Lake Superior district, however, is being delivered on January contracts, and at a price of about 13½ cents.

Hancock Consolidated has begun shipments of 'rock' to the Franklin mill, and an increase in working force will probably follow. It is reported that the Algomah is preparing to resume operations. The Algomah is in the exploration stage and has opened up a lode that is unique in the Michigan district. It is a brown amygdaloid carrying black oxide and green chrysocolla in irregular bodies.

The storage-bins at the Hancock mine are gradually being filled in advance of shipments to the Franklin mill. Underground work is being carried on by about 100 men, and a large number of drills are in operation. It is expected that daily shipments of about 200 tons to the Franklin mill will begin the first of April.——No action on the dividend has been taken by the directors of the Allouez Mining Co. Some of the larger stockholders have expressed a desire for some return on their investment. Production is now high and increasing gradually. The ore is good, costs have been reduced, and it is argued that a dividend of $1 would in no way embarrass the Company.——A total of 14,442 shares representing 161 persons has now been recorded in favor of the Ahmeek capital increase to 200,000 shares.

The itinerary of the annual visit to the copper district of the Bureau of Mines rescue-car has been announced as follows: Quincy, two weeks beginning April 19; Calumet & Hecla, two weeks following; Mohawk, the following week; Painesdale, the two weeks following. At the conclusion of the schedule, the car will be at the disposal of the Michigan College of Mines. It is probable that the car may go to Victoria before returning to its permanent station at Ironwood on the Gogebic iron range.

PORCUPINE, ONTARIO

DOME AND MCINTYRE YIELDS.—KIRKLAND LAKE DISTRICT.

During February the Dome mill treated 21,600 tons of ore and recovered a total of $84,412, or an average of $3.90 per ton, compared with $3.56 in January. The mill ran 97% of the possible time. Recent developments on the fourth and sixth levels have been satisfactory, and have succeeded in opening several bodies of ore of a considerably higher grade than the monthly averages. It is expected that there will be no difficulty in maintaining an average grade of about $4 per ton. The directors of the West Dome have issued a circular to the shareholders asking them to approve of changing the par value of the shares from $5 to $1, and the issue of five new shares of the new stock for each share of the old. The treasury will then contain 361,000 shares par value $1, which will be offered pro rata to the shareholders at 1½c. per share. This is expected to raise sufficient money to clear off the debts and pay the taxes for the next two years, but unless the Company succeeds in raising more money its position will not be improved. The West Dome was one of the best known properties in Porcupine a couple of years ago, and was floated by F. Augustus Heinze.

During February the McIntyre treated 10,900 tons of ore and recovered bullion to the value of $56,000. The ore averaged $8.77 per ton. This Company is gradually getting itself into a much better position, and at the present rate of earnings should be able to pay off the remainder of the bank loans in about four months.

The Nipissing has dropped its option on the Teck-Hughes mine in the Kirkland Lake district, although the position is such that the Company can take the option up again within the next 30 days. Just before work was stopped an extension of 30 days was given for the payment due March 1, and as the Nipissing had done sufficient work during the preceding month to keep the option in force for another month, they could if they desired take the option up again. All machinery has been taken off the property and the mine is being allowed to fill with water.——The Gibson Kirkland Lake Syndicate is the name of a new company which has been formed to take over seven claims in Teck and Lebel townships, about a mile north of the Tough Oakes mine. It is expected that development work will be started immediately.——The new mill of the Tough Oakes mine will be in commission within the next week or so, and from then on the property should be a consistent producer. About two weeks ago the Company succeeded in raising about $80,000 to pay off liabilities.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press

ALASKA

Juneau

At the territorial legislature at Juneau, Senator B. F. Millard introduced, on March 22, a bill to abolish the office of territorial mine inspector. It was referred to the committee on mining and manufactures. On March 24, by a vote of 15 to 1, the house of representatives passed the general 8-hour day mining bill, affecting all classes of mining in Alaska. Representative Dan Driscoll was the only one against the measure.

ARIZONA

Cochise County

It is reported that a smelter is to be constructed at Benson to treat ores from the Johnson district, 25 miles east, which is developing in a promising way. Benson is the nearest place where water and fluxes are easily obtained, and is on a railroad.

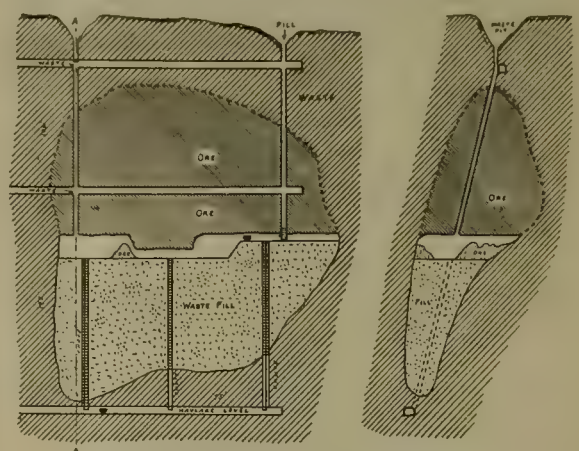
Gila County

Concentrate from the Inspiration company's 600-ton experimental plant is to be stored, instead of shipping to El Paso. The new International smelter at Miami is expected to be ready in May or June, about the same time that the 10,000-ton mill of the Inspiration is finished.

The report of the Arizona Commercial Mining Co. for the year ended December 31, 1914, shows that cash and accounts receivable in Boston and at the mine totaled $22,952, while supplies are valued at $13,983. Accounts payable at the mine were $7105; drafts outstanding, $4206; and notes payable at Boston, $50,000. The treasury contains stock worth $200,000. The president, Charles S. Smith, stated that connection had been made with the Grey shaft of the United Globe mine, and also with the main drift on No. 12 level of the Old Dominion, by a drift driven from the Arizona Commercial Copper Hill shaft, a distance of 1800 ft. Pumping and ventilation have been benefited thereby; also it is not now necessary to sink another shaft. Ore shipments were resumed on January 1.

Greenlee County

Mining methods of the Arizona Copper Co. are described by P. B. Scotland in the *Bulletin* of the A. I. M. E. for February. The mines of the Company are situated in the Morenci-Metcalf district in southeastern Arizona. This copper-bearing area covers a triangular mountainous area of about three square miles, rising abruptly from the gravel plateau of the surrounding country. In this area, an immense intrusion of porphyry has displaced, shattered, and engulfed the shales, limestones, and quartzites formerly bedded on the basal granite. The largest mines of the Company are the Humboldt and Clay at Morenci, and the Coronado, Metcalf, and King at Metcalf. These mines produce about 4000 tons per day of concentrating ore containing from 2.5 to 2.8% copper. The low-grade sulphide ore occurs as: (1) disseminated deposits in the main stock of quartz porphyry; (2) lode deposits in fault fissures in granite. The high-grade oxide ores were found as tabular deposits in limestone and shale close to contacts with porphyry. Low-grade oxide ore formed the outcrop of some of the sulphide orebodies; the majority of the outcrops, however, were barren. The method of extracting the ore is dependent upon the nature of the ore occurrence. Each orebody is a problem in itself. All influencing factors, as size, shape, position, nature, and grade of an orebody, and character of the inclosing walls, are fully considered before the method of extraction is decided. The oxide ores near the surface on Metcalf hill are extracted by open-cut work. Hand work is employed, steam-shovels not being necessary. Where the ore is hard and stands well, a system of open stoping without timber is employed with subsequent filling. In narrow veins with firm walls, underhand stoping directly into chutes is employed. In mining large orebodies, shrinkage stoping is generally used in conjunction with top slicing or block caving, the pillars separating the shrinkage stopes necessitating the use of either of the foregoing meth-



Longitudinal Section. Cross-Section.

SYSTEM OF OPEN STOPING AND FILLING AT THE ARIZONA COPPER CO.'S MINES.

ods for their removal. The principal mining method employed for many years in the district was square set and fill. The expense of using this system in the large bodies led to its disuse and the substitution of top-slicing methods. An excessive amount of timber had to be used in reinforcing the square sets to prevent serious caves, and the maintenance of rises to surface for waste became more difficult as the workings extended. The square-set method is, however, still employed in the extraction of orebodies of irregular shape and in the first stage of top slicing. Except in minor details, square-set practice here does not differ from that of other districts. A sub-level caving system is sometimes employed in mining the upper part of an orebody preparatory to top slicing. In narrow veins where filling is needed to support the walls, rill stoping is often employed. To eliminate the heavy expense of installing and maintaining chute rises every 25 ft. in the slices, a system whereby the ore will be loaded into cars directly in the slice is about to be tried out. In this system, which has been called 'panel slicing,' all of the working faces and all tramming will be on the same floor, and the use of tramming levels at 55-ft. intervals will be abandoned.

Air-drills are employed almost entirely in mining. Air at 100 lb. pressure is supplied by two Nordberg compressors of 4000-cu. ft. total capacity, direct connected to two alternating-current motors. One compressor at Morenci supplies the Hum-

boldt and Clay mines; the other at Coronado supplies the King and Coronado mines. One-man machines of various makes are used throughout. In slicing, 'jackhamers' are used in soft and water Leyners in harder ground. Giant ammonia powder of 30 to 40% is used in blasting, 1 lb. of powder breaking from 7 to 10 tons of ore. Prepared primers are issued to the miners from a number of supply magazines in the mine. Holman air hoists are used in handling the timbers in the stopes.

MOHAVE COUNTY

(Special Correspondence.)—Bullion shipments from the Tom Reed-Gold Road district totaled about $160,000 during March, from 14,000 tons of ore. The foregoing figures are based upon the mine and mill outputs of the Tom Reed and Gold Road properties, supplemented by the reports of the mine superintendents of the camp in general.——During the fiscal year ended March 31, the Tom Reed Mining Co., the largest gold-producing property in Arizona, mined 48,000 tons of ore having an average value of $24 per ton. The bullion shipped during that period was $1,152,000, the gold content being approximately $1,136,000 and the silver $15,000. Dividends paid totaled $591,211, or 65% on a capital of 909,445 shares.

Oatman, March 1.

CALIFORNIA

AMADOR COUNTY

Drainage of the Hardenburg mine, four miles from Jackson, has been stopped, and it will be allowed to fill with water. All machinery is to be removed.

ELDORADO COUNTY

The Union mine, which has been closed for some years, has been purchased by J. Finch, of Spokane, who has started work in charge of H. H. Lang.

INYO COUNTY

Fifteen miners have started work at the Wilshire Bishop Creek mine, in charge of Jess Riley. E. W. Walter is superintendent. Four inches of snow fell on March 28.

NEVADA COUNTY

The W. P. & C. Mines Co. was incorporated last week with the following officers: president, Edgar S. De Goyler; vice-president, J. E. Miller; secretary, T. C. Cunningham; directors: K. G. Dunn, Eugene W. Kay of the California Extraction Co., and O. P. Posey, all of San Francisco. The company will unwater and re-open the West Point and California mines at Deadman's Flat, and the J. E. Miller claims adjoining.——Gravel-bars near Foote crossing on the middle Yuba river are being washed with good returns.——A new electric hoist at the Providence shaft of the North Star property has been installed and tested.——R. L. Hathaway, of Nevada City, has secured the contract to erect a 10-stamp mill at the Plumbago mine in Sierra county. Five or ten more stamps will be installed as development warrants.——It is purposed to consolidate the principal properties in the Washington district.

PLACER COUNTY

The Borealis company, near Newcastle, has a 15-ton mill at work and has sent a carload of concentrate to the Selby smelter. The plant is to be duplicated soon.

PLUMAS COUNTY

In a 1000-ft. adit driven at the Gold Leaf mine between Greenhorn and Squirrel creeks, 8 ft. of quartz has been cut showing rich ore.

SHASTA COUNTY

The Victor Power & Mining Co., at Harrison Gulch, is employing 75 men, in charge of R. D. Jackson. The cyanide plant yielded $2500 during the last two weeks. The new Lane mill is giving excellent results. A hydro-electric power-plant is to be erected on Cottonwood creek.——The Pittsburg Mt. Shasta Gold Mining Co. has developed a large body of copper ore in the Little Nellie mine, and a mill costing $100,000 is proposed for its treatment. The company has spent $500,000 to date.

SIERRA COUNTY

The Twenty-one and Rainbow companies have consolidated, and a 20-stamp mill will be built to replace the one burned two years ago.——At the Tightner about 100 men are employed, and the mill continues to crush ore. An incline-shaft is being sunk to test the ore in depth, and is down 800 ft. A. Hall is manager.

TUOLUMNE COUNTY

The Tarantula claims, north of the Eagle-Shawmut mine, were acquired on April 3 by ex-Governor Henry T. Gage for $12,000.——Rich ore has been cut in the McCormick mine, east of Jacksonville.

COLORADO

GILPIN COUNTY

In order to increase the capacity and recovery at the Iron City concentrating mill at Black Hawk, the manager, O. J. Duffield, will let a contract for overhauling and additions. It is expected that the plant will then treat 100 tons per day instead of 50 as at present.——The Bates Leasing Co., of Black Hawk, had a good settlement for 22 tons of ore from the Globe smelter.——Below the 1100-ft. level of the Old Town mine, in the Russell district, a shoot is yielding up to 3½ oz. gold per ton in the Most mill at Black Hawk.——The Lake mine, in Virginia cañon, is producing about $1000 per day.

GUNNISON COUNTY

Shipping ore has been opened in the Carlton-Victor adit at White Pine, after 700 ft. of driving was done.

LAKE COUNTY (LEADVILLE)

Pumps for the Downtown pumping scheme are expected at Leadville by the middle of April.——Rich gold specimens were extracted from the Mt. Champion mine last week, and added interest is being taken in the Lackawanna and Twin Lakes districts. A mill is to be erected at the Miller mine at an early date.——The Garbutt is shipping 50 tons of ounce gold ore daily, and it is probable that a mill will be built.——Lessees at the No. 1 Jonny have resumed shipping zinc carbonate.——The Connors lease at Jonny No. 2 is yielding a little high-grade gold ore, but the vein is very narrow.——Horrigan Bros. continue to produce a good tonnage of tailing from the old Adams mill. This work is carried on in connection with the operation of the Leadville district mill, near the Arkansas Valley smelter, where a flotation process is giving good results.

SAN JUAN COUNTY

There will be a good supply of ore for Silverton custom mills this season. One of the Silver Lake mill-bins contains 1000 tons, and at the Contention mill another bin is being built.

TELLER COUNTY (CRIPPLE CREEK)

The gold output of this district in March is estimated as follows:

Plant.	Tonnage.	Av. val.	Gross val.
Golden Cycle	29,000	$48.00	$1,392,000
Portland (Colorado City)	10,000	19.00	190,000
Smelters	5,200	55.00	286,000
Portland (Cripple Creek)	16,100	3.20	51,520
Stratton's Independence	9,668	2.97	28,714
Colburn-Ajax	4,300	6.70	28,810
Neville-Free Coinage	2,000	3.00	6,000
Kavanaugh-Jo Dandy	1,000	2.40	2,400
Wild Horse	350	3.00	1,050
Total	77,618		$1,986,494

The high average at the smelters and Golden Cycle was due to rich ore from the Cresson mine, which has yielded approximately $1,000,000 since last November. The district's yield for the first quarter of 1915 amounts to $4,954,039.

Prospecting by diamond-drilling in this district is suggested by Leo Von Rosenberg, who is examining several properties. ——In the Ward lease at 700 ft. at the Empire State shaft of the Isabella a high-grade streak has been cut. Other ore being stoped is 9 ft. wide.

IDAHO

Lemhi County

At the Pittsburg-Idaho mine at Gilmore, 30 lessees and 28 company men are at work. More leases are to be let in

BOHANNON DREDGE, NEAR SALMON, LEMHI COUNTY, IDAHO.

April. Some lessees are getting good returns from the ore extracted.

Shoshone County (Coeur d'Alene)

It is reported that a consolidation of all the companies in the Mullan copper belt is proposed, including the Snowstorm, National, Missoula, Lucky Calumet, Snowshoe, Copper King, and others, the holdings of the consolidated concerns to be operated under one management, and the entire district to be developed by extension of the lower workings of the National and Snowstorm.

There being plenty of water for hydraulicking on the north side, near Kellogg, placer miners started work last week.

The Hercules mine is reported to be earning $600,000 per month, the net yield in 1914 being approximately $3,000,000. ——Several underground improvements being completed in the Marsh mine, it is probable that mining will be resumed shortly. At the mill a 5 by 10-ft. tube-mill, seven additional concentrating tables, a flotation plant, and other accessories are to be installed, increasing the capacity from 150 to 200 tons per day. The better price for lead has been the cause of these improvements.——On April 3 the Bunker Hill & Sullivan company paid its regular monthly dividend, amounting to $81,750. The total to date is $16,037,250.

From one to two feet of ore that assays from 20 to 34% copper is showing in the face of the adit being driven on the Reindeer-Queen mine near Mullan. The face is now at a depth of about 900 ft. The ore is a clean chalcopyrite. ——Reports from the old Charles Dickens mine, now known as the Knickerbocker group, are to the effect that zinc ore is being sacked from the upper workings and prepared for shipment.——Plans to reorganize the Idora Hill Mining Co. were outlined at a special meeting of the stockholders in C. E. Mallette's office in Spokane last week, and the directors have been empowered to proceed as their judgment directs, having been given full authority to dispose of the Company's holdings and equipment to a new company.——Development work on the Samson, situated on the east fork of Eagle creek, near Wallace, which has been going on all winter, has accomplished gratifying results. The work is being done under contract to drive 300 ft. on the vein, the drift now being in about 1000 ft. During most of this distance there has been more or less ore continuously, and during the past few weeks the character and quantity of ore has shown marked improvement. The face of the adit now shows about 30 in. of good milling ore. The ore is a fine clean galena, picked samples of which are reported to assay 60% lead and 80 oz. of silver.——An important development has been made in the Ray-Jefferson mine, adjoining the Interstate-Callahan properties on Nine Mile, according to telegraphed reports from D. L. McGrath, superintendent, to E. E. Ellis, of Missoula, Montana, secretary-treasurer of the Company. The message states that 12 ft. of excellent concentrating ore has been cut in the No. 2 adit, 1400 ft. in and at a vertical depth of 800 ft., and that the vein had not been cut through. Driving east toward the Interstate-Callahan lines, 500 ft. distant, will begin at once, and the ore-shoot thoroughly explored. The property is equipped with a compressor plant, operated with current from the Washington Water Power Co.'s transmission lines, and a full complement of machine-drills, which will make rapid development possible.——J. H. Hoskins, of Coeur d'Alene, reports an interesting mineral discovery near Wolf Lodge and about two miles from Beauty bay, an arm of Coeur d'Alene lake. It consists of a well defined vein standing vertically between walls of granite and slate ranging from 4 to 20 ft. wide. The interesting part of this discovery is that the vein contains minerals heretofore rarely known in this part of the country, namely, tin and bismuth. The vein also shows numbers of small stringers of lead, and picked samples assay high in silver. Assays from the vein, Mr. Hoskins says, show 42% tin, 216 oz. silver, and $40 per ton bismuth.

MICHIGAN

Navigation on Lake Michigan, between Michigan and Indiana points, opened on March 20, two weeks in advance of the opening date last year.

MISSOURI

Jasper County

A 'Zinc and Lead Handbook,' compiled by L. L. Wittich, has been published by the *Joplin News Herald*. It covers 60 pages, and is in handy pocket form, 3¾ by 8½ in. A map of the Missouri-Kansas-Oklahoma fields occupies the two centre pages. Not only does the work deal with the local statistics, but covers the lead and zinc business of the world. Generally the publication is interesting and valuable.

The Granby Mining & Smelting Co. has proved by churn-drilling the existence of a large body of ore at a depth of 185 to 230 ft. in its land about 1½ miles south of the town of Granby, and will commence at once on the erection of a concentrating plant with a capacity of 1000 tons per 24 hours.

MONTANA

Madison County

The old Rochester district is to be resurrected, and the Watsecca and Gold Coin properties will be reopened when electric power is arranged for.

Missoula County

There appears to be renewed activity in the Saltese district, which is supplied by the Northern Pacific and Milwaukee railroads, especially at the Tarbox, Hemlock, Bryan, and Last Chance mines. The last has shipped a good deal of lead ore.

Silverbow County

On March 30 the High Ore and Diamond mines of the Anaconda company, which have been closed for nine months, were re-opened, and 1200 men will produce about 1200 tons of ore per day. The former property is the deepest in the Butte district, being down 3400 ft., while the Diamond is opened to 2800 ft. At the Great Falls smelter, in Cascade county, two blast and three reverberatory furnaces are being blown

in to produce first-class ore and concentrate from Butte and Anaconda.

Shareholders in the Bullwacker company are considering the resumption of mining in the glory-hole of the property in the spring. Lessees two years ago had satisfactory returns, shipping 30,000 tons of 4.07% copper ore. The mine contains a large tonnage of ore. The leaching plant is not to be operated.

The U. S. Bureau of Mines rescue-car No. 5, which has been at Butte since February 18, has left the district. In charge of J. L. Boardman it has given valuable instruction to miners and others.

NEVADA

Elko County

At Gold Circle the Elko Prince, Eastern Star, Esmeralda, Hardscrabble, and Rex are being operated full time. A 50-ton mill is working at the last named. The Elko Prince has a large tonnage of ore blocked out. A mill is to be erected at the Eastern Star.

Esmeralda County

A drift from the rise above shale 'A' level, 18 ft. below the 921-ft. level, of the Jumbo Extension, is showing seven feet of $75 ore.——The estimated production of the Goldfield Consolidated company in March is as follows: Ore mined, tons, 32,075; gross extraction, $367,000; operating expense, $195,000; and net realization, $172,000.

Eureka County

The Union Mines Co., operating 35 miles south of Palisade, has about 3000 tons of silver-lead ore ready for shipment, and expects to receive from $15 to $27 per ton net for it. The mine has been well developed by adits.

Lincoln County

The annual report of the Prince Consolidated Mining & Smelting Co. at Pioche states that the available resources amount to about $150,000. Development has proved a large tonnage of iron-manganese ore about 240 ft. wide. Tests made on the Bullionville and Dry Valley tailing show an average of $11.80 per ton, the dumps being worth $1,417,864 at present metal prices. A profit of $3 to $5 per ton should be made on treatment.

Mineral County

According to the general superintendent, L. H. Metzger, the Aurora mill will start early in April. It has been shut down for alterations to the filter-plant.

Nye County (Tonopah)

During the week ended April 3, eight mines at Tonopah produced 10,117 tons of ore valued at $208,066.——A drum on the electric hoist of the Belmont broke last week, reducing the output. The Favorite vein is opening well at 1000 ft.——Rich ore is still being developed on No. 5 level of the California claim of the West End.——During March the Extension mill averaged 243 tons per day.——Considerable development is in progress in the Tonopah Mining Co.'s Sand Grass claim.

White Pine County

After being closed since 1907, the Ruth mine has been reopened by the Nevada Consolidated company. Mining will be in charge of William Spencer and William Caulfield, who have had experience with the Utah Copper Co. A 2500-kw. turbo-generator and other machinery is to be installed at the power-plant at McGill. A new reverberatory furnace has been blown in.

OREGON

Baker County

A stage-coach containing bullion worth $7000, traveling from the Rainbow mine to Durkee, was held-up by bandits near Rye Valley on April 5. The metal was on its way to the San Francisco mint.

Malheur County

In furtherance of the federal government's search throughout the United States for supplies of potash and nitrates, the recently discovered nitrate field near Homedale, Idaho, was visited by a representative of the Geological Survey in November 1914. The field lies in and about the valley of Sucker creek, near the state line, and about 16 miles southwest of Homedale. A number of prospects were visited and samples were collected for analysis. Two general classes of deposits were recognized, namely: (1) crevice and cave deposits in the lavas bordering Sucker creek, and (2) more or less bedded deposits in low rounded hills composed of sedimentary materials.

SOUTH DAKOTA

Lawrence County

(Special Correspondence.)—When the Black Moon mill of the Mogul company was completed a year ago the corporation had a floating indebtedness of considerable amount and owed some back taxes. In the year just closed the debt was all liquidated, some $7000 of taxes paid, and a good working fund established in the treasury. Of course in the space of a year it has been possible to get everything about the mill in good condition, and this has been reflected in a gradually increasing tonnage. During the first half of March the mill handled 120 tons per day. Previous to this the best average for a month was 100 tons per day. This tonnage brings the capacity up to nearly the maximum which can be put through the Dorr slime agitators. This will be remedied by the immediate installation of another agitator, so that the crushing department can be pushed to its full capacity, which will probably be found to be about 150 tons. It now appears that the Company is getting on a good financial basis. Interest on its $240,000 worth of 6% bonds amounts to $14,000 per annum, equivalent to $1200 per month, a sum that the property should be earning at the present time. The mine is in better physical condition than it has been for several years, with a good supply of ore in sight, and facilities at hand for economical operation.

Work at the Rattlesnake Jack mine, at Galena, is at present confined to shaft sinking, and it is understood that no further construction work will be undertaken at the mill until warmer weather. The mill is very nearly completed; a few weeks' work will put it in shape to operate.

Deadwood, March 15.

Pennington County

The 50-ton capacity mill near Hill City, which has been reconstructed by Robert McNish and associates, is ready to crush the 500 tons of tin-bearing ore on hand from a mine near the Etta. It is hoped to work the plant continuously.

UTAH

Juab County

Ore shipments from the Tintic district last week totaled 102 cars. About 200 tons of residue per day is to be sent from the old Sioux or Farrell mill at Mammoth to the A. S. & R. smelter near Salt Lake City. The dump contains between 30,000 and 50,000 tons of $7 silicious material needed at the smelter.——In March the Iron Blossom mine produced 150 tons of 36% zinc ore.

Summit County

The following dividends were paid last week at Park City: Daly-Judge, $45,000; Silver King Coalition, $187,500; and Silver King Consolidated, $62,500.——In December, 1913, the Daly West mill was destroyed by fire, a new one was erected, and it is now working at normal capacity. The mine and

plant employs 125 men. Most of the ore is coming from 1700 and 2000 ft. The general manager, H. G. McMillan, states that lessees are working above the 1200-ft. level.——The Snake Creek drainage tunnel is in approximately 11,000 feet.

WASHINGTON

Ferry County

(Special Correspondence.)—The Republic Consolidated Mines Corporation, as the owner of an option on the Lone Pine, Pearl, and Surprise mines, at Republic, has sold the option to H. A. Sell, one of a West Virginia syndicate, for $50,000, under certain conditions. Thirty miners are now employed.——The North Washington Power & Reduction Co.'s cyanide mill has been sold by W. W. Tolman, receiver of the Company, to F. R. Clark, of Spokane, Washington, for $25,000. The contract of sale has been approved by the superior court. The contract calls for the equipment of the mill for a capacity of not less than 100 tons per day.

Republic, March 20.

(Special Correspondence.)—The West Virginia Mining Co., with a capital of $1,000,000, has been incorporated, with Republic as the principal place of business and J. O. Jarrel, H. A. Sell, and John Benson as trustees. Mr. Jarrel is from West Virginia, Mr. Sell from Colorado, and Mr. Benson from Republic. The Company has taken over the Lone Pine, Pearl, and Surprise mines, at Republic. Mr. Benson will be superintendent of the Surprise, and Thomas Ferguson will have charge of the Lone Pine and Pearl mines.

The miners, creditors of the Western Union mine, have received 10% of their claims from the sale of garnisheed bullion. Another dividend is expected soon from the sale of ore at the smelters.

Republic, March 26.

CANADA

Alberta

(Special Correspondence.)—It is estimated that the Alberta Petroleum Consolidated Co.'s No. 2 oil-well will yield 100 bbl. per day, and a test is to be made to prove its capacity. The oil has a gravity of 37.7° Baumé.——The Western Pacific well makes 50 bbl. per day, and tests 48°.——The Moose oil tested 39°.——The Dome people, at 2200 ft., have finished their 'fishing' troubles, and expect oil within 50 ft.——The Prudential is drilling again, after its fire.——The Northwestern Pacific, at 2250 ft., is regarded favorably.——At 3120 ft. the Mowbray-Berkley well is reported to be in the Dakota sands.——At the Gratton, east of Edmonton, the well, in the last week of March, was down 607 ft., and there was trouble with water. Gas is coming out all the time, and a big 'gasser' is likely, with good oil-producing horizon lower down.——The Sweet Grass area, southeast of Calgary, is receiving considerable attention lately, but no well is producing so far.——Another share boom has started on the exchanges, but the professional nature of this move is plainly seen. Enough depth will be reached within 60 days in several wells to give an approximate valuation of the field.

Calgary, March 31.

British Columbia

The Hedley Gold Mining Co. in 1914 earned a net profit of $388,228 from 78,494 tons of ore averaging $10.80 per ton. The property is stated to have more ore in reserve now than ever before.——The Le Roi No. 2 company is paying a dividend of 24c. per share. Ernest Levy, the general manager, recently returned from England.

Ontario

During the 28 days ended February 25 the Hollinger mine produced 22,438 tons averaging $11.39 per ton, returning a profit of $154,714. The monthly dividend calls for $120,000, so there was a surplus of $34,714, and total surplus of $1,192,000. Working costs averaged $3.98 per ton.

PERSONAL

B. B. Thayer is at Butte.

Pope Yeatman is at Chuquicamata, in Chile.

W. DeL. Benedict is returning to New York.

A. G. McGregor was at Douglas, Arizona, recently.

Joseph W. Boyle has gone from Dawson to London.

Leo Von Rosenberg, of New York, is at Cripple Creek.

W. A. Dickey, of Landlock, Alaska, is here on a visit.

John Hoy, of Butte, Montana, is visiting the Exposition.

E. M. Rogers, of New York, has been visiting the Exposition.

W. A. Prichard has gone to London, on his way back to Colombia.

H. W. Gepp, of Broken Hill, has passed through New York on his way to London.

D. C. Jackling was married to Miss Virginia Jolliffe at San Francisco on April 5.

J. P. Charra is at Goldfield, examining mines in the interest of French investors.

John M. Nicol has had to leave Mexico, like many others, and is now in San Francisco.

Seeley W. Mudd and Philip Wiseman passed through San Francisco on their way northward.

E. P. Mathewson, recently in the hospital at Montreal, has returned convalescent to Anaconda.

Sherwood Aldrich, who has been spending a holiday in San Francisco, has returned to Colorado Springs.

G. T. Jackson has been promoted from superintendent to assistant manager of the Perseverance mine, near Juneau.

B. B. Neiding, formerly superintendent of the Kensington mine, has been appointed to a similar position at the Perseverance mine, near Juneau.

Harris J. Ryan has been elected honorary vice-president of the American Institute of Electrical Engineers, and he will act as a special honorary representative and officer of the Institute on the Pacific coast during the Panama-Pacific Exposition.

SCHOOLS AND SOCIETIES

The American Mining Congress is forming a branch in Utah, with headquarters at Salt Lake City, as it has done in Arizona and Montana recently, to further the objects of the society.

The South African Institution of Electrical Engineers held its annual meeting in Johannesburg during the second week of January. The total membership is 236, and receipts in 1914 amounted to $3300.

The Chamber of Mines and Oil of Los Angeles has a membership of about 260 mining and oil companies, individual operators and others. In 1914 there were 79 new members added. The total debt is only $150.

The *Official Register* of Princeton University for January 7 makes announcement for 1915-16 in the department of geology. This includes undergraduate, honors, and graduate courses, laboratories, museum, higher degrees, fellowships, and the graduate college.

The Electrical Association of Australia has recently been formed as the result of a conference between the electrical societies of Victoria and New South Wales, which are representative of practically the whole profession in those states. Other state's institutions will be admitted later on. O. W. Brain, chief electrical engineer of the New South Wales railways and tramways, is president.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, April 8.

Antimony	25 —25¾
Electrolytic copper	15½ 15¾
Pig lead	4.40— 5.35
Quicksilver (flask)	$80.00
Spelter	10¾ —11
Tin	40 —41½
Zinc-dust, 100-kg. zinc-lined cases	15

No changes are recorded in the local metal market.

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, April 8. The market may be summarized by saying that all metals are firm.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.		Average week ending	
Apr.	1 50.00	Feb. 24	48.70
"	2 49.87	Mch. 3	49.02
"	3 49.87	" 10	49.81
"	4 Sunday	" 17	51.18
"	5 50.00	" 24	50.33
"	6 50.25	" 31	50.14
"	7 50.25	Apr. 7	50.04

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	....
Feb.	57.53	48.45	Aug.	54.35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	....	Oct.	51.12	....
May	58.21	....	Nov.	49.12	....
June	56.43	....	Dec.	49.27	....

This week's average is a trifle lower than in the previous week, but the market is steady. On April 3 about 120,000 oz. was shipped from San Francisco to the Orient.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Mch. 10	80.00	Mch. 24	80.00
" 17	80.00	" 31	80.00
		Apr. 7	80.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60.00	Aug.	80.00	....
Mch.	39.00	78.00	Sept.	76.25	....
Apr.	38.90	....	Oct.	53.00	....
May	39.00	....	Nov.	55.00	....
June	38.60	....	Dec.	53.10	....

On page 569 of this issue of the 'Press,' quicksilver prices are discussed at length, and should help to clear up many doubts. New York advice on April 8 stated that there were no inquiries and the market was dull

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	....
Feb.	39.76	37.23	Aug.	50.20	....
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	....	Oct.	30.40	....
May	33.29	....	Nov.	33.51	....
June	30.72	....	Dec.	33.60	....

Tin on April 7 was quoted at 47c. per pound in New York, and £168 per ton in London.——In their monthly circular on tin, dated April 2, L. Vogelstein & Co. states that Straits shipments for eight months of the War totaled 40,329 tons, against 42,855 tons in the same period of the previous year, therefore they are normal. On the whole, it would appear that a sufficient supply will be forthcoming for this country.——The output of the Malay States in 1914 was 109,854,533 lb., a decrease of 2,129,333 lb. The year was discouraging, small mines were closed, 25% of the coolies were repatriated, and the Government averted a crisis by advancing on the output. Shipments to the United States were 22,032,267 lb., compared with 26,222,133 lb. in 1913. A consular cablegram of April 1 states that the tin situation at Singapore is improving, and the principal shippers are securing special permits for American orders.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Apr.	1 15.63	Feb. 24	14.42
"	2 15.63	Mch. 3	14.38
"	3 15.75	" 10	14.50
"	4 Sunday	" 17	14.59
"	5 15.75	" 24	14.90
"	6 15.87	" 31	15.37
"	7 15.87	Apr. 7	15.75

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	....
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.13	....	Oct.	11.10	....
May	13.97	....	Nov.	11.75	....
June	13.60	....	Dec.	12.75	....

According to the 'Boston Financial News,' the Michigan output in March will amount to nearly 23,000,000 lb. The Mohawk and Wolverine produced 1,634,000 lb. and 830,000 lb. of mineral (66% metal) respectively.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Apr	1 4.23	Feb. 24	3.85
"	2 4.23	Mch. 3	3.87
"	3 4.23	" 10	3.95
"	4 Sunday	" 17	4.01
"	5 4.23	" 24	4.15
"	6 4.23	" 31	4.15
"	7 4.23	Apr. 7	4.23

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	....
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	....	Oct.	3.60	....
May	3.90	....	Nov.	3.68	....
June	3.90	....	Dec.	3.80	....

Lead ore has advanced $1 per ton at Joplin, Missouri

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
Apr.	1 8.25 to 9.25	Feb. 24	8.25
"	2 8.25 to 9.25	Mch. 3	9.05
"	3 8.25 to 9.25	" 10	8.00
"	4 Sunday	" 17	7.92
"	5 8.25 to 9.25	" 24	8.59
"	6 8.25 to 9.25	" 31	8.50
"	7 8.25 to 9.25	Apr. 7	8.75

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	5.22	9.05	Aug.	4.45	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	....	Oct.	4.75	....
May	4.91	....	Nov.	5.01	....
June	4.84	....	Dec.	5.40	....

The spelter market still shows erratic movements, and is the subject of considerable discussion. In the Missouri-Kansas-Oklahoma region prices for zinc-blende continued to decline, the highest being $60 per ton down to $48 for the basis of 60% metal. The spelter market quotations were further complicated by the decision of the Merchants' Exchange of St. Louis to stop giving any to the Associated Press, because those that were given to the exchange by the brokerage firms were unreliable, according to the 'Joplin Globe.' As the New York market has not reported any specific price of spelter for two weeks, the only actual market figure generally available is London, which is reported firm at £43 per ton, or 9.2c. per pound. There are sales of spelter in New York and St. Louis, of course, but the actual selling figures have been badly confused with bids and offers to sell, which it is commonly known are the result of attempts to manipulate the market, either up or down. The Butte & Superior mill treated 41,710 tons of ore in March, which would yield about 13,500,000 lb. of spelter.

COMPANY REPORTS

NEW IDRIA QUICKSILVER MINING COMPANY

The report of this California quicksilver company is of interest, as the market for the metal has been considerably discussed during the past six months. Operations in 1914 resulted as follows:

	1914	1913.	1912.
Development, feet	12,367	9,182	11,080
Ore treated, tons	62,578	76,993	76,348
Quicksilver recovered, flasks	6,550	9,700	9,600
Average net price per flask	$41	.....	.....
Total revenue	$295,361	$363,054	$377,484
Operating expenses	340,371	298,041	303,721
Loss	45,010	*65,013	*73,763
Dividends	10,000	40,000	120,000
Previous surplus	144,600	119,587	165,824
Surplus carried forward	89,590	144,600	119,587

*Profit.

Storms involved the expenditure of about $20,000 in repairing the property and roads, and extraordinary development and lower-grade ore all contributed to the decreased earnings. The known orebodies have been nearly depleted above No. 7 level. Development was principally done on No. 9 and 10 levels, which produce most of the ore. The Molino adit, to develop the San Carlos deposits, is in 3900 ft. and is under them. A rise is being driven. The price of quicksilver up to August was $36 per flask. After the war started, it advanced to $75, at which price it was possible only to make small sales. The year's average was $41 per flask.

SENECA—SUPERIOR SILVER MINES, LTD.

The third annual report of this Cobalt, Ontario, company covers the year 1914. The president, S. Harry Worth; consulting engineer, W. E. Legsworth; and manager, R. H. Lyman, make the following remarks in part:

In spite of the decrease in the price of silver, the profit was greater than in 1913. It is the policy of the directors to sell the metal at current prices rather than hold for a rise, thus securing a larger profit than otherwise.

Development amounted to 3445 ft., 1004 ft. less than in the previous year, work being reduced to a minimum in August on account of the war. The Worth vein has been opened on four levels. On No. 3 level the ore-shoot is 400 ft. long, and 280 ft. on No. 4. Ore reserves are estimated to contain 2,035,000 oz. The ore-dressing plant is now a very complete mill, and is equipped to make a complete concentration of all fine material from the picking-table, and the final mill tailing is down to 5 oz. per ton. The shipping product of high-grade jig and table concentrates goes to the Deloro smelter. Additions to the plant consisted of a 4 by 8-in. Sturtevant crusher, 4½ ft. by 16-in. Hardinge ball-mill, a double jig and trommel, and another Deister sand and Deister slime-table. Shipments, the product of 16,871 tons mined, totaled 525 tons, and the production was 1,430,674 oz. silver worth $758,581. The cost was 30.53c. per ounce. The total profit amounted to $321,742, to which is added the previous balance of $85,290. Dividends absorbed $335,219, and the balance carried to 1914 is $71,814.

AMERICAN SMELTING & REFINING COMPANY

According to Daniel Guggenheim, president of this great concern, notwithstanding the demoralized business of 1914, and particularly the fact that the Company's large business in Mexico was not at all profitable, and the low prices of metals, due to the war, resulted in the cutting off of a large supply from the mines, yet, with all these discouragements, the net earnings of the Company were $10,571,915, or only about $700,000 less than the preceding year. The total turnover amounted to over $200,000,000, on which the net earnings were nearly 4½ per cent.

The policy of the Company is to make the smelting and refining charges low in order to encourage the supply of ores, and in the endeavor to offset these low charges the Company is mining coal, producing coke, owning and operating mines producing gold, silver, lead, copper, and zinc, and is now erecting plants for the refining and production of other metals, such as nickel, platinum, palladium, arsenic, bismuth, cadmium, tellurium, and selenium. The Company also produces sulphuric acid and sulphate of copper. The Company is also taking up the manufacture of metal products, and last year produced over 40,000,000 lb. of manufactured material. In connection with the large growth of the Company in refining copper, in 1908 the annual production of copper was approximately 50,000,000 lb., while last year the Company refined about 530,000,000 lb. Considerable attention is being paid to the welfare of employees, including accident prevention, hours, and pensions. The pension fund amounts to $520,238.

Financial results may be summarized as follows:

	1914.	1913.
Net earnings of operating properties	$11,603,015	$12,111,407
Other income	1,222,514	1,318,526
Total income	$12,825,529	$13,429,933
Total charges	3,793,964	3,673,393
Dividends paid:		
A. S. & R. preferred	3,500,000	3,500,000
A. S. & R. preferred 'A'	1,017,450	1,020,000
A. S. & R. preferred 'B'	1,500,000	1,500,000
A. S. & R. common	2,000,000	2,000,000
Total dividends	$ 8,017,450	$ 8,020,000
Surplus for year	1,014,115	1,736,540
Total surplus	$19,510,057	$18,495,942

Assets, which amounted to $188,577,237, include ore, bullion, and products on hand and in transit worth $24,660,942; cash, $8,034,778; and material and supplies, $2,785,635.

CALUMET & ARIZONA MINING COMPANY
SUPERIOR & PITTSBURG COPPER COMPANY

These companies operate at Warren, Cochise county, Arizona, the latter controlled by the former, which also controls the New Cornelia Copper Co. and other subsidiaries. The general manager, John C. Greenway, includes the following in his reports for 1914:

Development in the C. & A. amounted to 6328 ft., against 15,635 ft. in 1913. Only a little work was done at 1350 ft. in the Irish Mag shaft. Up to the time of curtailment in August, considerable sulphide ore was opened at 1250 ft. in the Oliver shaft. Results were not encouraging at 400 ft. in the Powell shaft. The recently acquired Higgins or Magenta ground was entered in November at 1000 ft. from the Cole area. The ore output was 66,467 tons.

Development in the S. & P. ground totaled 66,465 ft., compared with 47,201 ft. in 1913. The large body of oxide ore at 900 ft. in the Granville claim was blocked out and extensively mined. At 1000 ft., 50 ft. of sulphide and a good deal of oxide ore was found, being a continuation of the Granville shoot. A large tonnage of 2% ore was proved at 1300, 1400, and 1500 ft. in the Baton Rouge claim. The pump-station was completed at 1800 ft. in the Junction shaft and levels below 1500 ft. are to be developed. A total of 1,521,742,827 gal. of water was pumped. Work at the Junction has shown great tonnages of 2 to 4% ore. The motor-haulage system connecting

the Briggs, Hoatson, and Junction shafts was completed. Ore production amounted to 505,011 tons.

Low-grade sulphide ore, 25,491 tons, with high sulphur and iron content was sent from the various properties to the El Paso smelter, this ore being desired there, and a corresponding premium is paid. Ore reserves in the mines increased by 556,427 tons.

The smelter treated the following: C. & A., 64,702 tons; S. & P., 465,349 tons; and custom ore, 138,726 tons; a total of 668,776 tons. The blast-furnaces reduced 403,269 tons of ore and 31,299 tons of slag, etc. The reverberatories treated 171,500 tons of calcines, 43,485 tons of fettling ore, 19,297 tons of flue-dust, and 3813 tons of flux. The roasting furnaces treated 209,138 tons of ore, reducing 27.5% sulphur to 9%. The converters produced 32,059 tons of blister copper. Metal from Company ores totaled 49,992,909 lb. copper, 573,606 oz. silver, and 19,745 oz. gold.

The income amounted to $8,518,999; expenses, $3,085,535; and dividends, $1,851,009. In spite of the 50% reduction in output for five months, mining costs dropped 53c. and smelting 35c. per ton.

Concerning the Ajo property of the New Cornelia Copper Co., which contains over 40,000,000 tons of oxide and sulphide ore, the president, Charles Briggs, said: "If future results continue to equal those which we have already obtained, a plant with a daily capacity of 4000 tons of ore will be designed. Plans for financing have not been completed." As to the leaching process, J. C. Greenway, general manager, said: "After extensive laboratory work at Douglas, which gave promise, we erected a substantial crushing plant, consisting of jaw-crusher, Symons coarse crusher, Symons fine crusher, screens, etc., at Ajo, and installed a one-ton plant for actual trial in the field. This one-ton plant has been operated practically six months. For the past 74 days the plant has given an extraction of 80.87% for the total copper contained. Iron and other deleterious salts in the solution have been controlled to the point that a yield of 0.982 lb. of copper per kilowatt-hour has been obtained in the electrolytic plant. All the acid needed has been regenerated from the solution itself excepting a deficiency of approximately 1.4 lb. 100% acid per pound of copper. A 40-ton plant has been completed and is now in operation. We feel that the process has been worked out and that any changes in the future will be in detail only."

It is thought that ample water for all purposes has been found in the well drilled near the property.

CROWN RESERVE MINING CO., LTD.
PORCUPINE-CROWN MINES, LTD.

These two companies are taken together, as the first-named controls the other, one operating at Cobalt, and the other at Porcupine, Ontario. The report covers the calendar year 1914.

Crown Reserve.—The general manager, Samuel W. Cohen, makes an interesting statement regarding operations. Development amounted to 4056 ft., making 26,199 ft. to date, 469,552 cu. ft. of stoping, and 40,842 tons of ore broken. Eleven veins contributed to the total output of 1,425,320 oz. of silver. The Carson No. 1 is worked out as far as high-grade ore is concerned. In Gear No. 14 there is still a fair tonnage of rich ore in patches with the milling ore. No. 17 produced 620,000 oz., that part of the east end of the vein was taken out right up to the bottom of Kerr lake. Drainage of the lake was carried on successfully, although mud and clay interfered with pumping. Over 600,000,000 gal. of mud and water have been pumped, leaving probably 100,000,000 gal. more to be removed. Work by the Kerr Lake company in the bed of the lake shows several veins running into the Crown Reserve ground. The drainage enabled ore extraction from No. 17 and 24 veins, the latter producing 420,000 oz., which could not have been done otherwise and the output would have fallen off. Drainage of this lake was described in the *Press* of January 9, 1915. The value of No. 28 is erratic, but there is an appreciable amount of ore above the 150-ft. level. On the 200-ft. level, a shoot 190 ft. long has been opened on No. 30, there being 1 in. of high-grade and 48 in. of mill ore. Vein 33 was cut in Keewatin formation at 200 ft., and shows 1 in. of calcite with a little silver. Ore reserves contain about 1,500,000 oz. On the Silver Leaf property 800 ft. of work was accomplished, and while exploration at 500 ft. was unproductive, in the old workings at 75 ft. a 1-in. vein was cut between the conglomerate and slate, and has been opened 25 ft., yielding 1000-oz. ore. In the Drummond Fraction, jointly owned with the Kerr Lake company, No. 1 vein yielded 116,667 oz., netting $12,210 for each company.

Ore production was as follows: high-grade, 288 tons containing 920,994 oz., and mill ore, 31,347 tons yielding 467,757 oz., a total of 1,425,320 oz. valued at $740,093. Costs totaled 28.95c. per ounce. The output to date is 8678 tons yielding 18,429,141 ounces.

Financial results were as follows: Operating profit, $239,477; dividend from Porcupine-Crown company, $144,000; interest, $3832; and balance from 1913, $844,616, making a total of $1,231,925. From this, dividends amounting to $424,515 were paid, and after paying for prospecting, legal, and other expenses, the surplus at the end of 1914 was $771,711.

DRAINAGE OF KERR LAKE, COBALT; WASHING DOWN THE MUD.

Porcupine-Crown.—This property is managed by M. W. Summerhayes. Development totaled 4633 ft. during 1914, making 10,555 ft. to date, and results were most satisfactory. On the 100-ft. level the ore-shoot has been opened for 465 ft., 705 ft. at 200 ft., 979 ft. at 300 ft., and 700 ft. at 400 ft. On the latter level there is about 270 ft. of barren rock between the two shoots. At 500 ft. the vein was driven on for 65 ft., when the main fault was found, similar to conditions at 300 ft., but the fault problem was satisfactorily solved. A diamond-drill hole was put down near the eastern boundary, and 900 ft. south of the northern boundry. At 275 ft. 18 in. of $4 ore was cut, and at 1100 ft. about 20 ft. of formation of low-grade. Ore reserves are estimated at 85,000 tons worth $1,510,000, which is correct within 10 per cent.

The mill, which was described in the *Press* of July 18, 1915, treated 40,857 tons of $17.18 ore with 97.26% recovery. The revenue from bullion was $691,394, and operating profit $305,075. Adding balance from 1913 and sundry revenue, there was $457,979 available, from which $240,000 was distributed in four dividends and $5855 as bonus to employees, leaving a surplus of $212,124.

MINING DECISIONS

Mining Terms—Limited Application

A statute imposing a penalty for leaving unguarded a shaft, drift, or cut, within any town limits, refers only to mining excavations and cannot be applied to an unguarded sewer trench.

McLaughlin *v.* Barsden (Montana), 145 Pacific, 954. January 18, 1915.

Assessment Work—Delinquent Co-owners

In course of one of the many conflicts over the title to the valuable potash deposits in San Bernardino county, California, a temporary injunction has been granted restraining certain locators from claiming a forfeiture against their co-locators for failure to contribute to the performance of annual assessment work as required by law, where it appears from the bill that said co-locators had attempted to perform such work but had been prevented by force from so doing, and that to record such claim of forfeiture would cloud said co-locator's title to the claims.

Thompson *v.* Pack (California), 219 Federal, 624. December 10, 1914.

New Law Governing Phosphate Deposits

"Where public lands containing deposits of phosphate rock have heretofore been located in good faith under the placer mining laws of the United States and upon which assessment work has been annually performed, such locations shall be valid and may be perfected under the provisions of said placer-mining laws, and patents whether heretofore or hereafter issued thereon shall give title to and possession of such deposits: Provided, that this act shall not apply to any locations made subsequent to the withdrawal of such lands from location, nor shall it apply to lands included in an adverse or conflicting lode location unless such adverse or conflicting location is abandoned."

Act of Congress, approved January 11, 1915.

The Oil Withdrawal Case

In 1909, ex-president W. H. Taft made a temporary withdrawal by executive order of oil lands in California and Wyoming. Some months later prospectors entered on a portion of the withdrawn area, made locations thereon, and proceeded to extract large quantities of oil. Suit was brought by the United States authorities seeking to recover the land and to obtain an accounting for the 50,000 bbl. of oil alleged to have been illegally obtained. The District Court sustained a demurrer to the bill and dismissed it on the grounds that the President had no right to withdraw the lands in question without authorization from Congress. The case went to the United States Supreme Court on certiorari. In a lengthy opinion, delivered by Justice Lamar, and dissented from by Justices Day, McKenna, and Van Devanter, the Supreme Court reversed the judgment of dismissal on the principal grounds that, by years of acquiescence in executive withdrawal orders, Congress had impliedly conferred on the President the right to make such withdrawals, when in his opinion they were necessary for public purposes, until such time as Congress can act upon the matter.

United States *v.* Midwest Oil Co. (U. S. Supreme Court). Decided February 22, 1915.

[Note.—Readers wishing to obtain copies of this opinion in full in advance of its general publication in the reports, will find it printed in the San Francisco *Recorder* for March 15, 1915.]

BOOK REVIEWS

Methods in Metallurgical Analysis. By Charles H. White. P. 356. Ill., index. D. Van Nostrand Co., New York, 1915. For sale by the *Mining and Scientific Press*. Price, $2.50.

This volume adds to the already large number of books on metallurgical analysis, but the author, who is assistant professor of mining and metallurgy at Harvard and the Massachusetts Institute of Technology, states that he has brought together those methods which, owing to their fitness, seem to have been most generally adopted in American metallurgical laboratories. From several years' experience he finds that students who have had adequate preparation in qualitative analysis can take up metallurgical analysis at once, without having previously taken a general course in quantitative analysis. The first 45 pages of the work discuss the equipment of a 'lab,' selection of methods, sampling methods and apparatus, and operations in analyses in a thoroughly practical manner. Then follow chapters giving simple and quick methods of analysis of ore. The estimation of sulphur, silicon, phosphorus, manganese, nickel, copper, tungsten, and other metals, and gases, in steel, covers 53 pages, and may be said to be an important part of the book. Determinations are given of furnace products, gold and silver, fuels, oil, and some of the minor and rarer metals. Numbers of useful tables find their place as in most works of this kind. To show that it is up to date, it is only necessary to mention that such subjects as copper in steel, cyanogen in commercial cyanide, gas analysis, testing of uranium ore, and examination of boiler water are among the many given adequate space.

A Text-Book of Practical Assaying. By James Park. P. 342. Ill., index. Charles Griffin & Co., London; J. B. Lippincott Co., Philadelphia, 1914. For sale by the *Mining and Scientific Press*. Price, $2.50.

In 1894, the reviewer of this work, which is the first edition published in England, and revised and enlarged from the third New Zealand edition, studied pratical assaying, certain chemistry, and the cyanide process from the first copies printed at the Thames, New Zealand. Since then the cyanide portion of the book has been published in a separate volume, and the new one to hand has a much greater scope, covering both dry and wet methods of assaying in considerable detail. The author, who is professor of mining and geology at the University of Otago, Dunedin, New Zealand, originally prepared the notes for students, the matter covering a two years' course in assaying. The idea of the arrangement of the text has been to lead the student from the relatively simple operations necessary in the assay of gold and silver ores up to the determinations that pass insensibly into the quantitative analysis of simple and complex substances; and through imparting manipulative practice and a knowledge of first principles to initiate the student into the technical methods of ore valuation. Following this system, we find in the estimation of value of certain ores the dry assays are described, followed by the gravimetric and volumetric methods. For other ores and minerals only wet analyses are possible, these also being given. Any person with a small knowledge of certain reagents and materials could learn assaying from this book without trouble, owing to its practical style. In addition to ore determinations, there are methods for the estimation of rare earths, chlorine, sulphur, cyanides, lime, cement, coal, soils, fertilizers, oil shale, water, cyanide tests, and slag.

Bulletin 69, 'Petroleum Industry of California,' has just been printed, and is ready for distribution by the Mining Bureau.

New Machines and Devices

Information based on letters and catalogues from manufacturers, and staff observations.

Ore Treatment Apparatus at the Exposition

In the Palace of Machinery at the Panama-Pacific Exposition the Kelly Filter Press Co., of Salt Lake City, Utah, has a simple yet interesting exhibit explaining its apparatus for filtering slime. It consists of a standard size filter-press, the leaves of which are moved in and out of the cylinder by motor-driven gear, showing how they are run out for discharging residue, and then returned for the formation of new cakes. A small model press is in actual operation filtering and discharging slime, and may be inspected by visitors. A motor-driven vacuum-pump is part of the necessary equipment.

Commercial Paragraphs

The Dorr Cyanide Machinery Co. announces that after May, 1915, the address of its New York office will be room 2843, Whitehall building, New York, instead of 30 Church street, as heretofore.

The *Labor Saver*, the Stephens-Adamson Manufacturing Co., of Aurora, Illinois, monthly, for March contains interesting illustrated notes on ore handling in modern milling-plants (a reprint), freight-handling, coal-moving equipment, and the 'S-A' belt-conveyor removing gravel overburden from a clay bank.

The Terry Steam Turbine Co., of Hartford, Connecticut, announces that after March 22 the Chicago office of the Company will be in charge of A. W. de Revere, in the Peoples Gas building. An office has been opened in the Michigan Trust building, Grand Rapids, Michigan, in charge of A. L. Searles, to cover the southern peninsula of Michigan.

In *Bulletin* No. 40 the Cement-Gun Co., of Church street, New York, discusses the protection of steel with gunite without reinforcing. This was accomplished in protecting the steel sub-structure of the Cortlandt Street ferry-terminal of the Pennsylvania line, New York, from corrosion and rust, by a thin coating of gunite, applied without reinforcing. The steel was first sand-blasted to gray metal, and then coated to a thickness of ¼ to ½ inch. After four months no signs of cracking are visible.

Bulletin No. 46,251 of the General Electric Co. of Schenectady, New York, covers outdoor metering outfits. Power companies operating high-voltage transmission lines have found in many cases that a watt-hour meter and transformer outfit, combined in a unit and adapted for outdoor service, can be used to great advantage both from the standpoint of initial cost and of maintenance where it is not advisable to build a complete substation. The outfits described in this bulletin have been designed especially for this service and are offered as reliable, accurate, and compact units for outdoor metering service. They are admirably adapted for use in outdoor substations for measuring the amount of power supplied to the various feeders. Feeders are often run directly from a transmission line at intermediate points, the voltage of feeders and transmission line being the same. In such instances, these outdoor metering outfits furnish the most satisfactory method of measuring the amount of power supplied to each feeder.

In 'Conglomerate Ore,' *Bulletin* No. 112, the Williams Patent Crusher & Pulverizer Co., of St. Louis, Missouri, gives some details of the crushing-machines it manufactures. In the chain-hammer trommel-mill a central shaft has attached, by chains, a number of hammers weighing from 14 to 40 lb., and revolves at about 500 r.p.m. Outside of the swinging-hammers is a revolving trommel, 20 to 72 r.p.m., composed of bars spaced according to the size of the desired product. Ore up to 8 or 10-in. size is fed into the machine, and reduced. In the conglomerate mill the beaters weigh 14½ lb. each, and the total weight of the No. 1 crusher is 8500 lb., and No. 6 is 16,000 lb. The makers state that these machines are satisfactory in place of stamps or coarse rolls for first crushing, also as a preliminary crusher before Chilean mills, Hardinge mills, ball or tube-mills, stamps or rolls. Specifications are given of the 1915 models, also some letters from users.

The Traylor Engineering & Manufacturing Co. of Allentown, Pennsylvania, reports the following orders closed in the past two months. Conklin & Foss Co., who have the largest trap-rock quarry in the United States, purchased the largest jaw-crusher ever manufactured. This crusher is 66 by 86 in., weighs 520,000 lb., constructed of cast-steel throughout and manganese-steel fitted. The crusher will be driven by a Westinghouse M. S. 350-hp. motor. Twenty all-steel, 10-ton cars, to be used for transporting the stone from the quarry to the large crusher. These cars are of rigid design without any dumping apparatus. One set of heavy-duty type 'AA' rolls, 42 in. diameter by 16-in. face, for the Washington Asphalt Block & Tile Co. One 24 by 118-in. special furnace for the General Chemical Co. A carload of water-jackets for the Tennessee Copper Co. The Phelps-Dodge company ordered water-jackets for its Detroit copper-plant. The Interstate-Callahan Mining Co., near Wallace, Idaho, will add two sets of Traylor rolls, 30-in. diameter by 14-in. face, fitted with the improved design of side adjusting mechanism. The Consolidated Mining & Smelting Co., of British Columbia, ordered an improved short-length tube-mill, 6 ft. diameter, and five improved Traylor all-steel jigs. A 56 by 360-in. furnace for the Granby Consolidated company at Anyox, British Columbia. Thirty water-jackets for copper-smelting furnace for the Consolidated Mining & Smelting Co., Ltd., of Trail, British Columbia. A heavy Blake crusher, with jaw opening 18 by 30 in., for the General Chemical Co. The Balbach Smelting & Refining Co. has purchased a complete set of water-jackets for its lead furnace. The Boyd-Smith Mines, of Virginia, has placed an order for a set of Traylor automatic adjusted rolls, 24 in. diameter by 12-in. face. These rolls are of the same design as furnished to the Sulphur Mining & Railroad Co., which adjoins the Boyd-Smith Mines. The Tennessee Copper Co. purchased a 56 by 270-in. furnace, of special construction, fitted with cast-iron superstructure, and a 24 by 48-in. heavy-duty crusher. The Foster Paving Block Co. has purchased a No. 6 gyratory-crusher plant, complete, including elevator, feeders, gates, etc. Among some of the recent orders received from the lead district of Missouri is three sets of 42 by 18-in. extra heavy type 'AA' crushing rolls for the St. Louis Smelting & Refining Co.; one 30 by 60-in. heavy-duty Blake crusher for the same people; also a 30 by 60-in. heavy-duty crusher for the Mine La Motte Co. The Irvington Smelting & Refining Co., at Irvington, New Jersey, recently purchased a crushing-plant for handling matte which consisted of a 10 by 16-in. Blake crusher, screen, elevator, and a set of 24 by 12-in. type 'A' automatic adjusted rolls. The St. Louis Smelting & Refining Co. also purchased a 36 by 126-in. new lead blast-furnace.

Mining and Scientific Press

Edited by T. A. RICKARD

Volume 110 SAN FRANCISCO, APRIL 17, 1915 Number 16

YESTERDAY — TODAY

San Francisco celebrates the ninth anniversary of a calamity that won the sympathy of the world. On April 18, 1906, the devastation of earthquake and fire nearly destroyed the City; on April 18, 1915, she rises re-constructed, fairer than ever; and at her side stands the fabric of a vision, the Exposition that marks the establishment of the new waterway between East and West. We discuss the happy event in this issue.

MINE EQUIPMENT

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MFG. and SUPPLY CO. DENVER, COLORADO

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Buyers Directory—Page 26
Advertisers Index—Last Page

TABLE OF CONTENTS

EDITORIAL Page.

Notes 605
1906-1915 606
Speculation in Mines 606
Mining Ventures in China 607

DISCUSSION

FINANCING MINING OPERATIONS.

By Robert B. Todd 609

Many failures in mining are due to faulty financing of the undertakings. Our correspondent urges that all mining companies should be assessable, at least so far as development is concerned.

AMALGAMATION IN HARDINGE MILLS.

By H. W. Hardinge 610

Loss of quicksilver at the Plymouth mill was 0.025 oz. per ton of ore ground. The capacity of Hardinge mills ranges from 100 to 250 tons per 24 hours, according to the material being crushed.

METALLURGICAL PRACTICE AT PORCUPINE.

By C. H. Poirier 611

Re-grinding in Hardinge mills at the Vipond mill is justified on the basis that the installation cost is one-half that of stamps, the up-keep is less, only one-half the horse-power is required, and one-quarter less of solution is necessary.

RAISE OR RISE.

By F. Sommer Schmidt 611

Raise is in general use among mining men, but is not admitted by the dictionaries.

ARTICLES

THE ALASKA GASTINEAU MILL.

By L. E. Spray 612

The ore is broken in jaw-crushers and reduced to 2-in. ring by gyratories. It is then reduced to 10-mesh by two sets of rolls. It is then concentrated on Wilfley tables, classified, and the coarser product reground in tube-mills. The product of the tube-mills is concentrated on Wilfley tables. The high-grade concentrate is amalgamated and the low-grade is shipped. The remarkable departure from usual practice in gold milling attracts world-wide attention.

COST AT THE CROWN RESERVE MINE, COBALT 614

Page.

EXTRACTING COPPER WITH AMMONIA.

By C. H. Benedict 615

The first description of the process which Mr. Benedict has devised for recovering the fine copper from the tailing of the Calumet & Hecla mills by leaching with ammonia-bearing solutions.

CHOOSING ROCK-DRILL EQUIPMENT.

By P. B. McDonald 618

Sinking, driving, and stoping require different types of rock-drill equipment. The conditions that govern their choice are discussed by an impartial engineer.

CONDITIONS OF THE CHILEAN NITRATE INDUSTRY 619

Wages have decreased 25%, operating costs have increased. Three-quarters of the plants have shut down and many of the others are only working half-time.

ON CARNOTITE DEPOSITS—AND THE RAND BANKET.

By Chester T. Kennan 620

Conditions observed in Colorado deposits are described and their bearing on the formation of ore deposits in general is discussed.

DEPARTMENTS

CONCENTRATES 622

REVIEW OF MINING: Special correspondence from Butte, Montana; Platteville, Wisconsin; Denver, Colorado; Toronto, Ontario; Lordsburg, New Mexico; Luning, Nevada; New York 623

THE MINING SUMMARY 627

PERSONAL 631

SPELTER PRICES IN 1914-1915 631

THE MARKET PLACE:

Metal Prices 632

COMPANY REPORTS 633

Mysore Gold Mining Co., Ltd.; Goldfield Consolidated Mining Company.

BOOK REVIEWS 634

'Mining World Index of Current Literature,' by George E. Sisley. 'Centrifugal Pumps,' by R. L. Daugherty. 'Heating and Ventilating Buildings,' by Rolla C. Carpenter.

RECENT PUBLICATIONS 634

NEW MACHINES AND DEVICES:

Hoisting 10,000 Tons in 14 Hours 635
Concentrators at the Exposition 636
Pulleys at the Exposition 636
Commercial Paragraphs 636

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EDITORIAL

T. A. RICKARD - - - - Editor
THOMAS T. READ - Associate Editor

NEWS from Butte is good. Our correspondent there sends a cheerful and interesting letter.

WALL STREET'S effervescence as yet is mainly valuable for its sentimental effect. It represents an intelligent anticipation of events.

MINE operators in Mexico are weary of Huertistas, Maderistas, Carranzistas, and Zapatistas; they want to see the Wilsonistas to the front.

ACCUMULATION of gold in the United States is likely to continue on account of the one-sided condition of trade with Europe. Some of that gold might be used advantageously in stimulating business with South America.

IN this issue we publish a timely description of the Alaska Gastineau mill, the design of which marks a complete departure from standard gold-milling practice, and the adoption of ideas developed in the concentration of disseminated copper ore.

THE report on the petroleum industry of California, prepared by Messrs. R. P. McLaughlin and C. A. Waring, is now ready for distribution by the State Mining Bureau. It is an excellent piece of work, performed by capable men, and will be reviewed later in our columns devoted to that purpose.

OUR forecast of the route to be taken by the Government railway into the interior of Alaska has been confirmed by an official announcement by the Secretary of the Interior. The Alaska Northern Railway has been purchased for $1,150,000, and Mr. W. C. Edes is designated as chairman of the engineering commission that is to construct the line, at a total cost estimated at $26,800,000. Work is to commence at once.

AMONG the anomalies arising from the political chaos in Mexico is the depreciation in postage. Mexico is in the Postal Union and letters for the United States require a 5-centavo stamp, which during the Diaz régime was equal to 2 cents American. At the prevailing rate of exchange one can buy six or seven 5-centavo stamps for 5 cents gold. As the Government is doing business with other governments in the Postal Union on a gold basis, it is obvious that considerable financial re-adjustments will have to be made at the Postal Department.

ELSEWHERE in this issue we give the first detailed description of the process devised by Mr. C. H. Benedict for extracting the fine copper from the tailing of the Calumet & Hecla mills by leaching with ammonia-bearing solution. The difficulties encountered by earlier workers appear to have been overcome successfully in laboratory work. Engineers will await with interest the record of actual experience on a working scale. The construction of the first unit of the plant, which was delayed by the conditions created by the War, will soon be resumed.

EXPORT of tin has been placed under embargo by the British government. No tin metal or tin ore can be exported, except under special permit, during the period of the War, from any British possession or protectorate. Limited shipments to the United States can be made, under permit, if consigned to the British Consul-General at New York. When this was announced in London on March 22, the price of the metal fell, for the obvious reason that it restricts the market, tending to exclude the United States and Russia, more particularly, as buyers. In March the price had risen above the maximum in 1914. Nevertheless the demand for the metal is such that even this restriction of markets is unlikely to cause it to fall to the low level of last year. After the War, tin, with other base metals, will be in eager demand.

SHOULD Ontario have Government batteries? is a question asked in the *Canadian Mining Journal* of April 1 by Mr. George R. Rogers. He says that "of the various causes to which the decline in prospecting can be attributed, perhaps the chief of those within human control is the lack of sufficient capital to develop the many promising properties already acquired and held by the prospector." This applies to many other mining districts in the world. Mr. Rogers then discusses the State system of operating public crushing and treatment plants in Victoria and Western Australia, and says that the system should at least have a trial in Ontario. We have some personal knowledge of the Government-owned plants in Western Australia, and can say that on the whole they have been a decided success. They have been the means of stimulating mining and prospecting in many remote districts where no plant for recovering gold was available, and in localities where the freight to a custom-mill is prohibitive. Even when a group of small properties contains good ore, the collective owners cannot afford to erect a plant, and so in time are forced to close. Then the Government steps in and provides the means whereby the gold is extracted at reasonable cost. Discontent is not unusual among miners who have not received the yield they expected, but who ever heard of a prospector who did not over-estimate the value of his ore? In Western Australia there are 37 stamp-mills and cyanide-plants operated by the State. These cost £332,378, and have treated for small mine-

owners a total of 960,989 tons of gold ore yielding £4,109,321, and 64,920 tons of tin ore producing £80,835. It is certain that without these Government mills most of this metal would never have been recovered. The effort has stimulated mining and prospecting. One objection to the system does exist: the miners ofter extract the richest ore in their claims and then abandon them, whereas if the men had their own plants they might develop their properties. Most public-controlled utilities in Australia are fairly profitable, but the Western Australian public mills do not meet all charges; including operation, interest, and depreciation the total deficit in 15 years has been £413,965. However, the taxpayers no more object to this loss in the recovery of the gold than to the annual loss incurred on the great waterworks that supply the mines.

1906-1915

On April 18, San Francisco celebrates the ninth anniversary of its day of disaster, when the city was swept by the conflagration that came in the wake of an earthquake. The celebration is an expression of joyous vitality, of pride in a superb achievement, of confidence in a great future. To those of us who remember the trembling earth, the crumbling walls, and the encroaching flame, the 18th of April would be only the memory of a horror if all that is searing in the recollection had not been overlain and eclipsed by the stimulating experience of the later days of reconstruction and restoration. Today we live again the time when we saw the ruins removed, the streets cleared, the new foundations laid, and heard the merry sound of the riveters arising from among the steel skeletons that gave the promise of the new San Francisco.

"From mighty roots of concrete deep
The giant flowers spring from sleep
Along the barren highways of the city of my love."

The dawn of that resurrection dispelled the darkness of destruction. San Francisco triumphed over fate. Even the shackles of municipal corruption could not check her heroic courage and splendid audacity. From ruins scarcely cold the City rose in strength and beauty, the poet's "warder of two continents." Nine years ago she lifted an ashen face to the blue of a pitilessly perfect sky; today she smiles serenely in the sunshine of California and welcomes the whole world to her side. She celebrates not her restoration only, but the fulfillment of a dream that came to her while yet she lay stunned under the lurid heavens. The water-way joining West to East, the Pacific to the Atlantic, has been made; the dike separating the old and the new worlds has been pierced; the port of San Francisco has become the terminus of a new maritime commerce. It is fitting that the event should be signalized by a foregathering of representatives of industry from the four quarters of the earth. Unfortunately, it happens that this event synchronizes with a great war, pulling the heart-strings and darkening the imagination of all thoughtful men. Nevertheless the coincidence is not without a lesson, for it contrasts construction with destruction, the conquest of man over nature as against the reversion of mankind to the ethics of the jungle. To us, standing among the beautiful structures of the Exposition that marks the constructive genius of man and celebrates the accomplishment of beneficent engineering, the rumbling of the European upheaval comes like the sound of the surf heard far inland. We hear it not with indifference. Bret Harte called San Francisco "serene, indifferent of fate." That may have been when the original settlement of Yerba Buena first emerged from its Spanish background; that may have been true of the town that was built by the Argonauts in the Golden Age; but it is no longer true of the modern San Francisco. Too intensely vital to be indifferent, too cosmopolitan to be phlegmatic, the City by the Golden Gate pulsates with the energy of an international haven and vibrates with the life of one of the world's nerve-centres. The indifference is gone, the irresponsibility is vanished, San Francisco is awake to her destiny. With her back to the trail that brought her people over mountain and plain from the distant seaboard on the other side of the continent, she faces the sunset with an earnest look. The Atlantic breakers sound faint; the surf at her feet thunders a welcome. Her eyes have caught the glow of the horizon and in her ears is the song of the Pacific, bringing the promise of commerce with the immemorial East that has become a new West. She has waited; she has suffered; mindful of her past, confident of her future, remembering the hour of disaster and the morning of her resurrection, she gazes with gladness into the sunlit sky and thanks God most of all for her unconquerable soul.

Speculation in Mines

On another page we publish a letter from a correspondent who surmises that a revival of mining is likely, and that the time is opportune for discussing ways of making public participation more profitable than it has been heretofore. The subject is one of immediate interest. We shall discuss it with the hope that the expression of our own views may elicit the opinion of others having experience, by observation or by participation, in such matters. Mining, as a national industry, depends, in large measure, on public support. Owing to the risk inherent in the search for the metals in ore deposits, it has been found desirable and convenient to distribute the financial obligation of exploration and development among numerous shareholders, each contributing a small part of the working capital, instead of leaving the burden on the shoulders of a few operators. In the early days of the Comstock, the distribution of liability was effected by sub-dividing a mine into the number of feet that measured the extent of the claim. A shareholder owned a 'foot' or more of the property, and a speculator bought 'feet' instead of shares. This hardly sufficed to meet the necessities of finance, so the

proprietary was divided into hundreds or thousands of shares, until now a stock certificate may represent the ownership of one in a million parts of a mining enterprise. This development of the business has tended so greatly to popularize speculation in mines that the small shareholder in the aggregate has become an important factor. Another result followed: people quite ignorant of mining now dabble in shares; an undiscriminating, if not gullible, public has come to the support of the less responsible promoters of mining schemes. Obviously, it is desirable that the financial support available for new mining ventures should be wide, but it should also be discriminating, in order that it may prove remunerative. Those who have the welfare of the industry at heart want to see plenty of capital forthcoming, and they want to see that capital employed profitably, so that further supplies of it may be available as occasion arises. To ensure such a result the public must be given a run for its money. It must have a fair chance of a return of capital, together with a reasonable interest thereon. The interest must be proportional to the risk. Any return of less than 10% on a mining venture is insufficient, for the risk inherent in such a highly speculative business requires the redemption of capital within a relatively short period. To liken a metal mine to a manufacturing business is fundamentally fallacious, for a mine is a wasting asset. When exhausted, it has no goodwill. Even its equipment goes to the scrap-heap. On the other hand, no economic unit is so productive as a rich mine; it represents the mineral wealth concentrated by Nature during geologic periods; it is the harvest of a seed-time antedating human history; it is a treasure-vault that requires only the key of the enterprising explorer. However, the romance of fortuitous discovery is passing; the obvious outcrops and the superficial enrichments have been garnered; nowadays, to find ore, the miner must dig deep or win a precarious profit from the poorer or more refractory lodes that his predecessors discarded; today the exploitation of ore deposits calls for skill and experience; it demands the technology of the engineer. And only the deliberate statements of a properly qualified engineer are of any value to guide the speculator. This is the lesson that the public must learn. Only those versed in the appraisal of mines can give estimates that are of any value in this business. Of course, we are discussing the serious and legitimate phase of the industry. The selling price of shares may be affected by conditions entirely dissociated from actual mining operations; in the last resort it is the excess of buying over selling that elevates quotations, just as the excess of selling over buying depresses them. Artificial conditions can be, and often are, created by manipulation, and by unveracious statements by interested parties. Amid such a conflict of evidence, the public should look to the engineer in charge of the mine for a true statement of facts, and the engineer is on his honor as a member of an honorable profession to tell the truth. In the end, therefore, only a continued improvement in the status of the profession and the consequent reliability of the reports made by engineers of mines can safeguard the public.

Meanwhile we warn the unsophisticated not to confuse investments with speculations. In mining, the simpleton treats a mine as an investment, while the sagacious man recognizes it as a speculation. The placing of money to earn income is an investment; it assumes the use of capital so safely that only the question of interest arises. The use of money with a view to the rapid enhancement of the principal is speculation; it assumes that the fluctuation of the principal renders the question of dividend of secondary importance; the dividend becoming merely a factor in determining the rise or fall of the principal. The difference between an investment and a speculation is that the scrip representing an investment can be locked in a safe for a term of years, while the stock representing a speculation must be immediately available for realization in accordance with the vagaries of the market. We omit mines owned privately. As to all others, it is safe to say that the price of shares in one year usually varies over a margin far exceeding the amount of the dividend. The speculator leaves the dividend to the supposed investor and realizes upon the rise or fall of the shares themselves. The length of time it is safe to hold a mining share as a source of income depends upon the persistence of the orebody and the continuity of good management. But these are matters too important for casual treatment. For the present we lay stress on two basic ideas: (1) that mining is essentially speculative, and is most remunerative when so recognized; and (2) that the only appraiser of a mine worthy of confidence is the properly qualified engineer.

Mining Ventures in China

Last week we referred to the waste of experience in mining; no less to be deplored is waste of energy in an industry that requires great preliminary effort to realize the hope of profit. Years ago, when mining in general and metallurgy in particular were regarded by their practitioners as secret arts, much duplication of effort was unavoidable. That day happily is past, and most engineers now regard it as a part of their duty to make a record of their experience so that it may be freely available to their profession. Each record of experience establishes a base of supplies farther ahead into the wilderness of the unknown. The efforts of an investigator who starts at the farthest outpost will carry him into unexplored territory, whereas if he started from familiar regions his labors might carry him only as far as others have already penetrated. But this great thesaurus of research has the defect of its qualities, for it is so considerable in amount and so widely distributed that no little trouble is required to learn what is already a matter of record on unfamiliar subjects. The labor of making a careful search of current literature is always great, and there is the possibility that nothing useful may be found; hence it comes about that investigations,

especially those at the mill or smelter, are often begun without this necessary preliminary, so that research that might have been carried to a useful conclusion is stopped at the same point where some other worker laid it down. Labor is wasted. Scores of instances might be cited, but it will suffice to point a moral and adorn this tale to give some instances of wasted effort in investigating the mineral possibilities of China.

China has been known to the Western world for centuries, and in the course of that time a tremendous amount of literature has been written, covering every phase of scientific knowledge, from astronomy to zoology, in its relation to China. Many geologists and mining engineers have studied the mineral resources of that country; some of them, notably Ferdinand von Richthofen, have made elaborate and comprehensive reports. But in the development of a mining enterprise knowledge as to the character and extent of deposits is not sufficient, for many other factors must be considered, and in passing upon the feasibility of working any given deposit a vast amount of collateral information is required.

Of the geologists and engineers that have studied the deposits of China one or two score are still alive. In conducting any new investigation it would seem but reasonable to make use of the knowledge acquired by these, but with rare exceptions nothing of the kind has been done. In choosing the advisers to the Bureau of Mines at Peking, men were selected who had never been in China, and who must therefore devote a large part of their mental energy to familiarizing themselves with conditions quite new to them. An important corporation required an engineer to study the possibilities of China in one field of mining work, and selected for the purpose not only one who had never been in China, but who as well was quite unfamiliar with that branch of mining, having specialized in totally different work. When the Standard Oil Company was ready to start exploration for petroleum in China on a large scale it also, with the curious mixture of ineptitude and sagacity that characterizes the operations of that huge organization, made no attempt to utilize the accumulated experience of men familiar with the East, but sent out some of the best men available who were quite unacquainted with China. We have heard various reports of the results of their work, and, after discounting these sufficiently to allow for professional jealousy, the net residue indicates that these workers have had to overcome many obstacles that might have been avoided by those familiar with the country and its people. An engineer sent to explore an unknown country must perforce devote his energies to acquiring familiarity with general conditions, but in known territory it is an exhibition of the simplest business sense to utilize the information that is at hand. No one would consult a throat specialist to treat a cancer, expecting him to familiarize himself with surgery before undertaking an operation; the obvious procedure is to consult a skilled surgeon. An even more curious case has come to our attention, an engineer having made the journey to Peking in order to acquire information that might have been obtained by a half-hour spent in reading the files of the *Mining and Scientific Press*. The editors undertake no professional work, holding professional fees incompatible with editorial duty, but they are at all times willing to render assistance to their professional colleagues. Failure to utilize accumulated knowledge is merely a phase of ignorance.

In considering China as a field for mining investments, four factors must be taken into account. Is there good evidence that mineral deposits rich enough to offer hope of profit exist in China? Are labor conditions and other local factors influencing the cost of operation such as to indicate that mines can be operated on an economic basis? Is there a reasonable expectation of sufficient and growing markets safe from capture by imported products? Are the laws and regulations governing the mining industry such that mine-operators can expect to carry on their enterprises under fair and stable conditions? The first of these queries was discussed in detail in the *Mining and Scientific Press* of October 7 and November 11, 1911. Briefly, the answer is in the affirmative. Labor conditions in China are discussed in this same article, and again in more detail in the issue of November 25, 1911. The conclusion is that labor is both abundant and efficient, while wages are low. As regards markets, it is difficult to generalize concerning an area of nearly 4½ million square miles, but it is fairly evident that an immense, densely populated country, which is just entering upon an era of railway-building and general industrial development, must necessarily be an inviting field for the adventurous. So far, all the factors are generally favorable, but the fourth negatives all the attractions. The regulations and the Bureau by which mining in China is governed were discussed in the *Mining and Scientific Press* of June 20, 1914. It is there set forth that these regulations are so unfavorable to the investing of foreign capital in Chinese mines as to render it almost impracticable; in short, the regulations appear to have been drawn with the purpose of leading to a maximum of official interference, with opportunities for graft, and a minimum of work. Some of the junior officials in the Bureau of Mines are excellent young men who have studied mining; the chiefs are totally ignorant of any phase of it. Swedish and British mining advisers have been appointed, but there is no evidence as yet that their advice has been followed. Treaty stipulations provide that foreign capital must have equal rights with domestic in the development of mines, but this does not cover the present situation, in which neither is accorded reasonable rights. Attempts are being made to have a more liberal code substituted. Large organizations may secure concessions exempt from the general regulations, as is the case with the Standard Oil Company, and in some instances the expectation of profit may be sufficiently alluring to justify attempts to work under existing regulations.

DISCUSSION

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Financing Mining Operations

The Editor:

Sir—From all appearances, there is a revival in mining, and the public is taking an increased interest. The question will soon be interesting to many as to how to invest and what companies are worthy of encouragement. Following the panic of 1907, which was the end of the last mining boom, all companies of questionable merit were forced to the wall, and many meritorious ventures as well. As a result of the conditions prevailing during the last boom that were possible at that time, many states have passed stringent laws for the protection of the investor, and the government has taken a hand by prosecuting many of those not doing a legitimate business. While these conditions in the end will have a beneficial effect on honest mining, conditions have made it almost impossible, during the past few years, to raise the necessary funds for the development of promising properties. Today there are more promising prospects in Nevada and the Pacific Coast states than ever before, that could be put on a profitable paying basis for a moderate expenditure. On many of these properties large amounts have been expended, and they are sufficiently developed to warrant reduction facilities. Others have been developed to such an extent that they are beyond the 'wild-cat' stage and almost certain to make mines. While the speculative element cannot be completely removed from mining, I think the investor has a better chance of a 'square deal' today than ever, and that by using care and good judgment large returns can be made on such investments.

It would be well to review the past to a certain extent and show that many so-called failures were not the fault of the operator or promoter, and that most of the criticisms of the past come from those who have put a little money in some companies as a 'flyer' or a gamble, investing indiscriminately without any investigation in anything that was offered. I was in New York a few years ago endeavoring to raise funds for a reduction plant on a developed mine, and interviewed investors with that end in view. I was acquainted with a man connected with one of the largest wholesale grocery houses there, so I called on him and stated my proposition. He seemed interested, said I was just the man he wanted to see, but as he was busy would I call after office hours. When I called later he pulled out a bunch of mining certificates from a drawer, I think there must have been a hundred, and requested me to look them over and tell him if they were any good, as he had been unable to find out anything about them and had had them for several years. Out of the lot there were only four or five companies that I had ever heard of, and they were not operating at the time. I asked him how he had secured such a collection, and he said mostly by answering advertisements, although he had purchased some from solicitors. He is a hard-headed business man, but he had spent thousands of dollars in these stocks and had not taken the trouble of looking them up until years after. Another man had purchased stock in twenty-six companies, mostly mining. There were 500 shares in the lot of a company that I knew of, but of the others I had never heard. He offered the lot for $25, and I gave him $50, about the value of the 500 shares. I have them all yet; most of them apparently rank fakes, bought on the strength of the certificate without any investigation as to what the purchaser was buying.

These are only two instances of probably over a hundred cases—all people of rather more than average ability, merchants, railway officials, doctors, ministers, and lawyers. It is no wonder that the fake promoter can succeed and that the legitimate mine operator has been unable to raise a development fund. Following the panic of 1907, many non-assessable companies were unable to pay their debts or continue development. Stockholders were appealed to, meetings held, voluntary assessments asked for, but most of the propositions failed and stockholders who were willing to do their part would not unless all would respond according to their interest. This resulted, in many cases, in reorganizations as assessable companies. In some cases, enough stockholders would consent to enable them to change the company from non-assessable to assessable, but in some cases this was not possible on account of the laws under which they were incorporated. The companies were unable to pay their debts and continue operations. Some of the companies, rather than let their property go by default, permitted the properties to be sold for debt, bought them through a trustee, and formed new assessable companies. All previous stockholders were given the opportunity to come into the new companies on the same footing as those who engineered the reorganizations. Generally half of the stockholders did not accept the opportunity, and felt that they had been badly treated, and would have preferred that all should lose rather than have those who had faith in their companies, and were willing to accept the conditions, protect themselves in the only way possible.

I think every company should be assessable as far as developing is concerned. When property is bought with stock, it might be necessary to have a certain amount of non-assessable stock for that purpose. When purchased for cash, the assessable stock should be sold for an amount sufficient to pay for the property as well as cover the cost of promotion, organization, development, and the fixed charges controlled by the by-laws, and at the subsequent sale of treasury stock the price be increased equal to the amount of the assessments paid when sold. In this way any shareholder would come into the corporation on an equal footing at any time, and it would be 'up to' the stockholders whether to sell treasury stock for development purposes or be assessed for carrying on the work. This would prevent the operations of the fake promoter and make the investor realize that a corporation is a co-operative concern, as well as the fact that instead of 'taking a flyer' in any stock offered he should confine his investments to the most promising properties after careful investigations and render all assistance possible. Mining under proper conditions need not be more of a gamble than other industries. There is no more reason for losing money in mining than in any other industry. Statistics show that about 95% of those who engage in business fail—failures as great as there has been previously in mining with probably ten bogus promotions to one genuine. Look at the Goldfield boom. There were about six thousand promotions; all of them had stock for sale and sold more or less. If the nine-tenths of these had not been exploited, the tenth, or six hundred concerns, would undoubtedly now be running instead of about two hundred in the state of Nevada alone.

If the investor would give the same attention or scrutiny to mining that he does to other investments, it would be well and he would reap a larger reward than in any other business. There are more failures in mining for want of funds than any other cause. It takes money to develop a mine, and the loss in a prospect need not be great with the proper man at the helm. It is of more importance to know when to stop than to go ahead on an impossibility. Many a good man has been ruined and a good property abandoned for lack of funds occasioned by the individual stockholders declining to recognize their responsibility or to co-operate with the management. They blame delay and failure on the management when generally the stockholders are so indifferent to their own interest that it is practically impossible to accomplish results. The only way to remedy the prevailing conditions is to have all companies assessable. Then the burden of carrying on the necessary development is equitably distributed, and the man unwilling to do his share forfeits his interest. Usually this works no injustice. Sometimes people may be so situated that they cannot meet their assessments, and forfeit their holdings, but some plan must be had for raising funds, and it is not right that all those who are willing and able to carry on the proposition should lose all of their previous investment. The delinquent would be no better off and all stockholders would lose with him. The fact that a company is assessable removes from the enterprise the speculative element and brings home to the stockholder the necessity for co-operation.

ROBERT B. TODD.

Los Angeles, California, February 15.

Amalgamation in Hardinge Mills

The Editor:

Sir—I note the editorial in your issue of February 27 regarding amalgamation in Hardinge mills. You mention that amalgamation in conjunction with the Hardinge mills at the Plymouth plant has been dispensed with. In justice to the Plymouth management I wish to correct my suggestion, made in a previous discussion on this subject, that the test of amalgamating in the Hardinge mill was not carried on long enough for a decisive opinion. This was an error, for I have just received a letter from Mr. S. R. Brown, the mill superintendent, bearing upon this very subject. He states that a test-run of 21,000 tons of ore showed a total loss of only 528 ounces of quicksilver. This, reduced to economic figures per ton of ore ground, means a loss of 0.025 oz. quicksilver, or about one-tenth of a cent, per ton of ore. Mr. Brown also sends me an interesting photograph of gold amalgam balls, about ¾ in. diam., formed in the Hardinge amalgamator attached to the pebble-mill. These balls he describes as containing 50 to 60% gold, while the plate amalgam only contains about 25% gold. The total saving of the plant, as might be expected, is much higher than when the mill originally started; in other words, the amalgamation now appears to be highly satisfactory.

In the same issue of your journal I note the interesting article by Mr. J. W. Pindar bearing upon this subject. I concur in his opinion that there should be no more flouring of quicksilver in grinding in the pebble-mill than is produced by the grinding between the mullers of a pan. My own experience coincides with Mr. Pindar's in that a comparatively limited loss of quicksilver results in pan-amalgamation. Mr. Pindar, however, takes exception to the capacity of the Hardinge mill in the following words: "When I hear of a 22-in. by 8-ft. Hardinge mill endeavoring to grind, and properly amalgamate, 175 tons of ore per day, when the makers of that mill announce 144 tons as the extreme capacity limit for that size for grinding alone, and presumably under the most favorable conditions, I feel that something must be radically wrong and am not surprised at unsatisfactory results. On the other hand, I am surprised to hear of having to stop a Hardinge mill every day to clean it out."

Mr. Pindar is mistaken in this matter of capacity and misunderstands our claim. There are instances where the limit of the Hardinge mill is 144 tons; our company has records below 100 tons and above 250 tons, but 175 tons is not unusual. Crushing, like amalgama-

tion, is dependent largely upon requirements and necessities effected by the chemical and physical quality of the ore undergoing reduction.

In regard to stopping the mill and making a clean-up: as a rule an average clean-up would not be necessary for several days. Mr. Elmer mentioned that he cleaned up the inside of the Hardinge mill whenever he required an extra large disbursement, which sometimes was not necessary for several weeks.

New York, March 7. H. W. HARDINGE.

Metallurgical Practice at Porcupine

The Editor:

Sir—I have considered with interest your extracts from the paper of Mr. Noel Cunningham appearing in your issue of March 6. I take no exception to Mr. Cunningham's views as based upon his observation, but I feel that as manager of the Vipond plant, mentioned in the paper, I am perhaps better qualified to express my views upon the installation of Hardinge ball and pebble-mills.

As the pioneer introducer of these mills in the district, and in opposition to recommendations by other engineers, I had the temerity to carry out my ideas in the designing of the Vipond plant two years ago, and installed the then new system of crushing. Two years' experience has, at least in our case and that of our neighbor, the McIntyre mill, justified the departure, for the following reasons:

(a) First installation cost less than one-half that of stamps for equal capacity.

(b) Up-keep less than that of stamps.

(c) Twice the capacity in tons per horse-power.

(d) Crushing in one-quarter the amount of solution required by stamps and consequent reduction in cost in handling the solution after crushing.

Another item of considerable importance is the fact that our overhead mill-space has been reduced one-half, which, in a cold country like Porcupine, is of decided economic importance.

Referring to Mr. Cunningham's reference to Hardinge fine-grinding short conical mills: our fine grinders of the Hardinge type are only 6 ft. long, requiring 30 to 33 hp., which I believe is about half of the power required for the longer (20 ft.) mills in the other plants of the district. Those other plants, in my opinion, are not doing any more work than is being performed in our conical mills, which are "short" as compared with the ordinary cylindrical sliming-mill. As an evidence of my opinion, and with my directors' endorsement, I have now placed an order for a 6-ft. Hardinge ball-mill in order to double the capacity of our plant. While Mr. Cunningham writes from observation, I write from experience and observation as well.

As Mr. Cunningham mentions, the Vipond and the McIntyre plants have about equal proportions of the A and B class of ore mentioned in his paper.

Cobalt, March 16. C. H. POIRIER.

Raise or Rise

The Editor:

Sir—In my article on 'The Caving System at the Ohio Mine,' appearing in your issue of March 6, I see you have changed the "inclined raises" of my manuscript to "inclined rises." I am not taking offense at this, but there is apparently more than one way to get a rise out of a man. What is the matter with our good old 'raises'? "Inclined rises" sounds affected and unnatural to me. My friends 'the boys' who have been driving those raises will think I am trying to put on airs and be pedantic. I cannot recall ever having heard this particular kind of a hole in the ground called a rise in these Western states. This seems to me a good old book word that is fast falling out of use. I do not object to your making contributions conform to your style-sheet, but I think every effort should be made to conform to the usage of men in the business where this is permitted by the authorities, as is the case with this word 'raise.'

I think the less you tamper with a manuscript that stays within the law of correct usage, the better, and, while I care little about this particular word, I care more about a conciliatory attitude on the part of editors in questions of this sort.

F. SOMMER SCHMIDT.

Salt Lake City, March 16.

[Mr. Schmidt will be interested to know that the same point was raised by one of our editors, but it was finally decided that 'rise' is the proper spelling. The Century dictionary does not admit the form 'raise' at all, and the only sanction to be found for it is the Standard dictionary, which says "The same as rise." The noun 'rise' comes from the verb 'rise', which both dictionaries define as to dig or work upward in mining, in opposition to 'sink.' The use of 'raise' as an intransitive verb is not admitted by either dictionary. 'Raise' is undoubtedly in general use underground, and the verb 'to raise' is sometimes heard, but there is no authority whatever for the latter usage, and it will be agreed that what a miner makes by rising is a rise. As to changes in manuscript, it must be evident that the duty of an editor is to edit manuscript. That he should correct only the more obvious blunders seems as irrational as to expect the general manager of a mine to allow every man in his employ to do whatever may seem fit to him, short of absolute mistakes. The function of the editor is to facilitate the transmission of ideas from the contributor to the reader.—EDITOR.]

BULLION TRANSACTIONS at the San Francisco Mint in March were as follows: gold received, 329,283.779 fine ounces, and silver, 58,945.59 oz., the total value being $6,837,273.90. Coinage executed amounted to $4,160,000 gold, $78,000 silver, and $12,000 copper; also ₱77,000 in 20-centavo pieces for the Philippines. Coin, bullion, etc., on hand at the end of the month totaled $269,064,655.74.

The Alaska Gastineau Mill

By L. E. SPRAY

The first unit of the Alaska Gastineau Mining Co.'s ore-reduction works at Thane, one of Juneau's industrial suburbs, was started on February 18, 1915. The machinery went into motion like the parts of a watch, and has been in continuous operation ever since. The tonnage treated is considerably in excess of the expectations of the owners and builders. Whereas it was estimated that each section of the big mill would have a daily capacity of 1500 tons, the actual run has been nearer 2000 tons per 24 hours, and it is now believed that this mill, when all of the machinery is installed, will have a capacity of 10,000 tons daily instead of the 6000 tons first contemplated.

The work of installing the machinery for the remaining three sections of the mill is now under way, and it is planned that a new working section shall be added every 40 days until the plant is complete. With the exception of the coarse-crushing plant, the four sections are housed in one large building. The mill was designed by George Bradley and F. G. Janney, consulting engineers, under the supervision of D. C. Jackling, managing director of the company, along lines marking a radical departure from the regular system of handling gold ores. The old methods of crushing and amalgamating have here been put aside for the introduction of the comparatively new system of handling the so-called porphyry or disseminated copper ores—the methods that resulted in producing copper at a cost of 7 cents per pound. The very latest knowledge in building and engineering has been applied in working out the details of the construction and equipment; in consequence this mill contains some features not found in others of its kind—all tending to safety and economy.

Robert Semple was superintendent of construction, which began with excavating for the foundations in November 1913. The mill is built for permanency, concrete and structural steel being used throughout. Charles E. Bruff, superintending the installation of machinery, has been doing this sort of work for the Jackling mining interests for a long time, and he declares that this is the most modern and one of the finest mills in existence.

The coarse-crushing plant, also built of steel and concrete, is situated on the mountain-side at the terminus of the traffic railroad and at an altitude of 700 ft. above the sea-beach. The building is 100 by 100 ft., rising to a height of 125 ft. above its lower foundations. It has been constructed with a view to serving other units of the reduction works in addition to the one just placed in operation, and has a capacity of more than 20,000 tons daily.

The fine-crushing plant and concentrating mills are housed in what is practically one building, erected in a series of steps, measuring from the floor of each division or milling process, and designed in accordance with the gravity system that prevails throughout. The fine-crushing plant proper occupies a space of 80 by 360 ft., this portion of the building rising to a height of 160 ft.; the concentrating mills occupy a space 140 by 405 ft., that portion of the building reaching a height of 80 ft. The last or lowest floor of the concentrating mills is 192 ft. above sea-level, thus affording ample grade for the convenient disposal of the tailing, which is carried into the sea. A system of levels has demonstrated that the tailing may be carried to Taku Inlet, some considerable distance from the mill-site, and to a point where there is unlimited room for final disposal.

It requires about 6000 hp. of electrical energy to operate the mills and mines. This is furnished by the big Salmon Creek power-stations, owned by the company and erected simultaneously with the mine and mill development of the past two years. There are two stations, one at sea-level near the mouth of the stream, and the other at the upper end of the first basin at an altitude of 350 ft. immediately below the falls. An immense concrete dam holds in storage 19,000 acre-feet of water as reserve to keep the great Pelton wheels moving during the winter months when the natural flow of water diminishes.

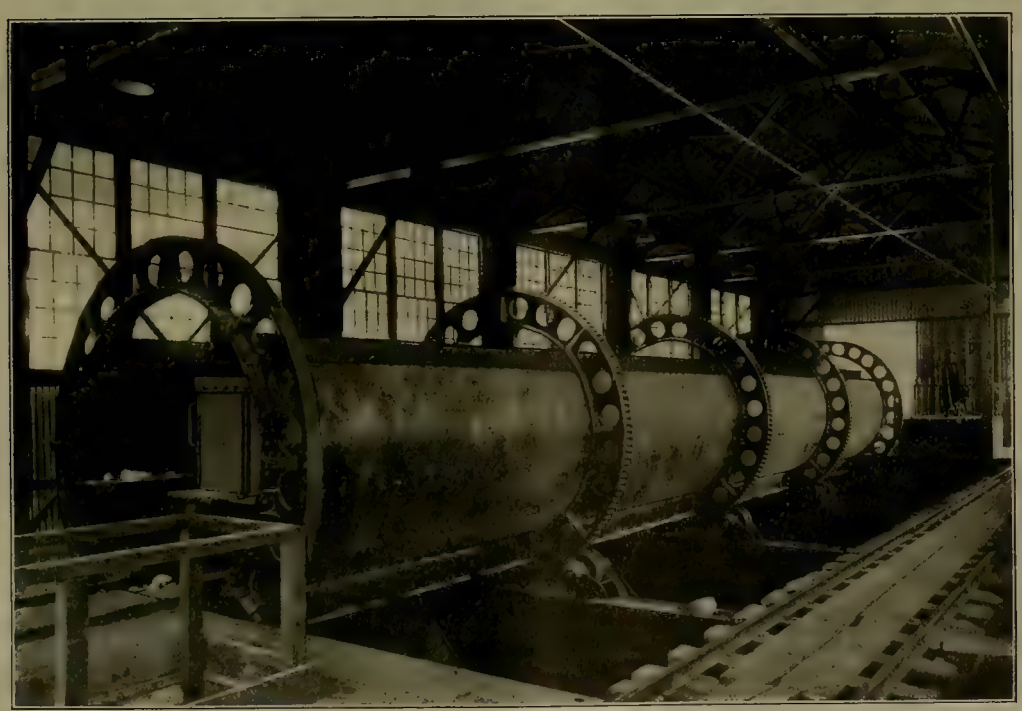
The ore comes from the Perseverance mine and is hauled to the reduction works over an electrified railroad for a distance of 18,000 ft., two-thirds of which distance is through the celebrated Sheep Creek adit, extending under and into the mine. The ore-trains consist of thirty 10-ton cars each, and are drawn by 18-ton electric locomotives. The trolley system is used on the road.

E. V. Daveler is superintendent of the mills. The milling process begins the moment the cars reach the tipple of the coarse-crushing plant. Four loaded cars are pushed into a long steel cylinder that revolves in response to the touch of the operator, the ore dropping to a large inclined grizzly of massive steel bars. Completing the revolution in a few seconds, the empties are replaced by loaded cars and the operation repeated, the entire train of 300 tons being discharged in a remarkably brief space of time.

When the ore strikes the grizzly the under-size drops through to a conveyor that feeds it into No. 8 gyratory crushers where it is reduced to 2-inch size or under, and thence to the ore-storage pocket. The over-size passes through two monster jaw-crushers and thence to the gyratory crushers for further reduction.

The ore-storage pocket is unique, in that it has been hewn from the solid rock of the mountain beneath the floor of the coarse-crushing plant. The big cavern with

ORE-CARS AT TERMINUS OF RAILROAD NEAR COARSE-CRUSHING PLANT OVERLOOKING GASTINEAU CHANNEL. DOUGLAS ISLAND OPPOSITE.



TIPPLE OF THE COARSE-CRUSHING PLANT. NOTE THE CAR—ONE OF FOUR—INSIDE THE REVOLVING CYLINDER.

a capacity for 10,000 tons of ore was stoped out from an inclined tunnel-way leading from the fine-crushing plant. The rock obtained in the process was utilized in the mixing of concrete for mill-construction, this material being used in considerable quantities.

The ore is drawn from the storage-pocket to the fine-crushing plant on a large conveyor-belt that travels through the inclined tunnel-way mentioned, a distance of some 600 ft. Here it goes through a pair of 72-in. Garfield rolls and is reduced to inch-size, the over-size returning by automatic skips, operating in balance, for another crushing. The under-size material passes to 54-in. Garfield rolls on a conveyor-belt and is reduced to 10-mesh; thence it passes over impact-screens, the under-size dropping through to the finished-bin and the over-size returning for another grinding. The ore is screened after each operation, the under-size always dropping to the next process. The material travels continually in a closed circuit until the Garfield rolls have reduced it to the fineness required for the finished-bin. The rolls are so gauged or set that the crushing process includes the impact of ore-particles with each other rather than a direct impact of rock with machine. This permits of a large and constant stream of ore through the rolls, the returning over-size, on conveyor-belts, traveling at a lively rate of speed and joining the persistent flow of new ore in the process. The automatic skips work in pairs, one going up as the other descends. Each skip holds three tons. It is set on a trap-chair that releases it automatically when the required weight of ore has been deposited in the bucket. It moves as silently and smoothly as if traveling in a channel of oil.

The ore remains dry until immediately before reaching the concentrating mills. After being drawn from the finished-bin, it passes over a set of Garfield roughing-tables; thence to Wilfley tables, and thence to the Richards-Janney classifier. The coarser product from the classifier goes to the tube-mills, of which there are 20 in the whole unit, and five now working. The tube-mill product, with the fine from the classifier, goes to the lower Garfield tables and is then finished on the Wilfley tables.

The final product consists of concentrates of different grades and values, the highest grade of which contains the gold that ordinarily would be amalgamated, and receives the same careful attention that is usually given to this product. The poorer concentrate is ready for shipment.

While the remainder of the machinery is being placed in position for operation in the present mill or first unit of the works, plans are being made for the immediate construction of another mill of equal capacity, thus increasing the milling operations to 20,000 tons each day. When one contemplates the enormous tonnage involved in a year's operation at this rate, he can not fail to be impressed with the tremendous ore reserves of the Perseverance mine from which it all must come.

It will be noted that there are two striking features in the milling system: first, the closed circuit whereby there is permitted a free and constant flow of ore, and in which the ore crushes and reduces itself through the incessant grinding of ore against ore in its passage through the rolls; and second, the first recovery of concentrate which is of the highest grade, and which contains in this case galena and the coarse gold as well as much of the fine that would be recovered by the ordinary amalgamating process in the battery and on the plates. The proportion of concentrate of this grade is small; at present it is being reduced and run into base bricks in a large ordinary bullion furnace.

The town of Thane is situated on Gastineau Channel about three miles from Juneau and almost directly opposite Treadwell. It was named in honor of B. L. Thane, general manager of the company, who has done so much toward bringing about the extensive developments in progress about Juneau.

The town contains, besides the big reduction works described, many modern service buildings such as extensive machine-shops, woodworking and carpentry shops, stores, warehouses, wharves, an auxiliary pumping-station, an auxiliary oil-burning power-station; homes for the employees, including 28 cottages, 6 lodging or rooming-houses, each with a capacity for 50 men, and a boarding-house with a capacity for 300 men—all built with every provision for safety and comfort.

A school has been established in a building provided by the company, and the children of employees have every facility specified by the Nelson law. The post-office is situated in the company's general store. Private enterprises conduct several businesses in or near the town by consent of the company, including a modern steam-laundry, but no liquor is sold on the premises nor can it be obtained nearer than Douglas or Juneau. A sturdy civic pride has already manifested itself in the community and the inhabitants have commenced to beautify the place.

Costs at the Crown Reserve Mine, Cobalt

In 1914 this property produced 1,425,320 oz. silver from 288 tons of high and 31,347 tons of low-grade ores, at the following cost:

	Cost per oz.
Mining and development	$0.0870
Power, light, and heat	0.0190
Maintenance	0.0140
Ore handling	0.0196
General expense at mine	0.0202
Superintendence	$0.0075
Total mining	$0.1673
Smelter	0.0127
Milling	0.0900
Depreciation, office, etc.	0.0195
Total costs	$0.2895

THE PANAMA CANAL is ready to make deliveries of fuel oil to vessels at Balboa and Cristobal, and has established a rate of $1.25 per barrel of 42 gal. for fuel oil sold by it to vessels alongside the cribs. There is no wharfage charge for vessels taking oil at the crib, just as there is no charge against vessels using the other docks solely for the purpose of taking on coal or other supplies furnished by the canal.

Extracting Copper With Ammonia

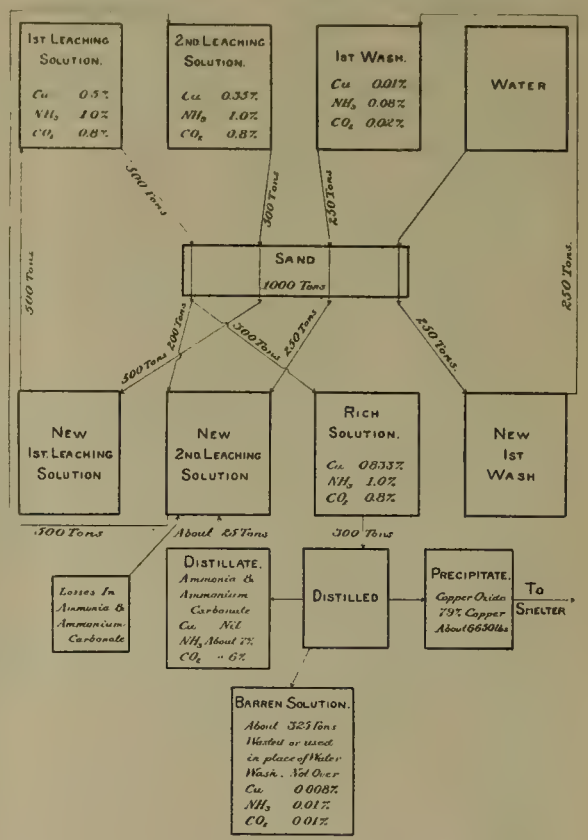
By C. H. BENEDICT

*It has long been recognized that (1) copper oxide will dissolve in ammoniacal solutions, yielding copper-ammonium compounds; (2) solutions of cupric-ammonium salts are capable of dissolving native or metallic copper, yielding cuprous-ammonium salts; (3) these cuprous-ammonium salts may be oxidized, by air or other suitable oxidizing agents, to cupric-ammonium salts; and (4) copper-ammonium solutions subjected to distillation, are decomposed with separation of copper oxide, ammonia being volatilized.

It has been attempted to apply ammoniacal solutions to the extraction of copper, including native copper, from its ores, but such processes have not heretofore been commercially successful, owing primarily to the heavy losses of the expensive and highly volatile ammonia, and to the high cost of the installation necessary to minimize the losses of ammonia due to volatilization from the solutions used. The present invention is designed to overcome these and other difficulties.

My investigations have shown that the losses of ammonia, which have been a serious factor affecting the commercial success of prior processes, are not due exclusively to volatilization, as has been heretofore assumed, but arise largely from the adsorption of ammonia by fine sand and slime, the adsorption by slime being greater than that by sand. I have also found that the adsorption losses are, in a general way, proportional to the concentration of the ammoniacal solution; and that in highly dilute solutions, that is to say solutions containing 2% or less of NH_3, in the free state or in unstable combinations with copper, the adsorption losses are so small as not to interfere with the commercial aspects of the process, provided the sand is substantially free from slime. The use of such highly dilute solutions presents the further advantage of minimizing the losses of ammonia by volatilization. It has not heretofore proved practicable to employ highly dilute solutions of this character for the extraction of copper from sand or other ores, for the reason that the solvent capacity of such solutions for copper is necessarily low as compared with that of stronger ammoniacal solutions, with the result that the volume of solution which must be handled and regenerated in order to produce a given quantity of copper has been large, this in turn necessitating a large and costly installation.

It is a primary object of the present invention so to operate a cyclical leaching process as to render it practicable to use these highly dilute ammoniacal solutions of copper for solvent purposes, securing thereby the advantage of small or negligible losses of ammonia and of copper, without unduly increasing the cost and size of the installation. To this end, the cycle of operations is so arranged that an amount of copper equal to that extracted from a given batch of ore will be found concentrated in a relatively small proportion of the total volume of solution brought into contact with this ore. A suitable volume of this stronger solution is subjected to distillation to precipitate its copper-content in the form of oxide, and to recover the free ammonia and any volatile ammonium salts, which are restored to the cycle



at the appropriate point; the volume so distilled preferably containing an amount of copper practically equal to the total quantity of copper extracted from the ore in the same cycle.

For clearness, the following terminology is used: The terms 'rich' and 'poor' and 'strong' and 'weak' are applied to the copper-content of the various solutions in the cycle, and the terms 'high' and 'low' are applied to the free ammonia-content of these solutions, all of these terms being of course merely relative.

The present process, in its preferred embodiment, involves an initial leaching operation with a solution which, in comparison with the solutions following it in the cycle, is richer in copper and preferably lower in free ammonia. A portion of the stronger effluent from

*Excerpt from U. S. Letters Patent 1,131,986.

the ore is subjected to distillation, this portion containing such an amount of copper that the quantity of dissolved copper in the circuit is maintained practically constant, that is to say, so nearly constant as to allow a repetition of the cycle; in other words, the quantity of copper recovered by the distillation is practically equal to that entering into solution from the given body of ore, the conditions being such, however, that this quantity of copper is derived from a relatively small proportion of the total volume of liquid traversing this ore. Under such conditions, it becomes practicable to use highly dilute leaching solutions, without the necessity of subjecting the total volume of solutions to a process of distillation in the course of each cycle. Following this initial treatment of the ore, it is subjected to the desired number of further extractions with solutions which are successively poorer in copper, the final solution being either water or a substantially barren solution or reject from the distillation. The second leaching solution, being poorer in copper than the first solution, is usually somewhat higher in free ammonia; and the succeeding solutions, herein for convenience termed 'washes', are not only poor or nearly free from copper but are also, preferably, successively lower in ammonia. The number of successive solutions or washes thus used will depend upon a variety of conditions as hereinafter mentioned.

The following is illustrative of the process as applied to the treatment of copper-bearing sand in successive batches or bodies of approximately one thousand tons, each batch being treated with four solutions, successively applied. For simplicity, the process will be described as applied to a single batch of ore, it being, of course, understood that in the practical application of the invention, it is not essential to adhere strictly to the precise cycle of operations described.

The four typical solutions, as applied to a sand assaying approximately ½% copper, in the order of their application to the sand, are designated and characterized as follows, percentages being by weight:

(1) First leaching solution: 0.5% Cu: 1.0% NH_3: 0.8% CO_2.

(2) Second leaching solution: 0.35% Cu: 1.0% NH_3: 0.8% CO_2.

(3) First wash: 0.01% Cu: 0.08% NH_3: 0.02% CO_2.

(4) Second wash: Water, or distillation reject containing only traces of copper and ammoniacal compounds.

It is of course to be understood that the compositions above given are illustrative only, and subject to some variation in accordance with the copper-content of the sand, and other circumstances. The first leaching solution contains ammonia, ammonium carbonate, and cupric-ammonium carbonate from a previous leaching operation. The other solutions, as well as the first leaching solution for subsequent cycles, arise in the course of the process in the manner later indicated.

A complete representative cycle involved in the treatment of a single batch of copper-bearing sand of the character specified is indicated graphically in the accompanying diagram.

Sand finer than 40-mesh, previously freed from slime by means of a Dorr classifier or otherwise, is run into a tank which for illustrative purposes may be 54 ft. in diameter by 12 ft. high. This tank should be covered, fitted with valve-controlled vents, provided with a false bottom of filter-cloth supported on a wooden frame and fitted with an overflow and with appropriate means for receiving and delivering the sand and the various solutions. The sand is run in with water in such manner as to be uniformly distributed. After one thousand tons of sand has been delivered to the tank, filling it with sand to a height of about ten feet, the water meanwhile overflowing, the excess water is removed by decantation and the sand drained to the surface. The first leaching solution is then led into the tank from above, the bottom valve opened, and the water displaced at as rapid a rate as filtration will permit. As soon as ammonia begins to appear at the outflow, indicating substantial displacement of the water, the lower valve is partly closed and the percolation rate adjusted as may be found necessary to secure a satisfactory solution of the copper-content of the ore. The first portions of the solution are found to be poor in copper and low in ammonia-content, owing to diffusion and imperfect displacement, and are run into the sump for the second leaching solution. Soon the first leaching solution, properly enriched in copper and now termed rich solution, appears and is permitted to flow to the rich-solution tanks for subsequent distillation. This rich solution is the richest portion of the effluent coming from the sand, and is ready for distillation. The volume of rich solution distilled for any one batch of sand is dependent upon the copper-content of the sand, and in practice will be, on the average, of a volume such that the copper-content of the rich solution distilled is practically equal to the copper extracted from the sand. The rich solution on distillation breaks up into copper oxide for the smelter, ammonia and ammonium carbonate for the second leaching solution, and a reject containing traces only of copper, ammonia, and ammonium carbonate; this reject may be used instead of water for the second wash, if desired.

As soon as the first leaching solution, amounting in all to some five hundred tons, has been run upon the sand and has reached the sand-line, the second leaching solution is run in, in approximately equal volume; and when this in turn has all reached the sand-line, the first wash is added, followed in the same manner by the second wash, the effort in all cases being to avoid mixing solutions, and to displace each by that next succeeding it in the cycle. The several effluent solutions are so manipulated as practically to maintain the proper composition balance, as between the chemical contents of the various solutions, a typical method by which this may be done being illustrated graphically in the diagram. There is thus established an equilibrium in the process, there being a regular progression of solutions in the following general manner: the second wash of charge N takes up

a little copper and becomes the first wash of charge N + 1; this in turn takes up a little more copper and receives the distillate and some dissolved copper from previous cycles and becomes the second leaching solution of charge N + 2; the free ammonia of this second leaching solution is partly used in dissolving copper, when it becomes the first leaching solution of charge N + 3, its copper-content having been fully oxidized to the cuprous condition; this first leaching solution having become saturated with copper by its passage through the sand, and having thereby lost its solvent power, is in part distilled, as before described, depositing its copper as 79% oxide, yielding its ammonia and ammonium carbonate as a pure product to join cycle N + 4 as a second leaching solution, and furnishing from its almost barren reject a second wash for a following cycle. In a plant containing more than one leaching-tank, these several operations are of course all going on at the same time, the total volume of solution in circulation being practically a constant: thus rich solution is continuously withdrawn from the leaching-circuit, and is replaced by an equal volume of second wash, less only the small volume of fresh ammonia and ammonium carbonate solution added to replace mechanical losses. In case the distillation is effected by free steam, the volume of solution is increased by its condensation, and a portion of the reject from the distillation, equal to the steam condensed, is thrown away in the course of each cycle.

The solvent power for native copper of these several solutions is of course dependent upon their content of cupric salts with the required proportion of ammonia; and theory indicates that a large amount of oxygen is required to convert the entire copper-content of the solutions to the cupric state. It has, however, been shown in practice that it is possible to accomplish this oxidation through the surface contact of the dilute solutions with the atmosphere, particularly after the process has reached the desired equilibrium, so that relatively large amounts of copper are being carried in solution. It is accordingly unnecessary, as a rule, in the regular operation of the process, to use any system of mechanical aeration of the several solutions. These are stored in covered tanks, with controlled vents, whereby air may be admitted as required. Means for injecting air under pressure may also be fitted both to the storage and leaching-tanks. It has further been shown, in practice, that whereas there is some appreciable adsorption of ammonia by the sand, even from solutions so dilute as those contemplated under the present invention, the adsorption of copper is practically *nil;* and the losses of copper are materially reduced by the employment, as described, of at least two leaching solutions, applied successively, the second leaching solution being poorer in copper than the first, and both solutions being highly dilute.

Obviously, the loss due to ammonia adsorption may be somewhat lessened by repeated washing, and it is possible and may be advisable to have a third wash following the second wash, the expediency of this being a commercial matter, entailing as it would an additional circuit of pipes, pumps, storage-room, and the like. So too the balance between the amount of rich solution distilled and second wash used is in part a commercial one, depending upon the cost of steam and the distillation loss, as against the recovery of additional copper and ammonia by more complete washing.

The present process is to be distinguished from processes depending upon the solvent effect of ammonia, with or without aeration: in these, the entire copper content of the effluent is derived from the ore, and it is obviously impossible to separate from any fractional portion of this effluent, less than its total volume, a quantity of copper equal to that dissolved from the ore. In other words, if a balance is to be maintained in successive cycles, the entire volume of effluent must be subjected to distillation or equivalent treatment for the recovery of copper. The present process is also to be distinguished from those depending upon a cupric salt for their solvent effect, and requiring precipitation from the entire volume of the effluent of a weight of copper equal to the increment derived from the ore. Such processes involve the regeneration of the total volume of the effluent, without providing a barren reject; hence, if a wash is used, it must likewise, at some stage of the process, be submitted to a precipitating operation, in order that it may be available for use as a wash in the succeeding cycles. In contra-distinction to these, the present process yields directly from the stronger portions of the effluent a greater or less proportion of barren reject, which is available as a wash, or which may be replaced by a like volume of water available as a wash: and the volume of liquor, to be distilled or otherwise treated for the separation of its copper, is limited to a portion only of the effluent instead of the total volume thereof. If the balance is to be rigidly maintained, the volume thus treated must of course contain an amount of copper equal to the increment derived from the ore; from which it follows that the volume to be distilled is smaller as the leaching solution, before application to the ore, is richer in copper. The present process, in its preferred embodiment, renders it practicable to employ an initial leaching solution relatively rich in copper, and thereby to reduce the volume of liquid subjected to distillation or equivalent precipitation method, to a comparatively small proportion of the total effluent: and the use of a second leaching solution relatively poor in copper avoids the necessity, which would otherwise exist, of using large volumes of wash in order completely to remove the rich solution from the ore. In other words, the second leaching solution, being relatively poor in coppor, combines to some extent the functions of a leaching solution and a wash; and to the extent that it combines these functions, it reduces the quantity of wash required.

THE PROMISCUOUS PLACING of 'safety-first' signs about mines, mills, and smelters has reached the point where it is of doubtful utility in many cases, according to *The Ingot*. Fewer signs, confined to the more dangerous localities, would seem to be more effective in impressing the desirability of the safety habit on all.

Choosing Rock-Drill Equipment

By P. B. McDONALD

Most mines possess rock-drills of several different makes, and some have a motley collection of drills perhaps none too well suited for the work in hand, usually purchased at various times without due regard for any standardization. Thus it is necessary to keep on hand repair-parts, from a half-dozen different drill manufacturers, that have a habit of getting mixed together on the warehouse shelves. A single mine may be driving with Sullivan and Ingersoll-Rand reciprocating drills, stoping with Cleveland, McKiernan-Terry, and Murphy hammer-drills, and sinking with some other make of plugger-drill; while there may be another variety or two of drill lying around the place, either going to rust underground or reposing in idleness in the corner of the warehouse, not used because some one cannot find a certain repair-part, or because a foreman has a prejudice against the type.

There is an excuse, of course, for getting the matter of rock-drills somewhat mixed, because there have been so many innovations in the design and construction of such machines in the past year or two that fashions in drills have changed almost as rapidly as in clothes. Newer and more efficient types of drills have constantly succeeded each other. The general tendency has been toward utilizing the hammer principle; first for up holes, as in overhead stoping; and then for down-holes, as in shaft-sinking by pluggers; and even for more or less flat holes in driving, as with the Leyner or new Sullivan mounted hammer-drill. Lighter, faster, and more automatic drills have also been sought. The heavy columns and bars for mounting drills have been replaced by lighter ones, which do not break a man's back to set up, or by none at all, as in the case of the stopers and sinkers. The future may see driving regularly accomplished by drills hung on a short rope or even held in the hands!

In picking out rock-drill equipment for a new mine, it is well to consider carefully a number of the newest models, and then to standardize on a type or types suitable for the three essentials of mining: sinking, driving, and stoping. It is, of course, necessary to know what kind of rock is to be broken. A mounted hammer-drill, such as the Leyner or new Sullivan, may be the best for a hard brittle rock, where clogging by mud in the bottom of the hole is not likely, and where the water principle through hollow steel is useful for dust prevention. For soft sticky rock such as slate, an old-fashioned reciprocating slugger type for pounding out results may give the best satisfaction in the end; in extreme cases even the declining tappet-valve drills may make up in sureness what they lack in speed. However, one or two of the newer light mounted drills can handle a wide range of rock; such as the butterfly-valve one-man machine that so startled operators a year or two ago. An auxiliary-valve drill, like the Sullivan high-speed, or the peculiar Holman that won its great name in South Africa, is also capable of wide use, since such a valve assures both quickness and certainty by its combination of the spool principle with the auxiliary tappet or ball.

The ball-valve machines have much to recommend them for ordinary average mining, where a combination of qualities is wanted, and the Chicago Pneumatic Tool Co. has seen fit to strongly feature them. For this same field the plain spool-valve drills are, and have been, very satisfactory. The Sullivan company has shown its faith in this type by sticking to it for many years; its later spool-valves are excellent in that they do not freeze readily, and are not so finicky as was the general case with spool-valves several years ago.

The foregoing refers only to mounted rock-drills, such as were used for all purposes around a mine until recently. Today mounted drills have their greatest field in driving, since stopers have superseded them for rising and overhand stoping, and pluggers for sinking. But they are yet an all-around drill, and in a small mine can be used to advantage for any purpose. On the other hand, I have seen several small mines that did all their work with a jack-hammer or two, making it do for all varieties of holes; while a stoper or ordinary hammer-drill can be utilized to do surprising things, as shown in the enlargement of the Rolling-mill shaft at Negaunee, working from the surface down by angle-holes from below. This is also illustrated by the many shifts to which a hammer-drill is turned in small mines, where it has been used for flat holes and driving. Stoping in some mining districts is still carried on with mounted piston-drills on tripods or bars, especially where the ore seam is at a flat angle, as at Birmingham, or where underhand stoping is performed in long 'rooms.' On the whole, however, no one doubts that hammer-drills have revolutionized stoping; as, to a smaller extent, plugger-drills of the jack-hammer type have revolutionized shaft-sinking.

An additional factor to consider in choosing rock-drill equipment is the type of labor that is available to operate and repair the drills. In some districts, it is impossible to get intelligent men, so that a drill requiring brains and judgment to make it go cannot be employed, even though it is a whirlwind at drilling when it operates. For a large mine with capable machinists and well equipped shops, specialized and freak drills can be tried, and often marvelous results attained, but for a small mine with none too good labor, a drill should be selected which will stand abuse and poor care, and will run fairly well anyway. Of the Wood drill it has long

been advertised that it can stand anything and still keep going, and most of the older types of drills possess the same comforting quality.

Some drills are finicky. They will drill very fast for a time, and then need nursing and humoring. The Leyner drill was formerly accused of this fault, but since the Ingersoll-Rand company has been manufacturing it, several improvements have been made that lessen the tendency. And it cannot be denied that in hard rock, with intelligent operators, the water Leyner is, like the old race-horse Maud S., a world-beater. Very likely other mounted hammer-drills will be put in the field, since the Leyner has demonstrated what can be done in that line, utilizing the scientific advantages of the hammer principle over the slugging or reciprocating method of punching hard rock. In fact, the new Sullivan mounted drill is much like the Leyner, being a 145-lb. machine of the hammer type with water attachment.

There are several other points of some importance to be observed in choosing a rock-drill, such as methods of lubrication, short-stroking arrangements, length of feed, and so on. But such details can best be decided by the man on the job to suit his own ideas on the subject, and no general principles are involved beyond common sense.

As to the various hammer or stoper drills of the unmounted air-feed type, I do not think there is so much difference. There are a number of good ones on the market. Their valves differ, some have spools, some butterfly, some ball valves, and some no valve at all, but practically all of them will hold a drill-steel fairly close to the face and hammer it "fast and furious." The McKiernan-Terry and the Cleveland Rock Drill Co. make an automatically rotated stoper (which saves the operator from twisting a handle back and forth), and it is prophesied that this improvement is likely to be adopted by other makers; but the labor of twisting a stoper is not so marked as was the case with a plugger-drill, where the workman has to feed the drill forward as the hole deepens. In the latter instance, the jack-hammer made a big hit by successfully introducing automatic rotation for pluggers and sinkers. With an ordinary stoper, compressed air from the air-line does the feeding, so that all a man has to do is to rotate by swinging a handle back and forth through a small arc.

As with stopers, so with pluggers or sinkers, there are a number of good makes on the market, and it is not so necessary to exercise careful judgment in the selection. It is not meant to imply that some stopers and pluggers have not certain advantages over others of their class, but such advantages (aside from automatic rotation of pluggers) are usually merely mechanical details which appeal to one superintendent and not to another. Thus it is a question of personal conviction, more than a matter of principle, whether a stoper has ordinary or reverse feed, whether it weighs 55 or 100 lb., whether a plugger rotates by the reciprocating energy of the hammer or by a separate small engine. Such matters can be best decided by the superintendent on the job to suit his own ideas and the details of the situation. It need only be said that the automatically rotating plugger is a surprisingly satisfactory drill for shaft-sinking or down-holes in general. Such machines are the Ingersoll-Rand jack-hammer, the Sullivan rotator, the McKiernan-Terry rotating plugger, the Cleveland 'mucker', and others. Hollow drill-steel is generally used for blowing out the rock-chippings by air or water. Other things being equal, having selected a stoper or plugger-drill, it is good practice to standardize the type for its own class of work in order to simplify the repair-parts problem. A large mine will probably require three kinds of rock-drills: mounted drills (either reciprocating or hammer type) of one-man or two-man style, for driving and all-around work (including perhaps stoping); stoper hammer air-feed drills for rising and overhead stoping; pluggers for shaft-sinking and block-holing.

One of the signs of the times is the fish-pole mounting for the Sullivan rotator, which permits that plugger-drill to be used for driving and all-around drilling. This is a sort of Jacob's staff steel rod on which the rotator can be hung quickly and conveniently for drilling short horizontal holes in soft rock. All the foregoing remarks are merely personal observations (on a subject in which it is difficult to get unbiased views) from experience in several mining districts. By no means have I tried to discuss all the different makes of rock-drills, and some very good ones I have not even mentioned. It might be pointed out that rock-drills sell for not far from a dollar a pound, but some of them are worth it.

Conditions of the Chilean Nitrate Industry

The average monthly production of nitrates in Chile from January 1 to August 1, 1914, was 5,404,729 quintals of 101.4 lb. Since August 1 the production, in quintals, has been as follows: August, 4,830,233; September, 2,856,600; October, 2,865,494; November, 2,659,875; December, 2,428,759; January, 1915, 2,082,549.

Wages in the nitrate fields have gone down 25%, but falling exchange has increased by 40% the cost of imported articles used in the reduction of nitrates. The Government has assisted in sustaining 70% of the output, but one company refused assistance in paper money worth 14c., as exchange might go back to 18c. plus, and payment be demanded at the higher price, causing the loss of all profit. Its production was 200,000 quintals per month. On August 1, 1914, there were 134 plants in operation. On February 1, 1915, there were 40, some of which were working half time. The nitrate on hand in Chile (24,000,000 quintals) is enough to supply the market for a year if monthly sales are not increased. On December 31, 1913, the supply on hand was 10,000,000 quintals.

Freights to Europe have lately been $17.63 per 22 quintals (2231 lb.). Sales are expected to Scandinavia, Spain, and Italy. Except in the United States and Great Britain, the demand is in excess of the supply, but vessels are scarce. The price on the Chilean coast is $1.38 to $1.40 per quintal—*Commerce Report.*

On Carnotite Deposits—and the Rand Banket

By CHESTER T. KENNAN

Any metal or mineral carried in solution may, under suitable conditions, be precipitated or deposited interstitially in sand or sandstone, or other porous or loose-grained rock; or such deposition may take place through replacement by mineral matter of easily soluble cementing material between the grains. Such orebodies are impregnation deposits, and may be primary or secondary in their character. From which it follows that the inducted minerals may also be of primary or secondary nature.

The fundamental agencies for the production of such primary deposits are: A fissure or subterranean water-channel carrying mineral-laden solutions at an opportune period; a loose-grained, porous, or otherwise easily permeable, wall-rock for the mineral solutions to impregnate.

The extent and richness of such deposits depend primarily upon the amount and richness of the solutions; the duration of time the mineralizing action continued; the degree of porosity of the rock mineralized; the amount of pressure exerted upon the mineralizing solutions; and, sometimes, upon the number of fissures, or water-channels, contributing to the same deposit. Naturally, the more porous and more easily permeable the rock, and the greater the pressure exerted upon the mineralizing waters, the more extensive and wide-spread the deposit will be. It is not infrequently the case that waters from disconnected and widely separate fissures meet and mingle, forming a continuous ore deposit between the fissures.

In case the pressure exerted upon the mineralizing waters is slight, and the rock not easily permeable, the mineralization is likely to take place only close to the producing fissure; but in the case where the rock is easily permeable, and inclined downward away from the fissure, the solutions may permeate the rock for a long distance. Eventually this deposit, by leaching and percolation, may become entirely disconnected from the parent fissure, and be re-deposited in an isolated position, clearly as a secondary deposit of this class—such are many of the carnotite and copper carbonate deposits in sandstone.

Another case may be quoted in which the ore deposit appears to be isolated from any distinct water-channel, where a deposit has occurred in loose or almost uncompacted sand, or weakly cemented sand; and by subsequent pressure and cementation the feed-fissure or producing plane of weakness has 'healed' so perfectly that evidence of its prior existence at that spot is wholly lacking. In many other instances, however, where the fissure was even slightly faulted, although now quite perfectly 'healed' and cemented, the 'drag' of the grains of sand along the plane of weakness is beautifully in evidence. A fine example of such an effect is found in the now famous Lady Belle silver mine on Horn mountain in Eagle county, Colorado.

In many instances, when feed fissures were 'capped,' or closed above the point of ore deposition, the mineralizing waters were forced into the porous rock or sand under enormous pressure; in this case the orebodies are apt to be richest near the feed-fissure, fading gradually in richness with distance from the feed-fissure. There are many ways by which fissure-vents become capped or obstructed: shale in the path of a narrow fissure will not 'fissure,' but merely 'shingle' or 'telescope,' leaving an obstruction in the channel impervious to the flow of water or steam. The latter effect may be modified in some cases by faulting. The opening of a narrow fissure through a thick stratum of clay, under pressure of overburden at depths in the earth, is likely to heal quickly, forming an impervious barrier. On the sides of a mountain, the strata frequently slip, or slide, on bedding-planes or planes of unconformity, and thus may cap whole series of fissures for many miles at once. A similar effect is accomplished by the intrusion of igneous sheets on bedding-planes and planes of unconformity; and by surface lava-flows. Nature has numerous ways whereby she caps, closes, or obstructs fissure-vents. The cumulative effect of the pressures attained may well be presumed, in instances, to have even caused volcanic explosions or earthquakes.

Mineral-laden waters, whether under subterranean pressure, or not, migrate, often long distances, through all kinds of water-channels in the earth's crust, as fissures, fractures, cracks, bedding-planes, joint-planes, slip-planes, planes of unconformity, lines of weakness, and through water-channels carved out by themselves along lines of easily soluble material.

That, in places, the resulting deposits may have been enriched, or have received some contribution, directly or indirectly, from surface erosion by the medium of descending and laterally moving waters through the aforementioned water-channels is admitted; but the Mother Goose theory, advanced by some eminent geologists, to the effect that the minerals formerly existed in infinitesimal particles in the surrounding country, and such particles took wing and flocked to a common house, is rejected as too fanciful.

While the foregoing principles are enunciated with special reference to ore deposits of gold, silver, lead, copper, carnotite, and other uranium and radium minerals found in the sandstones and conglomerates of the United States, they are no less applicable to any spot in the earth's crust where similar conditions have pre-

vailed, as, for instance, the copper mines on the Kirghese steppes, Siberia; many mines and deposits of this class in Bolivia; the copper mines in the conglomerate of the Lake Superior region; and the Rand banket.

Such ore deposits may be found in any sedimentary formation, where the prescribed conditions have prevailed.

Near Mauch Chunk, in Carbon county, Pennsylvania, carnotite deposits occur "in a 40-ft. layer of coarse-grained conglomerate lying near the base of the Pottsville formation (Pennsylvania) and just above the red Mauch Chunk shale (Mississippian)," so says U. S. Geological Survey Bulletin No. 580-H.

Deposits of this class have been observed sparingly in the Maroon (Carboniferous), in the red sandstone of the Red Beds (Jurassic), and more frequently in the white sandstone near the top of the Red Beds, these white strata being essentially identical in structure and composition with the white sandstone formation superimposed upon the Red Beds, and doubtless received their sedimentation from the same general area.

The Copper King mine in southern Routt county, Colorado, is an orebody of this class occurring in ancient quartzite and conglomerate of the Cambrian system. The Cambrian is here about 400 ft. thick, the orebody being near the top of the series. The nearest outcrop of igneous rock is about one mile to the north. About one and a half miles to the south, and higher in the geological column, is a fragment (at least 4 square miles in superficial area) of a thick sheet of lava. This impregnation deposit, as far as explored, uniformly occupies about 8 to 9 ft. thick of strata dipping approximately 20°. The orebody has been cut to a depth of 425 ft. by an inclined shaft, and also by about 400 ft. of drifts from the inclined shaft, all the workings being in ore continuously. Numerous 'knife-blade' feed-fissures intersect the deposit, but, as far as observed, none are prominently faulted. Partly owing to the softness and porosity of the rock at the time it was intersected by the feed-fissures, these fissures are now very narrow—frequently 'tight.' It is to be remarked that feed-fissures in this class of ore deposits are now rarely more than an eighth or quarter of an inch wide, and seldom filled with vein-matter. They are quite uniformly so small and inconspicuous that when obscured by the dust, powder-soot, and mud of a mine, they are commonly passed unnoticed, unless special search is made for them. Presumably they may have been somewhat wider at the period of ore-deposition, but by subsequent pressure and gravitational adjustment the walls have now been brought closer together. The valuable content of this ore-deposit is chiefly copper carbonate and chalcocite, with subsidiary amounts of native copper, red and black copper oxides, silver and galena.

In Colorado, New Mexico, Utah, and Arizona the thousands of such mineral deposits nearly all occur in the sandstone series lying between the Red Beds and the Dakota sandstone. Whether this intermediate series here constitutes the top of the Jurassic or the base of the Cretaceous is a mooted question. In the central-western part of Colorado it is called the Gunnison; on the eastern portion of the mountains, the Morrison; and in the northwestern part of the State, where it is much thicker, it is divided into the Flaming George and White Cliffs; while in the southwestern portion of the state, where it is approximately 1500 ft. thick, this series is divided into two portions named respectively the McElmo and La Plata, the latter being the lower member, and nearly always containing these carnotite deposits, when found in this geological province.

Carnotite and other vanadium and uranium minerals in commercial quantities (excepting pitchblende) are practically always found in ore deposits of this class, and, in the four states mentioned, most frequently in the lower portion of this series. At Horn Mountain and vicinity, the immediate geologic section (reading upward) is Red Beds for about 1000 ft. thick, Gunnison about 250 ft., Dakota about 350 ft., Ft. Benton Shale about 200 ft.; and lying upon Dakota sandstone, about a mile northeasterly from the mines, is a large section of the lava-sheet that at one time extended over the whole region. Aside from this lava the nearest outcrop of igneous rock is Porphyry mountain, some three miles southeast. The mines and productive formation on Horn mountain are seamed with a network of 'knife-blade,' 'tight,' and 'healed' fissures—many of them faulted, some intensely faulted. The main orebodies occur in the sandstone strata from 25 to 50 ft. above the top of the Red Beds, though sometimes 'leachings' of mineral extend down to the Red Beds. The chief minerals here impregnating these sandstones are silver sulphides, chlorides, bromides, native silver, and carnotite, with subsidiary amounts of copper carbonate, native copper, copper vanadate, and gold.

The foregoing principles and illustrations serve, incidentally, to account for the mineralization of the Rand banket, without recourse or reference to the irrelevant sophistries that have been published in the technical press.

COPPER PRODUCTION of Austria in 1913 was as follows, according to a consular report from Vienna: Of 32 works for producing copper ore, 10 mills, with 26 overseers and 753 workmen, were in operation in Austria in 1913. About 163,533 quintals (quintal = 2.2046 lb.) of copper ore, valued at 1,542,296 crowns ($313,086), was produced. In this output, which shows a decrease of 5.76% compared with the preceding year, the government mines furnished 2.36% and the mines under private ownership 97.64%. The mills produced 36.845 quintals of metallic copper, valued at 5,986,409 crowns ($1,215,241). Copper works controlled by the mining authorities produced, besides copper, speiss and copper regulus, 8966 quintals of copper vitriol, valued at 514,970 crowns ($109,806). The entire production of the province of Tyrol, 95.36%, is controlled by the government, and the full yield of the province of Salzburg, 4.64%, by private works.

CONCENTRATES

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Recovery at the Detroit smelter, Arizona, in 1914, averaged 95.45%. Copper in slag was 0.35 per cent.

Tuff comes from the Italian *tufa*. Vesuvius is responsible for the nomenclature of many volcanic products.

Cost of a horse-power year at the Copper Queen smelter in 1914 was $54.789, on a daily average of 4092 hp. developed.

Hornstone is a dark flinty veinstone; the mineralogical equivalent is 'chert.' The latter is Irish, and originally meant 'pebble.'

Peat-fuel containing upward of 60% moisture is being used in a by-product recovery power-gas plant near Osnabrück, Germany.

Krennerite is a telluride of gold, resembling calaverite as regards composition, but differing from it in possessing a perfect cleavage.

The Welcome Stranger nugget was found at Moliagul, near Dunolly, Victoria, in 1869. It weighed 2280 oz. and was valued at $47,670.

Nuggets are water-worn pieces of native gold. The term is restricted to pieces of some size, not mere 'colors,' or minute particles. Fragments and lumps of vein-gold are not called 'nuggets,' for the idea of alluvial origin is implicit.

Wind action, or aeolian agency, is manifest in the shallow cemented deposits from which much gold has been obtained in Western Australia. Such deposits are the product of wind and rain, assisted by gravity acting on a slightly inclined surface.

Recovery of metals by water concentration at the Broken Hill South mill in 1914 was 76.7% lead, 54.9% silver, and 10.6% zinc; but adding the recovery from the zinc concentrate by flotation, the total extraction was 89.2% lead, 83.9% silver, and 84.4% zinc.

China clay imported into the United States amounts to about 300,000 tons per year. Of this, 25% is used in ceramic manufacture (pottery), the remainder being consumed in the paper, bleaching, and other industries. There are a number of deposits of commercial value in this country.

Repair cost of storage-battery locomotives at the Bunker Hill & Sullivan mines runs from $0.00359 to $0.01189 per ton hauled. Trolley locomotives cost from $0.00435 to $0.00641 per ton. In the first instance the highest expense was up to $55.456 per month, and with the other machines $93.912 per month.

Wheelbarrows or trucks are employed to some extent in practically every industry. Their use should not lead to accidents, yet many workmen are injured when handling such equipment. Some accidents occur because the wrong kind of barrow or truck is used for handling certain materials, or because the barrow or truck is of weak construction or in poor repair; some injuries are caused by the lack of handle guards for the protection of the workmen's hands, or by unsuitable floors, pathways, or runways over which the barrows or trucks are wheeled. For the most part, however, injuries received by workmen when handling barrows and trucks are caused by their own carelessness. Wheelbarrows should be selected carefully for the specific work that they must perform. There is a right barrow for every task, and usually the right one is the safest one.

A correspondent asks for a rapid and accurate method of determining the amount of tin in ore or gravel. The dry assay of tin ore is only to be recommended for works purposes, mines, or prospectors. It is not accurate enough for buying and selling, but should suffice to give a good idea of the value of the material in the district where our correspondent is situated. The cyanide assay is of the most general applicability, and is as follows: grind the ore through a fine screen, say 80 mesh, and weigh out 10 grams. Also weigh 40 grams of coarsely-powdered commercial cyanide. Mix half with the ore, place in a clay crucible, and cover with the remainder. Fuse the mixture at a red heat for 15 to 25 minutes, pour into a mold, and detach the tin button from the slag. The weight of the button $\times$ 10 represents the per cent of metal in the ore, when 10 grams is taken. The crucible may also be taken out of the fire when fusion is complete, allowed to cool, broken, and the tin detached. When the ore contains much ferric oxide, it should be digested with strong hydrochloric acid, provided the tin is present as cassiterite (tin oxide), and if much pyrite is present it should be evaporated to dryness with nitric acid, before extraction with hydrochloric acid. The cleaned sample is then washed with water, dried, and assayed. The sample should, of course, be weighed before treatment with acid. The cyanide used must be free from sulphates and sulphides, otherwise the result will be low. The assay charge should be as free from gangue as possible, otherwise there will be loss by slagging. This may be prevented by taking a larger sample and panning it down before assaying.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

BUTTE, MONTANA

General Recovery.—Power Schemes.—Anaconda's Reduction Plants.—Butte & Duluth Affairs.—Anaconda-Pilot-Butte and Butte & Superior.—Elm Orlu Suits.—Montana Phosphate.

The continued good prices for copper, and the high price of zinc have resulted in Butte's mines and mills returning to nearly normal scale of operations. Of course, the zinc properties have been running full time for some months, but the copper mines that suffered curtailment last summer are just beginning to put on full crews again, and to ship somewhere near the normal amount of ore to the mills and smelters. The only large property that has not yet re-opened is the East Butte. This will shortly re-open, however, with a milling and smelting capacity greater than ever before.

The business men of the community are quick to respond to the revival of mining; the general impression being that Butte is now having good times, with a promise of still better things. This should not be interpreted, however, by miners away from Butte, as indicating that the labor supply is insufficient, for throughout the winter there have been many idle men waiting for the chance, which they now have, to secure employment.

The railroads are undertaking some improvements and new construction, particularly the Chicago, Milwaukee & St. Paul, which is spending large sums in the electrification of its main line from Harlowtown, Montana, to Avery, Idaho. Large numbers of men are employed in connection with this work, and it is predicted that the electrified division between Three Forks and Deer Lodge will be ready for traffic before the end of the year.

The Montana Power Co. is also expediting its hydro-electric installation at the big falls of the Missouri, near Great Falls, and Thompson Falls on Clark's fork in the western part of this state. These industrial undertakings, together with the increased farming activity, augur well for the business outlook and general prosperity of Montana for the coming year.

In this same connection it should be mentioned that the Anaconda company has re-started its reduction plant at Great Falls, and that some ore is now being shipped there for smelting. Also at Great Falls the company has begun the installation of a large electrolytic refinery, to cost approximately $2,000,000. At this plant most of the copper now sent to the eastern refineries will be refined and cast into bars for shipment to the various points of consumption. At Anaconda the changes in the reduction works are frequent, and of great importance. For instance, the reduction plant to treat the slime by the Laist leaching process has been cast aside in favor of a flotation process. This change will also mean the ruthless abandonment of the recently installed and much praised 20-deck round tables, as they will not be needed in connection with the flotation plant. The Laist leaching process, however, will be used in connection with the enormous tonnage of tailing that has accumulated below the mill in the past dozen years. In connection with this leaching process, the first unit of the sulphuric acid plant of 100 tons per day is nearly ready for production.

But the news is not all favorable. The Butte-Duluth Mining Co., with its copper-leaching plant east of Butte, has been meeting with difficulties, financial and otherwise. The company has been placed in the hands of a receiver, and bankruptcy proceedings have recently been instituted by creditors of the company. The troubles of the company are not all public information, but it is safe to say that the chief one has been in connection with the attempts to evolve a favorable method of leaching the oxidized ores, and electrolytically precipitating the copper thus dissolved. In spite of rumors to the contrary, it is now well known that the Anaconda company did not exercise its option on the property, for reasons variously given, but probably in connection with the results obtained in the diamond-drilling that tested the orebodies. Those responsible have not yet given up hope of its successful outcome, and expect to see some return for the $750,000 spent in the enterprise.

The litigation between the Anaconda and the Pilot-Butte companies over the apex to orebodies is still dragging along, without any definite decision in favor of either side. A recent phase of the case was the citing of the Pilot-Butte company into court for contempt in connection with the extracting of ore from certain ground from which both litigants had been restrained from working. The Court decided

CLAIM MAP OF BUTTE.

that the Pilot-Butte was in contempt, and imposed a nominal fine, together with a warning against the repetition of the offense.

The apex controversy over orebodies between the Butte & Superior and Elm Orlu is assuming definite shape, and apparently is coming to trial before long. A formidable array of technical talent has been reserved by both sides to present the evidence in support of their various contentions. On the side of the Elm Orlu are the following experts: Walter Harvey Weed, Horace V. Winchell, J. F. Kemp, John D. Irving, and F. T. Greene; while for the Butte & Superior are gathered John W. Finch, Walter H. Wiley, Rollin D. Salisbury, W. H. Emmons, W. L. Creden, F. A. Linforth, and A. L. Longley. Because of the expense to the litigants, it is to be hoped, of course, that this litigation will not be long drawn-out, but from the standpoint of the disinterested onlooker the trial should be worthy of attention, because of the brilliant array of talent to be pitted against each other on the witness-stand. Such a gathering of witnesses reminds

one of the olden days in Butte when the Heinze trials were on. The best engineers from all over the country were gathered together to testify. A peculiar phase of this present litigation lies in the fact that ex-Senator W. A. Clark, who is probably the largest individual stockholder in both enterprises, is interested in both sides of the case. In other words, it would seem as if he were being made to bring suit against himself, and pay handsomely for the privilege.

The activity of the U. S. Geological Survey in prospecting and valuing the phosphate resources in Montana has resulted in arousing the interest of some private capital in the development of the phosphate industry. A company has recently been formed to develop phosphate deposits near Philipsburg, Montana. The company is securing local capital with the intention of erecting a mill at Philipsburg for grinding phosphate rock, and selling it raw as a fertilizer throughout the state, and elsewhere. The outcome of such an enterprise will be watched with much interest, because it has been considered a question whether the western states were yet ready or in need of a fertilizer, and also whether the raw rock would satisfactorily answer such needs as do exist.

TORONTO, ONTARIO

Power at Porcupine and Cobalt.—Dome Directorate.—Hollinger Mine Development.—Cobalt Companies.

Shortage of power has seriously interfered with operations at Porcupine, as well as at Cobalt, and lately the companies, with the exception of the Dome and Hollinger, which have special arrangements with the power company, have only been receiving half their usual supply. Most of them have auxiliary steam plants which have been started, although this considerably increases the cost of production. Fortunately the difficulty over power shortage cannot be of long continuation, as the spring floods will shortly relieve the situation.

The Dome, the monthly returns from which have lately been somewhat of a disappointment, owing to the low grade of the ore treated, took a sharp upward turn in the share market on the election of J. R. De Lamar to the presidency to replace Ambrose Monell, who has occupied that position since its organization. This and other changes in the board were accompanied by a report that the shares would be placed on a dividend basis.

At the Hollinger, work has been started on a winze from the 800-ft. level of No. 1 vein for 125 ft. where another level will be opened. The vein is strong at 800 ft., and of good average grade for the 200 ft. so far opened. The main Hollinger shaft, now down 550 ft. is being sunk to connect the workings at 800 ft. At the Acme, development is under way at the 675-ft. level, and the shaft is down 40 ft. below that depth. A station will be cut at 800 ft., from which level a cross-cut will connect with the central main shaft of the Hollinger through which all ore will eventually be hoisted. The Acme output is now supplying 20 of the Hollinger stamps, and will provide ore for the additional 20 stamps which should be in operation early in April.

Nearly all the annual reports of Cobalt companies show considerable reductions in ore reserves. The Temiskaming has greatly improved its position by following up the vein entering from the Beaver on the 500-ft. level. This vein has been again cut at 460 ft., 30 ft. from the Beaver boundary, where it is 7 in. wide, assaying 3500 oz. per ton. The annual report of the McKinley-Darragh shows a production of 1,396,540 oz. of silver, being the smallest output since 1906. The cost of production shows an increase from 22.33c. in 1913 to 31.33c. in 1914. Total estimated ore reserves were 2,132,000 oz. as against 3,210,000 the previous year. The report was not hopeful as to the likelihood of further important discoveries. The net profits were $307,652 and dividends were paid amounting to $404,584.

PLATTEVILLE, WISCONSIN

Review of Conditions Affecting Zinc-Ore Production.—District Yields of Ore.—Prospecting, Development, and Leasing Activity.

A careful survey of operations and production of zinc ore in the Wisconsin districts for March reveals conditions full of promises to be realized several months hence. With high prices for metal all the month the natural deduction would seem to warrant a much increased extraction of raw ore from mines. Bad weather and bad roads militated, so the operators stated, against the free delivery of ore to railroads. This was true enough, but bad weather can interfere little with underground work, except where delays might follow as a consequence of floods, and in this respect the spring break-up and rains worked no damage at least in the Wisconsin field.

The month opened with spelter at high prices, both spot and future ruling strong, and on an almost equal footing. Speculators through the metal exchanges upset reasonable calculations by precipitating quotations which erroneously reflected the true condition of the actual markets, and large consumers of spelter charged manipulation with a display of intense feeling, which quickly restored the quotations to a more satisfactory standing. A large amount of business was transacted both for domestic and export consumption of spelter. The sales of domestic requirements called for a large tonnage of prime western spelter for delivery over the next three or four months, while substantial orders were filled for export. As far as known, most of this business was done by one concern. A careful investigation of the market showed that many prominent producers of spelter have nothing to sell from April and May production, and most of these are in the same position regarding June. Producers were so well sold ahead that there is no chance for weakness to be displayed in the metal markets for months to come.

St. Louis quotations ruled at 9 to 10c. most of the month, with the actual returns nearer to the higher figure prevailing most of this 30-day period. Sheet zinc continued at the highest price ever known to the industry, $13.50 per cwt., f.o.b. Illinois points, less 8% discount in car lots. Brass special could not be obtained in quantity at all, and one or two spot deliveries of small lots were traded in at 12 cents.

Ore production was under normal, and it is this fact coupled with the further fact that future deliveries are entirely dependent on material yet to be recovered from the ground that portends trouble for smelters in the near future. Prices for zinc ore opened at the beginning of the month at $60 to $70 for 60% metal content. These prices suffered a severe slump part of the month, the range at one time running below $50. While no tentative agreement exists among miners to curtail production, it appears manifest to the close observer and to the discriminating mind, that a bond of secret fellowship was working through mysterious channels among operators to curtail production. This holds true for nearly all of the prominent zinc-ore producing regions of the country, not alone in this section. All of the elemental factors comprised in the big game played between buyers and sellers seem alert to every phase of excited as well as extraordinary conditions, and no opportunity is lost to secure every possible advantage to be derived from high prices. Under the influence of figures never dreamed of before it would appear that a considerably increased output should be in evidence. Miners are not displaying any anxiety to boost production, and it is quite clear they propose to get all they possibly can for the material yet to come out of the ground while metal markets remain high. The usual ratio for the selling price of ore is figured on a basis of 8 to 1. The average trend of prices during March conveyed a ratio of 6½ to 1, and miners freely acknowledge that they

are not at all satisfied with the offerings being made by buying representatives of smelters.

Deliveries of ore for the month were reported as follows: Benton, 7,886,000 lb. zinc, 209,390 lb. lead, and 1,224,730 lb. pyrite. Galena, 3,820,000 lb. zinc; Hazel Green, 2,678,000 lb. zinc, Livingston, 2,670,000 lb. zinc; Cuba, 2,350,000 lb. zinc; Platteville, 2,130,000 lb. zinc; Linden, 1,280,000 lb. zinc.; Harker, 688,000 lb. zinc; Shullsburg, 366,000 lb. zinc; Dodgeville, 66,000 lb. zinc; and Mineral Point, 50,000 lb. zinc; making a total of 23,984,000 lb. zinc; 203,930 lb. lead, and 1,224,730 lb. pyrite.

The gross production of raw ore from all mines for the month aggregated 19,778,550 lb., and net refined ores from separating plants and from mine direct to smelter 14,398,370 lb. The reserve of zinc ore in the district at the close of the month was 2500 tons. Several million pounds of lead ore was carried over.

Boom conditions are in evidence all over the region. Prospecting has received great impetus, and mine development is well under way in all the districts. Drilling companies are being organized, and scores of new mining associations have been recorded. Leasing is in great demand, and every available mineral tract has been conserved for mining purposes. An insistent demand for miners, machine-men and shovelers exists throughout. At several points shovelers are receiving as high as 17c. per can of 1000 lb., and earning from $3 to $5 per day. Numbers of miners' cottages are being built to accommodate the influx of men being brought into southern parts of the area.

LORDSBURG, NEW MEXICO

New Concentrating Plants in the Pinos Altos District.—Chino, Eighty-five, Cossack, and Calumet & Phillipsburg Companies.

In the Pinos Altos district, Grant county, nine miles north of Silver City, work has been commenced on two concentrators. One is being built at the Cleveland mine by the Empire Zinc Co. It will have a capacity of from 100 to 200 tons of ore per day, and in it will be incorporated some form of the electrostatic or magnetic separation process for sulphide zinc ores. The other mill is under construction by the Pinos Altos Mining & Milling Co., recently organized by Stauber, Wright, and Cadelle, operators of the Pacific No. 2 and other Savannah Copper Co. properties, and the Langston mine. The concentrator is being built on the site of the old Gilette mill, adjoining the Gilette mine. The ore is heavy in zinc sulphides and is most valuable in gold, silver, and copper. It is understood that several different concentration processes will be used in the mill, principally the electrostatic method. Stauber and Wright have made thorough investigations as to the best method of treating their complex ores, and it is thought they have arrived at the correct process. Lack of successful milling facilities has been the greatest obstacle to progress in this district. The plant may be in operation by June 1. Custom ores will be treated. The Empire Zinc Co., after extensive tests, has decided on the construction of its mill, and has recently completed a narrow-gage mule tramway from the mines to the Santa Fe railroad near Silver City. The erection of these two plants give evidence of renewed activity in the Pinos Altos district.

The Chino Copper Co.'s addition to its power plant is progressing well. Additions are being made to the flotation plant. The result of flotation tests on the Santa Rita ore have been satisfactory, and the Company will give further attention to this method.——The Eighty-five mine at Lordsburg has been closed down for about a week on account of a broken crankshaft on the main hoist. An electric hoist has been ordered to replace the gasoline equipment.——At Bland, Sandoval county, the Cossak Mining Co. is operating its stamp-mill and cyanide plant with good results.

NEW YORK

Business Revival in New York.—Miami and Inspiration.—Rio Tinto.—Alaska Juneau Finances.—United States Smelting and Alaska Ebner.—Exploration Company of London.

It has been years since Wall Street has seen such reversal of form as took place this week. The depression has been so heavy and for so long that it was hard to shake it off. The copper issues have not been slow; they could hardly hang back with the metal market as strong as it is. If the present higher range of prices and increased activity takes on the wished-for appearance of continuity it will not be long before there will be consolidations among copper properties that will interest the public.

Already there is some talk, following persistent advertising campaigns of Miami and Inspiration, that these two properties are to be joined financially, as they are physically. The former has just resumed its quarterly dividend payments. Some of the rumors about the Inspiration have been based

SHAFTS, POWER-HOUSE, CRUSHING-PLANT, ORE-BINS, AND HOUSES AT THE INSPIRATION.

on the shareholding of the Anaconda. This company owns 150,000 Inspiration shares. The possible absorption of Inspiration may be on a share-for-share basis.

Rio Tinto has suffered by reason of war conditions. It would be a natural first thought that this property, practically owned by French and English capital, would have been one to profit by the abnormal demand for copper as used in munitions of war. Its profits in 1914 were only $3,687,000, against $7,789,500 in 1913. It is an odd commentary on commercial conditions that mines here should be getting back to normal with all possible haste, while a mine in Spain with such controlling interests, can run but four days per week without piling up metal that cannot be sold.

The Alaska Juneau deal is to go through, but the market fireworks, which promised to flare up so bright, have all been effectually dampened. Four hundred thousand shares of stock are to be allotted to an underwriting syndicate. It is said that this has already been subscribed several times over. The capital stock of the Juneau is being increased from $150,000 to $15,000,000 by changing the par value from 10c. to $10 per share.

The United States Smelting, Refining & Mining Co. is defendant in an action in the United States court to compel the surrender of a large block of stock of the Alaska Ebner Gold Mines Co. which it is alleged to have received from the bondholders' committee under an agreement which is now attacked as being unfair. The plaintiffs are heirs of the late Edwin P. Hatch. Some other certificate-holders are associated with them for the purposes of this action.

The Utah Consolidated becomes a substantial holder of Anaconda by reason of the sale of the International Smelting & Refining Co. to that company. Utah owned 5000 shares of

International, which is now replaced by 16,500 Anaconda shares. Utah Consolidated made over $500,000 profit in 1914, which is good for a property that has been spoken of as worked-out. It has been a gold mine, a copper mine, and a lead mine in turn, and still has ore in reserve for another year's operation.

The Exploration Company of London must look on the Tomboy as something of a life-saver. The mine made a profit of $29,535 during March. The mill treated 12,000 tons of ore from which bullion was shipped worth $43,500, and concentrate valued at $44,000. There never was a better illustration of the idea of the holding company in mining operations. While all of the operations of the Exploration Company in Mexico have been seriously interrupted or stopped, the Tomboy is running smoothly and carrying the load until the closed mines can be re-opened. If we are to have a real period of expansion in mining enterprise, it is to be hoped it will come along the lines of development in this direction, rather than attempted exploitation of single properties. If the organization of development companies is made along the right lines, the industry can have greater public support of the right kind than it has ever had in this country.

DENVER, COLORADO

BRIGHTER OUTLOOK FOR MINING IN THIS STATE.—NOTES ON CRIPPLE CREEK MINES.

The mining business in Colorado looks better today than it has for several years. There is a better feeling among mining men generally; mining engineers report more inquiries, if not more work, for and about mines, than at any time within ten years. This may be accounted for in several ways. New and important strikes in different parts of the state, the high price of zinc, the surplus of money in banks, and lack of other legitimate enterprise.

In Cripple Creek all the principal mines, with one or two exceptions, have found large bodies of good-grade ore in their deepest workings, from 1500 to 2000 feet.

The Portland is looking as well, or better, than at any time in its history. Large bodies of ore, running from 1½ to 3 oz. gold per ton have been opened up at 1800 feet.

The Vindicator and Golden Cycle are both shipping high-grade ore below 1600 ft. The Vindicator bought the mining claims of the Golden Cycle, an adjoining property, in March of this year, for $1,300,000, for which it gave notes for $35,000 each, payable every 30 days; instead of paying these notes monthly, it is paying one every week, and taking all the money out of the Golden Cycle mine. The company will pay its usual dividend of 3c. per share per quarter on the 25th of this month.

The Isabella company is working more than 50 sets of leases, besides doing considerable work on company account. This company also is in a better financial condition today than it has been for 7 or 8 years.

The Granite, formerly the Gold Coin, is sinking the main shaft below the 1200-ft. level, and shipping a good grade of ore. About two months ago this company bought the Dead Pine holdings, which was adjoining ground; an apex suit that had been started was settled by the purchase.

The old Independence is still pegging away, but not doing as well as it did in 1900, when in 30 days it produced over $600,000. The company is still paying dividends, however, most of which come from milling the old dump.

A new plant has been installed on the El Paso, and work has been started on the extension of the Roosevelt adit, the waste from which is hoisted through the El Paso shaft.

A 100-ton cyanide mill is being erected on the Jerry Johnson. The Cresson has produced over $1,000,000 in the past three months, from a pear-shaped cave or vug; this vug, being 23 ft. long, 13 ft. wide, and about 40 ft. high, is still shipping picture ore. This was probably the richest orebody of its size ever discovered at Cripple Creek. The vug was found on the 1200-ft. level and the vein has just been cut on the 1400, or 200 ft. below, where it shows good ore.

That the grade of the Cripple Creek output is improving is indicated by the reports of the mills and smelters, particularly of the Golden Cycle mill, which treats about 65% of the total ore shipped out of the district. Their statement shows the average value of the ore treated in 1913 to have been $16.25 per ton; in 1914, over $19 per ton; and for the first three months of this year, over $25 per ton, and last month this mill treated 29,000 tons of ore, averaging $48 per ton, amounting to $1,392,000, which is a record production for the plant. The total production of the district for March was about $2,000,000, details of which appeared in the *Press* of April 10.

HOUGHTON, MICHIGAN

MARCH COPPER OUTPUT.—SCALE OF OPERATIONS.—ISLE ROYALE AFFAIRS.—ANNUAL MEETINGS.—WHITE PINE.

The demand for Lake Superior copper appears to continue without any prospect of decrease. Production in March is estimated to have been at least 4,000,000 lb. more than in February. Homer A. Guck estimates the March output at over 20,000,000 lb. These figures approach the maximum production of the copper country. If the increase can be maintained, April should set a new record. This great yield is directly due to the European war. The mines and mills are doing their utmost to supply the demand. Some of the mills operated every day in March, including Sundays. The Centennial-Allouez mill worked five stamps every day. The Mass Consolidated mill is working three shifts. The Mohawk-Wolverine mill is working at full capacity. More men are being added to the working forces at the mines and mills, and wages have been raised. The wages of the men working on tribute at the Winona have recently been increased. Substantial advances have been made in the prices of nearly all the copper shares. People in the copper country are showing renewed interest in buying shares.

At the annual meeting of the Centennial Copper Co., the directors were re-elected with the exception of Quincy A. Shaw. He is succeeded by Walter L. Frost.——At the annual meeting of the White Pine Copper Co. the directors were re-elected with the exception of Quincy A. Shaw. He is succeeded by John M. Longyear.——At the annual meeting of the Cliff Mining Co. the directors were re-elected excepting Quincy Shaw and T. N. Perkins, who are succeeded by Randolph C. Grew and W. E. L. Dillaway.

In a recent letter to shareholders of the Isle Royale, Dana de Cordova criticizes the management. He also calls attention to the issue of an injunction enjoining the Calumet & Hecla from voting its shares, or employing proxies of other shareholders in election of directors for the Isle Royale, who are, or are intended by the C. & H. to be at the same time directors or officers of the C. & H. The shareholders are asked to consider whether they are being benefited by having their property tied up with managers having larger interests. Mr. Cordova asks whether the C. & H. management is more than a delusion. Michigan holders of Isle Royale shares do not agree with Mr. Cordova.

It is reported that the mill at the White Pine mine was tested last week. The first shipment of 'rock' from No. 3 shaft will be made before the end of April.

The Houghton Copper Co. will build a railroad-spur to its mine. It is stated that there are 10,000 tons of rock on the dumps at the mine. Arrangements have been made with the Calumet & Hecla to crush it.

Construction work at the new Isle Royale mill is being rushed. It probably will be June before the mill is in operation.

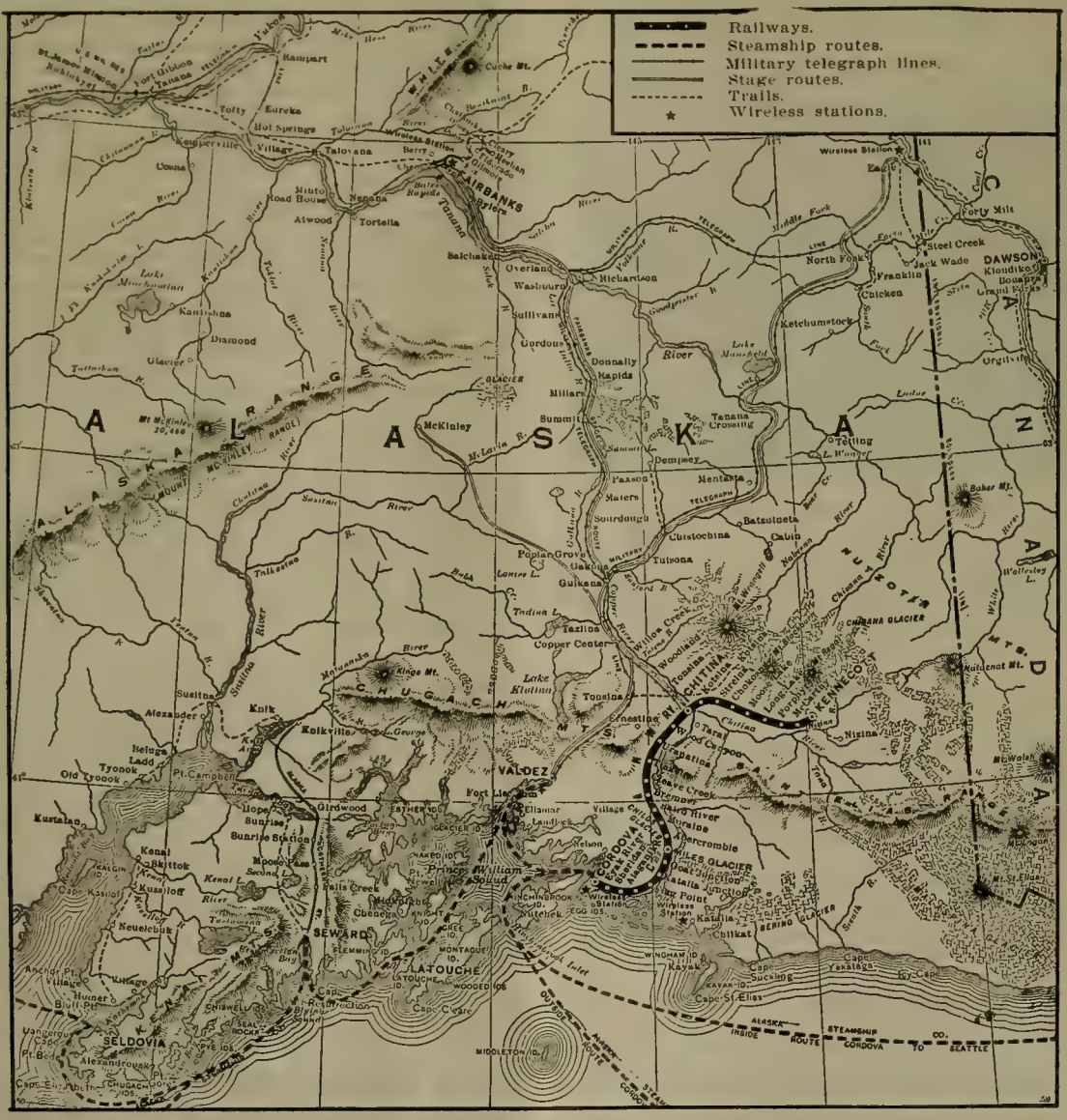
THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press.

ALASKA

The route of the United States Government railroad in Alaska was made public in Washington, D. C., on April 10, and the Department of the Interior made the following statement:

"Commencing at the town of Seward on the westerly shore of Resurrection bay, thence following along said westerly shore in a northerly direction to the head of said bay; thence following up the drainage of Salmon creek to a summit between said drainage and the drainage of Snow river; thence following the drainage of Snow river to Kenai lake; thence continuing northerly along the easterly shore of Kenai lake, along Falls creek, along the shores of Lower and Upper Trail lake and up Trail creek to a summit in the Kenai mountains near Mile 45 from Seward; thence descending along the drainage of Placer river to the head of Turnagain arm of Cook inlet; thence following the northeasterly shore of said Turnagain arm and crossing Portage creek and Twenty-mile river to the mouth of Kern creek, near Mile 71 from Seward; thence in a northwesterly direction along the shore of Turnagain arm to near the mouth of Big Rabbit creek; thence leaving Turnagain arm and running northerly to a 3 west, Seward meridian; thence running northeasterly to


Railways.
Steamship routes.
Military telegraph lines.
Stage routes.
Trails.
Wireless stations.
ALASKA RANGE
ALASKA
Mt. McKinley 20,466
McKinley
Summit
Tanana Crossing
FAIRBANKS
DAWSON
Klondike
Forty Mile
Steel Creek
Jack Wade
North Fork
Franklin
Chicken
Ketchumstock
Orgilvie
Eagle
Tanana
Rampart
Tolovana
Hot Springs
Eureka
Tofty
Minto
Nenana
Tortella
Atwood
Salchaket
Overland
Richardson
Washburn
Sullivan
Gordon
Donnally
Rapids
Millers
Glacier
Diamond
Kantishna
Lake Minchumina
Kuskokwim
Yukon
Tanana River
Middle Fork
Forks
Dempsey
Nenana
Paxson
Meiers
Sourdough
Gulkana
Tulsona
Poplar Grove
Oaklake
Batzulneta
Cabin
Chistochina
Tazlina
Copper Center
Lake Klutina
Willow Creek
Woodland
Tonsina
Chitina
Kotsina
Strelna
Chakina
Long Lake
Porphyry
Nizina
Chisana
Chisana Glacier
Nutzotin Mts.
Mt. Wrangell
Mt. Walsh
Mt. Sanford
Mt. Drum
Mt. Jarvis
Mt. Natazhat
Mt. Hayes
Mt. Deborah
Mt. Moffit
Mt. Hess
Mt. Geist
Mt. Fairweather
Mt. Wolverine
Mt. Kimball
Mt. Vancouver
Mt. Logan
Mt. Augusta
Mt. Blackburn

near the end of Knik arm of Cook inlet; thence running northerly across the flats at the head of said arm and crossing Knik and Matanuska rivers to a point about two miles north of the Matanuska river; thence running in a westerly and northwesterly direction, crossing the little Susitna river and following along the southwesterly slopes of Bald mountain to Willow creek, a tributary of the Susitna river; thence in a northerly direction following the drainage of the Susitna and Chulitna rivers to Broad pass, situated in the main Alaska range of mountains; thence crossing Broad pass and entering the drainage of the Nenana river; thence continuing northward, following the drainage of the Nenana river to the Tanana river; the total distance from Seward being 416 miles, more or less. Also, starting from a point on the above described line situated two miles, more or less, northerly from where said line crosses the Matanuska river, and thence running in an easterly direction, following the drainage of said Matanuska river and its tributaries, a distance of 38 miles, more or less, to the Matanuska coalfields."

The route includes the existing Alaska Northern line, which runs from Seward through the Kenai peninsula for a distance of 71 miles to Turnagain arm. This road will be purchased at a cost of $1,150,000. Construction will be carried on under contract, and is to start as soon as possible.

In one of the orders signed by the President, the Alaska Engineering Commission, of which W. C. Edes is chairman, was instructed to look after the health of the men at work, and to adopt a system of compensation for accidents similar to that in force on the Panama Canal. The proposed lines will cost about $26,800,000.

On April 1 the house of representatives of the territorial legislature recommended for passage Bill 48, submitted by the committee on mining and manufactures, an act supplementing the mining laws of the United States in their relation to Alaska. The new mining bill amends the Roden law, enacted by the first legislature, in regard to assessment work. It declares that assessment work shall be done on only one claim of an association group, where it is shown that such work is development and improvement of the entire group. The bill further cuts down the fees hitherto paid recorders, providing $1.50 fees for recording one claim, and 25c. for each additional claim named in the group. On March 29 Senator Charles A. Sulzer introduced in the upper house of the legislature a memorial asking Congress to establish a school of mines at Juneau, under the provisions of an act recently approved by President Wilson.

The Alaska Gastineau company is to construct another dam near Sheep creek to increase its supply of electric power. The first unit of the mill is described on page 612 of this issue.

ARIZONA

Gila County

The report of the Ray Consolidated company for 1914 shows that in the mine at Ray, Pinal county, development totaled 75,261 ft. Work in future will be at a decreased rate, as the mine is now well opened. Reserves are estimated at 74,765,789 tons averaging 2.214% copper. The smelter at Hayden, Gila county, produced metals worth $7,597,723. The net profit was $2,359,623. Dividends paid were $1,089,322.

In the well being put down near Roosevelt by the Tonto Basin Oil Co., a strong flow of gas has been encountered at 1000 ft. Oil is expected at any time.

The annual report of the Old Dominion company at Globe may be summarized as follows: All construction work started in 1912 was practically completed in 1914. Total yield of metals was copper 30,210,361 lb.; silver, 148,459 oz.; and gold, 3308 oz. The gross revenue was $2,674,205, and profit $978,509. Dividends paid were $445,500, against $810,000 in 1913. The surplus at the end of the year was $967,292, compared with $1,193,247 at the beginning.

CALIFORNIA

Amador County

A description of the dam built by the Kennedy company to store tailing from its mill appears in *Western Engineering* for April. The structure is known as a multiple-arched dam, and was designed by John S. Eastwood. It is 455 ft. long, 30 ft. high, contains 1233 cu. yd. of concrete, and up to the 50-ft. contour, the ultimate height, its capacity is over 16,000,000 cubic feet.

Calaveras County

At the Royal mine at Hodson ore extraction has been started and the mill is partly ready for treatment.

Eldorado County

The property of the Larkin Mining Co. is to be sold to the highest bidder to pay its indebtedness.

Kern County

Additional machinery is arriving at the Gold Peak mill and cyanide plant in the Caliente district to increase the output. A. T. Copley is in charge.

Modoc County

Little has been heard from the High Grade district for a considerable time, and interest is given the place by the Modoc Mines Co., which is to sink to 500 ft. and drive a drainage and transport adit to connect with the shaft. A hoist, compressor, aerial tramway, and mill are to be installed. N. E. Guyot is manager for the William Wrigley interests of Chicago.

Nevada County

An incline shaft sunk in 1870 has been found in the bed of Wolf creek, close to the Golden Center of Grass Valley mine. This probably accounts for the water flowing on the 500-ft. level of that mine, being fed by the creek. The old timbers in the shaft are well preserved.——In the suit of Giuseppi Damiano v. the Birchville Mining Co. for $25,000 damages, the jury, on April 8, awarded him $12,000. The plaintiff was injured in the company's mine on May 13, 1913.

Shasta County

A 100-ton fume-control plant using the Heslewood process is to be erected by the Balaklala Consolidated Copper Co. at Coram.——The Trinity Copper Co., whose property adjoins the Balaklala, has appointed Frank M. Leland, of the latter, as its general manager.——Ten men have been sent from Kennett by the Mammoth Copper Co. to its Spread Eagle mine, which has been closed since August, 1914.——The 10-stamp mill at the Uncle Sam mine was re-started last week after being shut down for two years.

Siskiyou County

(Special Correspondence.)—The Isabella Copper Co. has let a contract to Charles McCoy and B. Keyser for driving 100 ft. The management has planned extensive work for the summer. Emmett E. Rader is superintendent.——Good ore continues to show in the Commodore mine, on Barkhouse creek, recently taken under bond by H. J. Barton and associates of Oak Bar. It is probable a small mill will be erected soon.——Arrangements are being made for the re-opening of the King Solomon mine, near Cecilville, under new management.——Six stamps are dropping at the Conzetti mine, in the Cecilville district, and late developments have been encouraging. In the shaft a vein 11 ft. wide is being opened, and attention is also being paid to three other veins from 4 to 8 ft. wide. The ore being milled is said to yield over $40 per ton.——Rich gravel has been uncovered in the Freshour Bar property by Nelson Bros. of Gottville, operating under lease. At a depth of 62 ft. the channel has been exposed for a width of 150 ft., and has an approximate depth of five feet. Numerous small nuggets and coarse gold have been taken out, one nugget extracted soon after the strike being valued at $175. It is the first rich find made in the district this season,

and much interest is shown by owners of neighboring mines A. S. Calkins, of Etna Mills, is heavily interested.——Placer mining along Klamath, Scott and Salmon rivers, and their tributaries, is decidedly active this season, a result of late rains and deep snow in the mountains. An abundance of water for summer sluicing is indicated. All the large properties are operating full-handed. ——An option has been taken on the Sugar Hill mine by Charles E. Eberline, superintendent of the South Fork hydraulic mine at South Fork. Operations will commence within a few weeks. Work has been resumed at the South Fork with a full crew engaged.

Etna Mills, April 5.

COLORADO

Clear Creek County

Lessees in the Mendota mine are producing a good tonnage of zinc and lead ores, especially the former. The mill, operated by Stephens Bros., is yielding three tons of zinc and one ton of lead concentrate per day.——Bruce, Brandstetter, Hummer, De Masters, Mottshall, Harper-Nelson, and Convery-McClusky, individual leasing companies in the Capital mine, are all getting satisfactory returns.——Three feet of copper-gold-silver ore has been opened in the Waldorf in East Argentine. A 20-ton lot averaged about $81 per ton.——Steady work is under way at the Virginia City, Seven-thirty, Mineral Chief, Centennial, and Onondaga companies' properties.

Eagle County

The geology and ore deposits of Red Cliff are described by A. H. Means in the January issue of *Economic Geology*. Much attention has of late been given to the deposits of Leadville, particular interest being shown as regards the relation of fissure veins to blanket deposits in that district. At Red Cliff the conditions of deposition are similar to Leadville, and, as at Leadville, there are fissures and blanket deposits. At Red Cliff, however, it was possible to determine the relation of the fissure veins to the blanket deposits, and it is this point which is the item of principal interest in the following paper.

The Red Cliff or Battle Mountain district (altitude 8600 ft.) is situated in the southeastern part of this county, about 20 miles north-northwest of Leadville and 75 miles south of west from Denver. The district lies on the Pacific slope 12 miles northwest of Tennessee pass (altitude 10,229 ft.) on the continental divide, and comprises the towns of Red Cliff and Gilman, which have a combined population of about 400. Red Cliff is the railway station for both towns and is on the main line of the Denver & Rio Grande. The town of Red Cliff is situated in the bottom of Eagle River cañon, while Gilman lies on the shoulder of Battle mountain, 3½ miles distant.

During 1904 to 1912 Eagle county, of which Red Cliff is the principal district, produced 143,749 tons valued at $2,502,387. Previous to 1904 no exact statistics are available. During the '80s and '90s many properties were producing regularly, and the output before 1904 must have been larger than from 1904 to 1914.

The ore deposits of the district are confined to a relatively small area, the largest part of which lies in the cañon of the Eagle river between Red Cliff and Gilman, a distance of about 3½ miles. The deposits may be divided as follows: (1) fissure veins in the granite carrying principally gold and silver with some copper, lead, and zinc; (2) replacements in the quartzite consisting of zinc-blende and galena bodies, also narrow veins carrying gold and silver; and (3) replacements in the limestone comprising large bodies of zinc-blende and considerable deposits of chalcopyrite and pyrite. In the oxidized zone a little carbonate of zinc is mined.

The Bleak House mine is at present entirely in the quartzite, and consists of an adit which is in 900 ft. along the strike of the vein to the end-line of the property. The point of great interest in this mine is the continuation of a fissure vein from the granite into the overlying quartzite, the dip changing sharply from 55° northeast in the granite to vertical in the quartzite. The Rocky Point, Ground-Hog, and Champion mines have extensive workings. The Rocky Point is situated on the side of the cañon in the quartzite, while its workings penetrate into and under the Iron Mask, which is in the overlying limestone. The Ground-Hog and Champion are about three-quarters of a mile south of the Rocky Point, though in the same horizon as the latter. Another deposit of considerable interest, situated in the quartzite just a short distance south of the Ground-Hog, is known as the Black Iron. This property could not be visited because the entrance is badly caved and on that account a first-hand description cannot be given. The most important mine in the camp, the Iron Mask, is in the limestone, together with other properties of lesser importance. It has been operated steadily for about five years, producing in the neighborhood of 100 tons of ore per day. The ore is raised along a single-track incline to the surface and is then carried to the mill in the bottom of the cañon by an aerial tram. The mill, somewhat enlarged from its original capacity, now treats about 100 tons per 24 hours. The treatment consists of roasting in shaft furnaces, followed by magnetic separation and wet concentration by tables. The ore mined on the Iron Mask property is principally zinc-blende, which occurs in a gangue of recrystallized dolomitic limestone. The ore is accompanied by galena, pyrite, and, to a less extent, chalcopyrite. The next mine of importance in the limestone is the Belden, the deposits being similar to the Iron Mask.

VIEW OF EAGLE RIVER CAÑON, RED CLIFF, COLORADO.

The origin of the deposits may be briefly summed up as follows. First theory: (1) The deposits in the limestone were derived from the overlying porphyry, the minerals being carried into the limestone and replacing it through the agency of the magmatic solutions exuded from the porphyry. (2) The deposits of the 'quartzite ore horizon' in the quartzite are due to the reaction of the ascending magmatic waters with descending waters which resulted in general deposition and zone of sericitic alteration. (3) The fissure veins in the granite owe their ore to ascending alkaline solutions, which upon entering the quartzite deposit rich ore. They are later than the blanket deposits. Second theory: (1) Both limestone and quartzite orebodies are the result of one period of mineralization. The ore-bearing solutions ascended from depth, deposited at the quartzite ore horizon due to the peculiar favorability of this horizon to precipitation. They then continued upward without further deposition till the porphyry was reached, this later acted as an impermeable barrier and caused further precipitation; and (2) the fissure vein de-

posits resulted from the precipitation by ascending alkaline solutions, which upon entering the quartzite deposited rich ore. They are later than the blanket orebodies.

LAKE COUNTY (LEADVILLE)

The long expected pumps for the Penrose shaft of the Down Town scheme have arrived, and their installation is under way. Repairs to the shaft timber are complete.——The zinc smelter is almost ready to resume.——Two large oreshoots have been opened in the St. Louis adit in the Big Evans district. The Third Venture Mining Co. has this property under lease in charge of Fred Johnson. On No. 1, 2, and 4 levels $30 to $40 ore is now being mined. Fourteen men are employed.

SAN JUAN COUNTY

It is reported that the Garfield Smelting Co. has leased the Silver Lake mill to E. W. Waybright and others for use as a custom plant. An oil-flotation process is to be installed which will increase the recovery.——Operators of the Ledge, Gold King, Sunnyside, and Frisco mines are busy.

IDAHO

SHOSHONE COUNTY (COEUR D'ALENE)

The report of the Federal Mining & Smelting Co. for 1914 shows that 21,091 tons of ore was shipped to smelters, and 389,450 tons was treated in the local mills. The former averaged 34% lead. The concentrate shipped totaled 35,967 tons, and with the crude ore averaged 44.67% lead and 16.01 oz. silver per ton. There was also shipped 4200 tons of zinc ore assaying 44.61% metal. On account of the metal market the Morning mine at Mullan was closed for some months, while the properties at Wardner were curtailed. This resulted in development only amounting to 7256 ft., against 16,224 ft. in 1913. Ore reserves in the various mines total 988,450 of milling and 48,640 tons of shipping ore, a slight decrease. Dividends paid amounted to $5 per share on the preferred shares, totaling $599,305. A contract has been made with the Montana Power Co. to supply electricity, which will save about $50,000 per year.

At 900 ft. the east drift of the Hypotheek has been extended 320 ft. The face shows 24 in. of galena, also some carbonate ore. On the 700-ft. level the shoot is 532 ft. long.——It is probable that the Frisco mill will re-start in a week or so. The new process includes water concentration, flotation, and magnetic separation.

MISSOURI

FRANKLIN COUNTY

A modern 10-stamp mill and cyanide plant is to be erected by E. B. Whitworth and his brothers on their claims near Catawissa. The ore is low-grade.

JASPER COUNTY

Activity throughout the Missouri-Kansas-Oklahoma district has been halted somewhat by reason of the declining market, and a good many operators are marking time so far as new developments are concerned. The weather continued bad during the week ended April 4, however, but it is thought that with the arrival of good weather there will be a decided increase in production.

MONTANA

BEAVERHEAD COUNTY

It is reported that Salt Lake City and Butte people have acquired the old Golden Leaf mines at Bannack. The price paid was about $200,000. A large tonnage of ore is ready for treatment, and a mill is to be erected.

MADISON COUNTY

Options are being secured on certain gravel areas near Twin Bridges. In 1914 a Californian syndicate did some drilling there, but stopped after a few weeks' work.

SILVERBOW COUNTY

The North Butte company is operating at about 70% normal capacity. Cross-cutting is under way at 3000 ft. from the Granite Mountain shaft to cut the Edith May vein. At 2800 ft. this vein shows high-grade ore.——The report of Paul Gow, superintendent of the Pilot-Butte mine, shows that development in 1914 amounted to 2642 ft. The Pilot shaft was sunk from 2090 to 2420 ft. Stations were also cut. The middle vein at 2200 ft. was opened for 275 ft., 75 ft. of which was high-grade zinc ore from 2 to 8 ft. wide. At 2400 ft. this shoot assays 15% zinc and 4 oz. silver per ton. In sinking the shaft the bornite vein was discovered in cutting the station at 2400 ft. It is from 8 to 10 ft. wide, the shoot being from 2 to 7 ft., and averages 5% copper and 5 oz. silver. At 2400 ft. the Gow vein was opened for 210 ft., and 110 ft. on the 2200-ft. level. The Glance vein has been opened for 130 ft. at 2200 feet.

Work has been resumed at the East Butte mine, which has been closed since last August. The mill started on April 15, and the smelter will be blown-in on April 20. About 500 men will be employed. Oscar Rohn is general manager. The monthly output will be about 1,250,000 lb. of copper. During the shut-down the plant was overhauled.

Silverbow county had a population of 72,500 people on March 1, 1915.

NEVADA

ESMERALDA COUNTY

It is reported that litigation over apex rights at Goldfield may be settled at an early date.

The annual report of the Atlanta Mines Co. shows that operations in the last year cost $86,937. Of this, $13,000 was the cost of new pumping equipment. Development was practically confined to the 1750-ft. level. The Goldfield Consolidated has leased the south half of the Grizzly Bear claim, below 1400 ft., to the Atlanta company; this is a satisfactory arrangement.

The report of the Pioneer Consolidated Mines Co., operating 50 miles south of Goldfield, for 1914 shows that 8000 tons of $6 ore was treated by 10 stamps, a 6-ft. Huntington mill, and cyanide plant. Total costs were $2.68 per ton. Most of the ore came from the Bonanza stope and the 250-ft. level. It is proposed to treat the slime which is being stored.

HUMBOLDT COUNTY

Rich gold ore has been discovered in the Honey Bee claim of the Finland property in Finland cañon, 9 miles northeast of Lovelock. The owners are Y. M. Ward, H. E. Downey, and A. Beneditti. A rush has commenced.

NYE COUNTY (TONOPAH AND MANHATTAN)

Eight mines at Tonopah produced 10,913 tons of ore valued at $222,394 during the week ended April 10.——Development in the Tonopah Mining Co.'s claims totaled 503 ft., mostly in the Sand Grass.——The Extension shipped $65,725 worth of silver, concentrate (35 tons assaying $300 per ton), and slag.——At 700 ft. in the Wandering Boy claim of the Jim Butler 8 to 12 ft. of good ore is being broken-down.——Stoping at 1230 ft. in the Merger is yielding $60 ore.——The Belmont company reports as follows for the quarter ended February 28: revenue from products, $666,474; net income, $324,942; dividend on April 1, 187,500; resources, $1,425,440.

At Manhattan, Mushett and Wittenberg have ordered a crusher large enough to break sufficient ore to keep the tube-mill in continuous operation. A revolving trommel will be installed in place of the grizzlies now used to separate the oversize from the fine material that is treated. Cost of open-cut mining and the simple milling process is only about 45c. per ton.——High-grade ore has been cut by Pace and Yerick in a quartz lease of the Merger company——It is rumored that the Big Four is to resume work.——The Rakestraw lease of the Nevada Mining & Development Co. has started producing ore.

PERSONAL

James F. Kemp is expected at Butte.

J. E. Bamberger is in San Francisco.

W. H Emmons was at Butte last week.

R. J. Grant, of Denver, is in New Mexico.

Herbert E. Colliran has returned to Denver

L. C. Trent, of Los Angeles, called at this office.

John S. Colliran is expected from Korea on May 3.

John T. Glidden, of the Cerro de Pasco, is at Boston.

Charles Butters will soon return from Cobalt, Ontario.

A. Stanley Elmore is on a visit to New York, from London.

R. A. F. Penrose, Jr., was at Denver early in the month.

Charles T. Kirk is inspecting mines at Kelly, New Mexico.

David Keith, of Salt Lake City, was in San Francisco during the week.

R. D. Salisbury has been at Butte in connection with mining litigation.

A. R. Weigall sailed from London for Japan, by way of Suez, on April 10.

Norman C. Stines is expected in San Francisco shortly, to spend the summer.

Llewellyn Humphreys passed through San Francisco on his way to Plumas county.

R. C. Sticht has been elected president of the Australasian Institute of Mining Engineers.

Philip Argall sails from New York by the *Adriatic* on April 21 on his way to London.

George D. James, of Napa, California, is at Auburn, Placer county, on professional business.

K. C. Parrish is returning to the United States for a holiday after two years in Colombia.

J. T. Dixon has been detailed to make an inspection of the Crown Mines, at Johannesburg.

William Spence Black is now superintendent of the Mobile mine in the Goodsprings district, Nevada.

Robert T. Hill is making a survey of southern California, under contract with the U. S. Geological Survey.

E. C. Morse is in charge of the mill at the Valperazo mine at Dolomi on Prince of Wales Island, in southeastern Alaska.

Elwood Mead, who has been director of irrigation in Victoria, Australia, has resigned, and is returning to fill a position in the United States.

J. S. Douglas, Walter Douglas, Charles Sumner Smith, and Waldo Smith were at Globe recently to make a formal inspection of the Old Dominion mine.

W. P. Hammon, Newton Cleaveland, George L. Huntress, J. B. Thomas, R. E. Paine, and O. W. Smith have been visiting the dredges of the Yuba Consolidated Gold Fields company in Yuba county.

J. F. Mitchell-Roberts has resigned his position as chief engineer to the Wilfley Mining Machinery Co. of London, to take up private work. He will be absent from London for about nine months.

John Palmer Cosgro, formerly general manager in Mexico for the Mine & Smelter Supply Co., has accepted a position as chief engineer and general manager of sales, for the Wilfley Machinery Co. in London.

William J. Ninness, for eight years head mining captain of the Mass Consolidated Mining Co., was found unconscious in a skip at the 11th level of B shaft at eight o'clock on the morning of March 30. Captain Ninness had a fractured skull and died at noon without any explanation of the accident. He started underground in a skip with a new drilling-machine, which he intended to test. It is believed that he fainted and fell into the bottom of the deep skip in such a way as to fracture his skull.

Spelter Prices in 1914-1915

Spelter production and prices are the subject of a U. S. Geological Survey bulletin prepared by C. E. Siebenthal. The unprecedented and spectacular rise in the price of this metal in January and February of 1915 has caused the statistical position of spelter to be examined as never before. Stocks and great demands for export served to augment the deep interest in the metal. The production of primary spelter increased from 346,676 to 353,049 tons. The consumption was

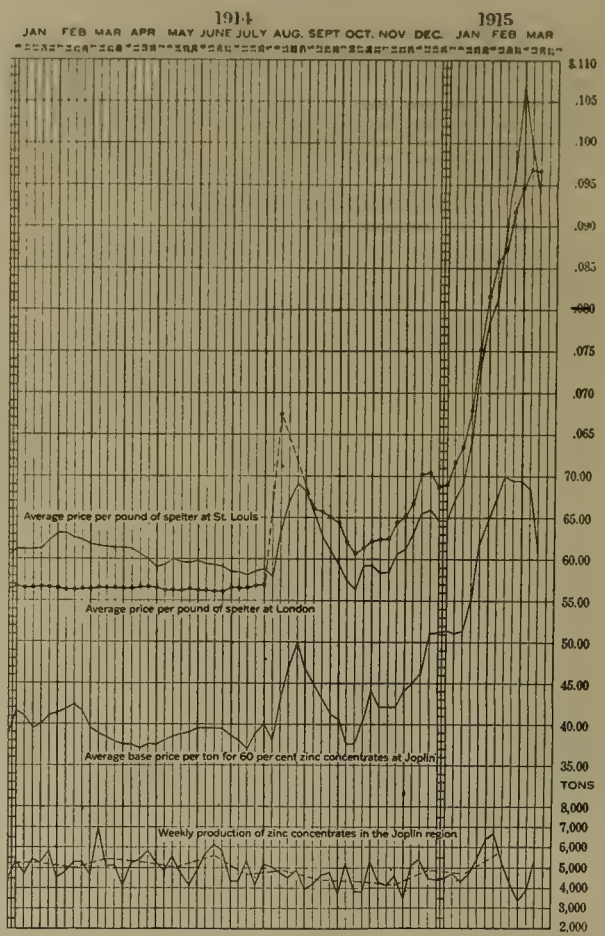


DIAGRAM SHOWING AVERAGE WEEKLY PRICE OF SPELTER AT LONDON AND ST. LOUIS; OF 60% ZINC CONCENTRATE AT JOPLIN; AND WEEKLY PRODUCTION (SALES) OF ZINC CONCENTRATE IN THE JOPLIN REGION IN 1914-1915. THE BROKEN LINE SHOWS THE WEEKLY SALES, AVERAGED BY MONTHS.

299,130 tons, compared with 295,370 tons. Production of secondary metal decreased from 53,748 to 46,415 tons. Owing to the great exports of spelter, and the domestic consumption, it is probable that the demand in 1915 will amount to 594,000 tons. This, however, is not the maximum possible quantity to be required. Taking all sources of supply into consideration, if the United States is called upon to supply say 600,000 tons, the metal will be probably at hand without increasing the mine production above normal, to contribute nearly 560,000 tons of this quantity. The remainder can be produced easily from domestic sources. It is possible that high prices may so limit domestic consumption as partly to offset the advantage gained from the increased foreign demand.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, April 15.

Antimony	25 —25¾
Electrolytic copper	16½—16¾
Pig lead	4.40—5.40
Quicksilver (flask)	$80.00
Spelter	10¾—11
Tin	15 —16½
Zinc-dust, 100-kg. zinc-lined cases	15

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, April 15. Copper is strong and advancing, lead quiet, and spelter firmer.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.		Average week ending	
Apr.	8 50.25	Mch. 3	49.02
"	9 50.12	" 10	49.81
"	10 50.12	" 17	51.18
"	11 Sunday	" 24	50.33
"	12 50.12	" 31	50.14
"	13 49.87	Apr. 7	50.04
"	14 49.87	" 14	50.06

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	....
Feb.	57.53	48.45	Aug.	54.35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	....	Oct.	51.12	....
May	58.21	....	Nov.	49.12	....
June	56.43	....	Dec.	49.27	....

While the silver market is steady, there is little tendency to go higher. India is not supporting the market much. Exports from London to the East up to March 25 amounted to £1,480,500. In that period of 1914 the value was £1,677,000; China and the Continent have given a little strength. On April 10 about 350,000 oz. left San Francisco for the Orient. The Nipissing company is shipping a good deal of metal to New York instead of London. This is the result of increased insurance rates on bullion across the Atlantic. The Calumet & Hecla and Quincy copper refineries forwarded 36,568 and 13,868 oz. respectively to New York last week.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date		Average week ending	
Apr.	8 4.20	Mch. 3	3.87
"	9 4.20	" 10	3.95
"	10 4.20	" 17	4.01
"	11 Sunday	" 24	4.15
"	12 4.20	" 31	4.15
"	13 4.20	Apr. 7	4.23
"	14 4.20	" 14	4.20

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	....
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	....	Oct.	3.60	....
May	3.90	....	Nov.	3.68	....
June	3.90	....	Dec.	3.80	....

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	....
Feb.	39.76	37.23	Aug.	50.20	....
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	....	Oct.	30.40	....
May	33.29	....	Nov.	33.51	....
June	30.72	....	Dec.	33.60	....

Prices in New York on April 15 varied from 50 to 60c. per pound. The Vulcan Detinning Co. reports sales amounting to $195,009 for the first quarter of 1915. The profit was $26,658. Business showed a fair increase, due to an improved market. During its financial year ended February 28, the Cornwall Tailings Co., England, made a profit of £8000, against £16,900 in the previous period. From 143,216 tons of tailing 432 tons of black tin was recovered.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Apr.	8 15.85	Mch. 3	14.38
"	9 15.85	" 10	14.50
"	10 15.95	" 17	14.59
"	11 Sunday	" 24	14.90
"	12 16.05	" 31	15.37
"	13 16.20	Apr. 7	15.75
"	14 16.30	" 14	16.03

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	....
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	....	Oct.	11.10	....
May	13.97	....	Nov.	11.75	....
June	13.60	....	Dec.	12.75	....

Exports of copper during the week ended March 27 totaled 22,503,362 lb. Of this, England took 6,102,769; France, 3,767,021; Italy, 6,571,652; Sweden, 4,822,991; and Norway, 770,585 lb. From August to February inclusive, the total exported was 369,073,376 lb., against 556,968,115 lb. in that period of the previous years.

According to a consular report from Santiago bids for sheet copper for government railways close on April 24.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Mch. 17	80.00	Mch. 31	80.00
" 24	80.00	Apr. 7	80.00
		" 14	80.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60.00	Aug.	80.00	....
Mch.	39.00	78.00	Sept.	76.25	....
Apr.	38.90	....	Oct.	53.00	....
May	39.00	....	Nov.	55.00	....
June	38.60	....	Dec.	53.10	....

The quicksilver market is dull. Some sales have been made at $80 per flask. One New York concern quotes $65. London reports £12, or $57.60.

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
Apr.	8 9.00	Mch. 3	9.05
"	9 9.00	" 10	8.00
"	10 9.00	" 17	7.92
"	11 Sunday	" 24	8.59
"	12 9.25	" 31	8.50
"	13 9.25	Apr. 7	8.75
"	14 9.25	" 14	9.12

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	5.22	9.05	Aug.	4.46	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	....	Oct.	4.75	....
May	4.91	....	Nov.	5.01	....
June	4.84	....	Dec.	5.40	....

On the previous page of this issue is a chart prepared by the U. S. Geological Survey showing spelter prices to March 20, 1915. The output of metal in 1914 was 353,049 tons. Domestic consumption was 299,130 tons. Exports totaled 64,029 tons of domestic production. Stocks at December 31, 1914, amounted to 20,095 tons. Exports in January and February, 1915, were 30,597,854 and 29,203,018 lb. respectively.

COMPANY REPORTS

MYSORE GOLD MINING CO., LTD.

This Company operates at Kolar, state of Mysore, India, and the report of the superintendent, R. H. P. Bullen, covers the year 1914. With plans it occupies 78 pages, and contains many interesting notes, as follows:

There were 167 Europeans, 111 Anglo-Indians, and 8992 Indians employed during the period. Development down to 3226 ft. amounted to 26,249 ft., a decrease of 1082 ft. compared with that in 1913, due to power shortage in March to June. Total rainfall was 17.66 in. The average number of machine-drills working was 94.8 per month. Ore reserves are estimated at 1,014,000 tons, also 250,000 tons of low-grade material which will eventually be milled. Work in McTaggart's and the southern part of Ribblesdale's sections of the mine was mostly in low-grade ore. In the north part of the latter area, rich quartz was opened on No. 13 level, and a winze below the level was sunk 312 ft. on ore 5 ft. 6 in. wide, assaying 2 oz. 17.9 dwt. per ton. No. 14 levels north and south were driven from the winze to open this shoot, and exposed 127 ft. worth over 2 oz. for 4 ft. 9 in. width.

The stamp-mill crushed 304,375 tons of ore averaging $14.75 per ton. Waste sorted out amounted to 61,250 tons, or 16.75% of the tonnage sent to the sorting floors. By amalgamation there was 81.22% saved. Tailing leached totaled 261,734 tons assaying $2.63 per ton, consuming 0.44 lb. cyanide and 0.07 lb. zinc per ton treated. A 500-ton slime plant started in October, and slime treated in this and the test plant totaled 44,874 tons, averaging $2.60 per ton, using 0.69 lb. cyanide and 0.16 lb. zinc per ton. The total output was 212,381 oz. fine gold.

The gold yield was valued at £899,498. Royalty to the Mysore government amounted to £54,049. The total expenditure in India and London was £363,245, and profit £488,859. Dividends amounted to £213,500. The balance from 1913 was £176,885, and carried forward to 1915, £150,729. Costs were 16.64c. per ton lower than in 1913.

GOLDFIELD CONSOLIDATED MINES COMPANY

The report of this well known company for the year ended December 31, 1914, contains a great deal of interesting information, and items of cost and other data will be abstracted for other issues of this journal. Briefly, the year resulted as follows:

The property produced 338,192 tons of ore, of which 332,750 tons of an average gross value of $12.57 was milled, and 5442 tons of $29.01 was shipped. The gross value of this tonnage was $4,340,786. Deducting metallurgical losses, smelter discounts, and the cost of ore purchased, a total of $414,438, the sum realized amounted to $3,926,348. The expenses, including mining, milling, transportation, construction, taxation, and general expenses were $2,091,124, leaving a net realization from operation of $1,835,224.

The total operating expenses were reduced from $6.34 to $6.02 per ton, a difference of 32c., and the net operating expenses from $6.28 to $5.91, a decrease of 37c. per ton. This result would be satisfactory if a uniform reduction in costs had appeared in all the individual items, but an analysis of the figures shows increases in some of the costs and decreases in others. Increases are noted in stoping, milling, dump moving, and general expense; while decreases appear in development, total mining, concentrate treatment, total milling, and freight and treatment on ore shipped. The increased cost of stoping, 10c. per ton, is undoubtedly due to the larger proportion of ore obtained from re-working old stopes. During the last month of the year stoping was commenced in three new blocks of solid ground, which should aid in checking this tendency to increase during the coming year. Milling costs rose slightly during the summer when a larger percentage of dump ore was being treated. It was not so easy to treat as ore fresh from the mine, due to its poor settling qualities. The larger percentage of dump ore handled automatically increased the cost per ton as applied to the total production, though the actual cost for moving was much lower.

The increase of 6c. per ton for general expense was made up of a number of comparatively small items, which in the aggregate total a little more than $17,000. The cost of development work, 30,028 ft., at $7.32 per foot, was lower than for the preceding year, and this, coupled with the smaller amount done, served to reduce the total mining cost 9½c. per ton.

One dividend was paid within the year, at the rate of 30c. per share, aggregating $1,067,744. A further dividend at the rate of 15c. per share was declared within the year, and was paid in February, 1915.

At the commencement of the year the company had cash in bank amounting to $1,074,372. At the close of the year, after paying operating expenses and one dividend, the company's cash balance amounted to $655,703, with bullion and miscellaneous products settlements outstanding of $203,123. In June, 1914, the company acquired 592,000 shares, equal to 87% of the issued shares of the Aurora Consolidated Mines Co., at a cost of $763,011.

Total construction costs for the year were $94,659, of which $91,672 was expended for equipment for the re-handling of mill tailing. The gross production of the mine to date is 2,111,054 tons of ore, of an average value of $30.15, and a total gross value of $63,658,089. Of this production, $11,200,000 was made by lessees in the early days, and $2,700,000 was made by the constituent companies, prior to their acquisition by this company. The gross production by the company itself has been approximately $50,000,000. To date the company has paid dividends amounting to $27,398,215, or $7.70 per share.

Ore reserves are estimated as follows: milling, 141,500 tons; and shipping, 500 tons. This apparently shows a slight increase, $6000 tons, in the measurable ore reserves; but the increase is probably more apparent than real. While the method of estimating used was substantially the same as for the preceding year, the stoping experience for the past year has shown that in nearly every instance a larger tonnage has been mined from each block than it had been estimated to contain, and that, therefore, the ore reserves a year ago were underestimated. Therefore, less allowance has been made in the present estimate for the discovery of barren spots and the estimate is believed to be more accurate than the preceding one. The well-known irregularity which characterizes the distribution of the gold in the orebodies renders it impossible to estimate the value per ton of the developed ore. During the last two months of the year, however, discoveries of high-grade ore were made which render it certain that the ore reserves now in sight have a better average value per ton than those at the beginning of the year.

The mines of the company produced the following ore:

	Tons.	Average.
Mohawk	180,511	$12.37
Combination	43,496	14.81
Jumbo-Clermont	31,179	14.59
Laguna	38,201	13.37
Jumbo No. 2	2,164	18.35
Dumps	31,471	7.18
Contractors	5,728	12.95
Total	332,750	$12.57

The Jumbo-Clermont produced 5442 tons of shipping ore, containing $120,616 in gold and silver, and $37,282 in copper, an average of $29.01 per ton.

BOOK REVIEWS

MINING WORLD INDEX OF CURRENT LITERATURE. Vol. VI, for second half of 1914. By George E. Sisley. P. 234, with author's index of 10 pages, and subject index of 5 pages. Mining World Co., Chicago, 1914. For sale by the *Mining and Scientific Press*. Price, $2.

This useful compilation appears so regularly that it needs no introduction or comment. Under the headings of geology and mineralogy, metals and metal ores, non-metals, mines and mining, mills and milling, chemistry and assaying, metallurgy, power and machinery, and miscellaneous, the articles appearing in about 350 technical journals throughout the world have been carefully indexed, making the publication of value to editors, libraries, and those who desire to keep records of such information.

CENTRIFUGAL PUMPS. By R. L. Daugherty. P. 187. Ill., Index. McGraw-Hill Book Co., Inc., New York. For sale by the *Mining and Scientific Press*. Price, $2.

The introduction of the steam-turbine and the electric motor has reduced the cost of operation of centrifugal pumps and widened the field of their use. One result of this has been that the practical development of the centrifugal pump has outstripped the literature on the subject. The present volume will tend to remedy this condition. After describing the general features of centrifugal pumps, both of the turbine and volute type, the general theory of the entire subject is developed. Characteristic curves are then discussed, also the general question of pump efficiency. Two short chapters are devoted to a comparison of centrifugal and displacement pumps, and to a contrast between the various types of the former. The contents of the remainder of the book is best described by the chapter headings: Pump Testing, Costs, Rotary and Screw Pumps, Applications of Centrifugal Pumps, Design of a Centrifugal Pump. Problems are given at the end of most of the chapters and an appendix contains review questions. The book is well illustrated and there are a number of charts.

HEATING AND VENTILATING BUILDINGS. By Rolla C. Carpenter. P. 583. Ill., index. John Wiley & Sons, Inc., New York. For sale by the *Mining and Scientific Press*. Price, $3.50.

This is the sixth edition of a useful treatise. Few departments of engineering have more to do with the health and comfort of the general public than the heating and ventilation of buildings. The first five chapters deal with the theoretical basis for the consideration of the subject. Pipe and fittings used in heating systems are next discussed, and then radiators and heating surfaces. Following this, boilers and hot-water heaters are considered, space being devoted to the different types of boilers in use, together with their accessories and the methods of setting them. Next in order come steam-heating systems of both the gravity and the pump-return type. Then hot-water and hot-air systems are discussed. The subject of mechanical ventilators leads to that of hot-blast heating. A short chapter is devoted to electric heating, and one to thermostats and other temperature-regulating devices. A chapter is given to the heating and ventilating of special kinds of buildings, schools, factories, etc. Specifications and the general commercial aspects of the subject are then considered. The final chapter deals with the 'conditioning' of air, both for the removal of dust and for securing the correct proportion of humidity. The appendix contains a list of references and a number of tables, including the general mathematical tables to be found in most text-books as well as others especially valuable in heating and ventilating work.

RECENT PUBLICATIONS

GROUND WATER IN SOUTHEASTERN NEVADA. By Everett Carpenter. *Water-Supply Paper* 365. P. 86. Ill., maps, index. U. S. Geological Survey, Washington, D. C., 1915.

PULP CONSTANTS. By G. H. Clevenger, H. W. Young, and T. N. Turner. P. 16. Ill. Reprint from the *Mining Journal*. A thorough investigation into specific gravities of solutions and pulps.

PROCEDURE FOR ESTABLISHING A LIST OF PERMISSIBLE PORTABLE ELECTRIC MINE LAMPS. P. 13. U. S. Bureau of Mines, Washington, 1915. Contains details of fees, character of tests, and conditions under which lamps will be tested.

PLAN of Kirkland Lake and Sesekinika gold areas, showing the properties of Ogilvie and McKinnon. Townships of Teck, Lebel, Otto, and Boston, district of Temiskaming, Ontario, Canada. 27 by 33 in. Scale, 40 chains to 1 inch.

SPECULATION ON THE STOCK EXCHANGES AND PUBLIC REGULATION OF THE EXCHANGES. An address before the American Economic Association at Princeton, New Jersey, December 29, 1914, by Samuel Untermeyer of New York. P. 48.

ORE DEPOSITS OF NORTHEASTERN OREGON. By Arthur M. Swartley. Vol. I, No. 8, *The Mineral Resources of Oregon*. P. 229. 98 illustrations. Corvallis, Oregon. December, 1914. An abstract of this paper was published in the *Press* of February 27.

THE TOM REED-GOLD ROAD MINING DISTRICT, MOHAVE COUNTY, ARIZONA. Map and details of certain operating companies. Published by the Tom Reed-Gold Road Association, Los Angeles, California. A review of this publication appeared in the *Press* of April 3.

ZINC AND LEAD HANDBOOK. By L. L. Wittich. P. 60. Map. Published by the *Joplin News Herald*, Missouri, 1915. This is a useful compilation which should be in the hands of all zinc and lead miners and dealers. The booklet was reviewed in the *Press* of April 3.

University of California publications, Berkeley, 1915:

THE COMPREHENSIVE STRENGTHS OF PORTLAND CEMENT MORTARS OF VARIOUS PROPORTIONS. By Arthur C. Alvarez. P. 4. Chart.

SOME PHYSICAL PROPERTIES OF MAGNESIAN CEMENT MORTARS AND CONCRETES. By Arthur C. Alvarez. P. 44. 5 plates.

THE CONSULTING METALLURGIST AND METALLURGICAL INVESTIGATIONS. By W. B. Blyth. P. 38. Illustrated. Abstract from *Bulletin* of the Australasian Institute of Mining Engineers. Melbourne, Victoria. This paper is of considerable value to metallurgists, as showing the errors they are liable to get into. In the *Press* of April 3 an abstract was made from this paper on the subject of flotation of gold ores.

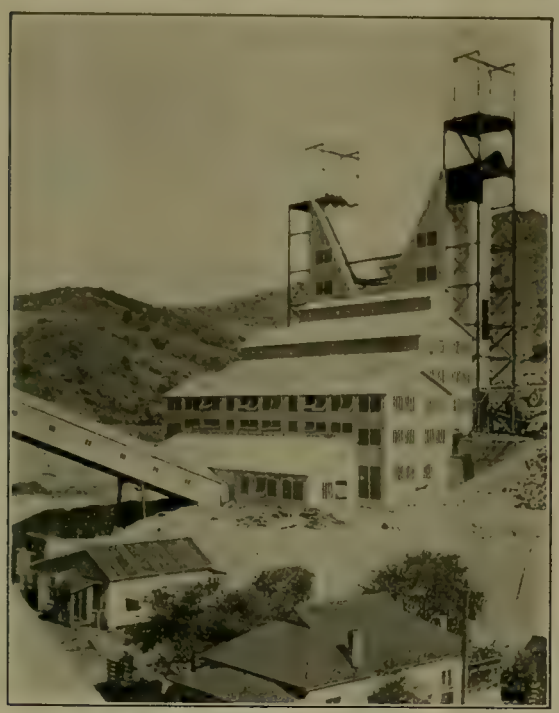
ESTADISTICA MINERA DE CHILE EN 1910. Compiled by Don Guillermo Yunge. P. 466 and numerous maps. Santiago de Chile, 1913. A detailed account of the republic of Chile and its mineral production. It also contains several papers on copper, including one on the Chuquicamata deposits, which will be translated for the *Press*.——ALSO ANUARIO ESTADISTICA DE LA REPUBLICA DE CHILE. 1913. Vol. VII. Mines and Metallurgy. The mineral output in 1913 was valued at ₱364,126,550, of which nitrates accounted for ₱325,970,081.

New Machines and Devices

Information based on letters and catalogues from manufacturers, and staff observations.

Hoisting 10,000 Tons in 14 Hours

At the Inspiration Consolidated copper mine, Miami, Arizona, a concentrating plant to treat 10,000 tons per 24 hours is nearing completion. To hoist this quantity of ore some



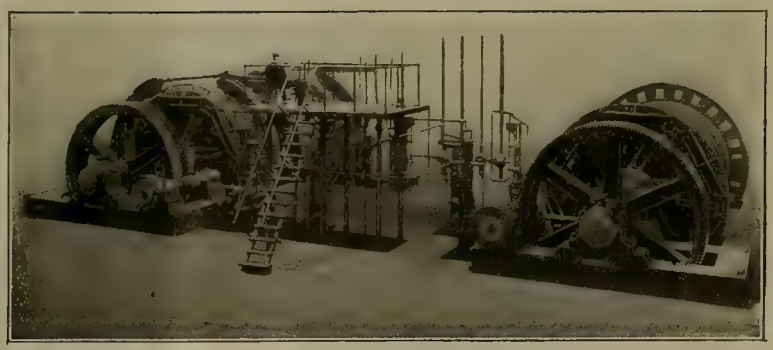
TWIN SHAFTS AND HOIST-HOUSE AT THE INSPIRATION COPPER MINE, MIAMI, ARIZONA.

massive machinery is necessary. The engineers of the Nordberg Manufacturing Co., Milwaukee, Wisconsin, and the General Electric Co. of Schenectady, New York, have succeeded in designing an electric machine capable of hoisting 10,000 tons in 14 hours, with capacity for overload up to 14,000 tons in that time. The machinery has been installed at the mine, and the following notes should give an idea of the system employed.

As will be seen from the first half-tone, there are two shafts at the mine close together, an arrangement well known on the Rand, and, becoming more generally used. This and other conditions being favorable, it was decided to arrange two hoists in one building and operate them automatically. The hoists can be started up for an all-day run by closing a pilot-switch. Each hoist will then start, run, stop, and rest automatically. The two hoists make alternate trips, one hoist running while the other is loading and dumping. By opening auxiliary pilot-switches the rope-speed may be decreased, in order to reduce the number of trips per hour at times when the output of ore is low. Ordinarily, one hoist begins to accelerate just before the other hoist finishes a trip. However, in case the output increases above normal, another pilot-switch can be closed; this will cause each hoist to begin its trip considerably before the other hoist has finished a trip, obtaining thereby a greater number of trips per hour than normal. Skips which weigh 12,000 lb., and carry 24,000 lb., are to be loaded automatically in the mine.

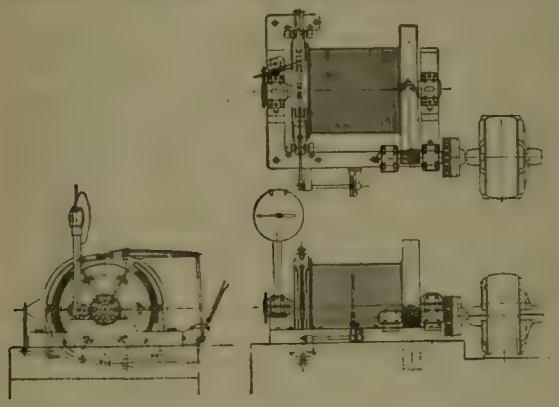
In order that the automatic control mechanism may not be a cause of delay or confusion in case it becomes necessary, on account of conditions inside the mine, to depart entirely from the automatic schedule of operation, all details have been worked out so as to provide that certain features of the control can be instantly disconnected at any time. Either hoist can then be controlled by an operator in the ordinary manner. The throw-over from automatic to hand operation and the reverse, is accomplished entirely by throwing levers, and does not require any readjustment of mechanism. The means whereby, in automatic operation, the hoist is retarded to rest and the brakes applied at the end of the trip, is also effective when operating by hand-control providing, thereby, complete over-wind protection.

Although the problem of designing the control seemed formidable at first, due to the necessity of providing so many different rates of automatic operation, and providing for a simple and safe transition from automatic to hand operation, and the reverse, a thorough study of the conditions resulted in a relatively simple and compact equipment. The advantage gained by the use of the automatic control mechanism is that, considering all conditions, four operators per day, two per shift, can be dispensed with. As the hoist-house, sub-station, and compressor-house are under the same roof, the starting and stopping of the automatic operation of the hoists, inspection, occasional operation by hand control, and in fact all attendance on the hoists can be taken care of by the operating force required for the sub-station and compressors. The hoists have two drums 10-ft. diameter by 65-in. face for 1000 ft. of 1¾-in. rope. The load consists of rope, 4850 lb.; skip, 12,000 lb.; and ore, 24,000 lb., making the rope pull 40,850 lb. They will work in balance with a normal rope speed of 750 ft. per minute. Each hoist is driven by one 580-hp. direct-current shunt-wound hoist motor, coupled to the pinion shaft of the hoist, and driving the drums through a single reduction of



SIDE VIEW OF THE TWIN HOISTS.

Falk gears. Each hoist-motor is operated from a separate generator by means of generator-voltage control, as is the usual practice for large direct-current hoists. The two generators are driven from a single induction-motor and flywheel,



END AND FRONT VIEW AND PLAN OF HOISTS.

comprising a three-unit set with exciter overhung at one end, and flywheel arranged outboard at the other end. Power is obtained from the Roosevelt dam of the U. S. Reclamation Service.

Concentrators at the Exposition

In the Palace of Mines and Metallurgy at the Exposition the Senn Concentrator Co. has a working exhibit in its amalgamator, concentrator, belt concentrator, batea, and table machine. All of these have the characteristic pan motion. At a later date a pulp will be used on the machines to show their actual action.

Pulleys at the Exposition

One of the features at the American Pulley Co.'s exhibit in the Palace of Machinery at the Exposition is the demonstration which shows the perfect balance of all 'American' pulleys. A 72-in. diameter by 36-in. face, triple-arm, steel-split American pulley, weighing approximately 1500 lb., is turned with perfect ease with a thread of the thinnest silk. The American pulley is so built that the spider arms give the greatest strength with minimum air resistance. A new device called an 'efficiency indicator' (patent pending), measuring accurately to 3/1000 of a horse-power, shows the exact amount of power required to revolve any pulley.

Commercial Paragraphs

The WITTE IRON WORKS CO., of Kansas City, Missouri, has changed its name to WITTE ENGINE WORKS, but remains under the same ownership and management, Ed. H. Witte controlling the firm.

A large number of safety lamps with automatic lighting device, made by the KOEHLER MANUFACTURING CO., Marlboro, Massachusetts, is being exhibited in the 'mine' at the Panama-Pacific Exposition.

Adjustable quick-discharge 5 by 16-ft. tube-mills have recently been sold by CHALMERS & WILLIAMS, INC., of Chicago Heights, Illinois, to the Cusi Mining Co., Chihuahua, Mexico, and the Standard Silver-Lead Mining Co., British Columbia.

The GOLDMAN PROCESS CO., of St. Louis, Missouri, sends a pamphlet on water-treating process. Impurities in water are a source of trouble in steam-boilers, resulting in scale, pitting, and loss of efficiency. The Goldman company claims to have a simple and cheap method to minimize such troubles, which are common on mines and railroads.

The 500-hp. Diesel engine of the BUSCH-SULZER BROS.-DIESEL ENGINE CO., in the centre of the Palace of Machinery, at the Exposition, will be opened up for inspection of visiting engineers from 9 a.m. to 5:30 p.m. every Monday, so that they may see the enclosed working parts which cannot be seen while the engine is in operation.

The LAGONDA MANUFACTURING CO., of Springfield, Ohio, has just published a booklet entitled, 'Lagonda Boiler Room Specialties.' It describes and illustrates the firm's several types of boiler-tube cleaners, with latest improvements, and boiler quick repair tools. It also deals with the automatic cut-off valve and multiple strainers made. A copy may be hand on request.

JOHN H. BANKS, formerly of the firm of Ricketts & Banks, announces that he is at 61 Broadway, New York. Facilities for ore testing on a practical scale continue as heretofore, the equipment for analytical and assay work having been installed with reference to ores, fuels, and metallurgical products, and the laboratory staff selected for ability and experience in this class of work.

The WESTERN ELECTRIC CO.'S business in 1914 resulted as follows: sales, $66,408,484 ($77,532,860); net earnings after paying fixed charges, reserve for contingencies, etc., $2,670,960 ($3,171,695); dividends, $1,500,000 ($1,500,000); and surplus, $1,170,960 ($1,671,695). Figures in parentheses are for 1913. Orders on hand at January 1, 1915, were $4,309,000 in value less than on January 1, 1904. The number of employees at January 1, 1915, was 15,650, compared with 19,856 at January 1, 1914.

The introduction of the OLIVER FILTER into the Coeur d'Alene district of Idaho for dewatering flotation concentrate is creating considerable interest among the millmen of that state. The Oliver filter installed at the Gold Hunter mill, near Mullan, is reducing the lead flotation concentrate to an average of 6½% moisture, and has so far exceeded expectation that Oliver filters have recently been ordered by the Bunker Hill & Sullivan Co. at Kellogg, Hercules Mining Co. at Burke, and the Consolidated Interstate Mining Co. at Wallace. In addition to these four filters for the Coeur d'Alene district the Inspiration Consolidated Copper Co. of Miami, Arizona, is installing four Oliver filters with a total capacity of 1000 tons per day, and the Anaconda Copper company is adding five additional Oliver filter units to the three units which have been in operation there for the past year. The Oliver filters at the Anaconda plant are 11 ft. 6 in. diameter by 12-ft. face, and have an average capacity of 330 tons each per day.

The GENERAL ELECTRIC CO., of Schenectady, New York, announces that practically all the sizes and types of Edison mazda multiple lamps are affected by reductions in list prices that were put into effect April 1, 1915, by its Edison Lamp Works. On the regular straight side and round bulb lamps, from the 10 to the 250-watt sizes, also on sign lamps, stereopticon lamps, etc., the reductions range from 3 to 20c. per lamp, according to size. These reductions, which average about 10% will tend to popularize further already popular lamps. The new concentrated filament vacuum lamps of 25, 40, and 60-watt sizes now list at only 5c. per lamp more than the regular lamps of corresponding sizes. On the gas-filled multiple lamp of 100 to 1000-watt sizes, the reductions range from 50c. to $1 per lamp, the average reductions being between 20 and 25%. The introduction of gas-filled lamps has been exceptionally rapid. Over 1,000,000 are already in use. The decreased cost of these lamps will undoubtedly result in a still more rapid replacement of vacuum lamps by the more efficient gas-filled units.

Mining and Scientific Press

Edited by T. A. RICKARD

Volume 110 SAN FRANCISCO, APRIL 24, 1915 Number 17

HYDRAULIC MINING is one of the most impressive applications of water-power. By means of it large deposits of low-grade gravel are exploited profitably. See the article on Atlin in this issue.

THE

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Clamp is Adjustable to Fit any Drill Column or can be Bolted to Timber

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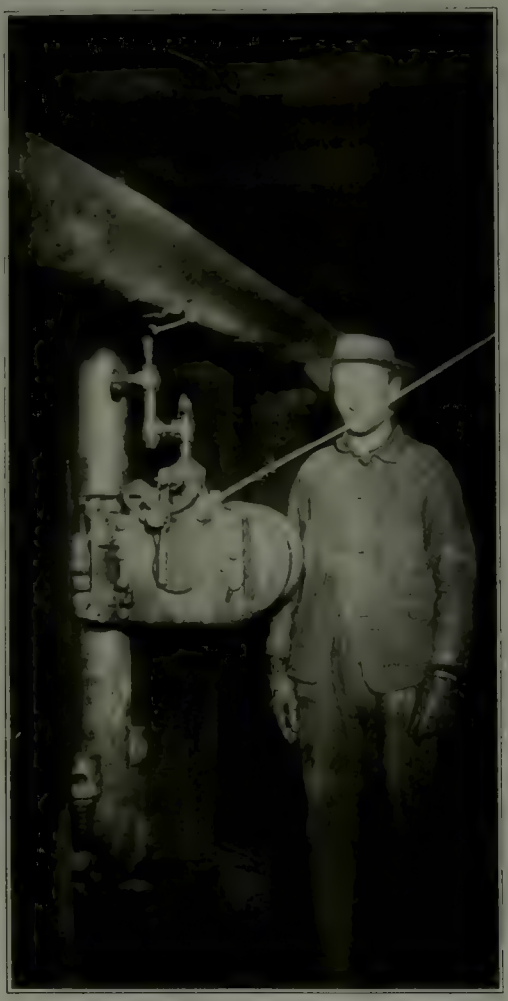

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Pulls 750 Pounds

Holds 500 Feet of Rope

Engine is Reversible

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All Joints Ground

No Stuffing Boxes

Gears are All Enclosed

Powerful Brake Lined with Raybestos

This is a real hoist—built right. It has been tried out in every conceivable kind of service. It is a money saver and you cannot afford to be without one.

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SAN FRANCISCO, APRIL 24, 1915

Buyers Directory - Page 30
Advertisers Index - Last Page

TABLE OF CONTENTS

EDITORIAL

Page.

Notes 637
Copper 638
Alaska's Great Goldfield 638
On the Threshold 639
Courtesy in Discussion 640

DISCUSSION

LIFE AND PROPERTY IN MEXICO.
By Americanus 641

An operator, in the light of his own experiences, endorses our editorial comment.

ASSAY OF ORE CONTAINING METALLICS.
By George C. McIntyre 641

Details of the method followed at the Omaha plant of the American Smelting & Refining Company.

AMALGAMATION IN HARDINGE MILLS.
By K. C. Parrish 641

Mr. Parrish wishes to know what the results of amalgamation in cyanide solution would be.

'ROCK' OR 'ORE.'
By Homer Arago Guck and W. A. Hopper 642

Pro and con, with notes by the Editor.

A SUGGESTION.
By F. Sommer Schmidt 643

An engineer suggests that discourtesy adds no force to criticism.

ARTICLES

THE HUMAN SIDE OF MINING.
By James F. Kemp 644

Mining engineers, more than other men, need to be versatile. Technology too often ignores the call of humanitarianism. Professor Kemp thinks that universities might well have a professor of life.

HYDRAULIC MINING AT ATLIN.
By A. D. Hughes 647

The average depth of the deposits worked is 60 ft. Water is available under a head of 140 ft.; eight monitors are in use, three of them employed for stacking the tailing. The most economical size of pit is 30,000 cu. yd. The working season averages 180 days; in this time 175,000 cu. yd. is excavated. The working cost ranges from 12c. per yard in No. 1 pit to 20c. in No. 2, where clay gives trouble and decreases the daily yardage.

Page.

THE ANACONDA EXHIBIT.
By E. S. Bardwell 654

All the activities of the Anaconda Copper Mining Co. are well exemplified by its exhibit in the Mines Palace of the Panama-Pacific International Exposition.

LEACHING OF COPPER ORES BY THE HOFFMAN PROCESS.
By Frederick J. Pope 655

The problem of the leaching of the oxidized copper ores at Ajo, Arizona, has been studied by F. J. Pope and A. W. Hahn, who have devised a process in which the iron is removed from the solution before electrodeposition of the copper is attempted.

A TEMPORARY ZINC-BOX.
By A. W. Allen 657

An engineer describes the method he pursued at a South American gold mine when the permanent equipment failed to arrive in time.

SOCIOLOGICAL WORK BY THE PHELPS-DODGE COMPANIES 658

Records of the results attained during 1914 in conserving the health and welfare of the employees of this great organization.

DEPARTMENTS

CONCENTRATES 659
REVIEW OF MINING: Special correspondence from Kalgoorlie, Western Australia; Boston; Toronto, Ontario; Cripple Creek, Colorado; New York 660
THE MINING SUMMARY 664
PERSONAL 668
SCHOOLS AND SOCIETIES 668
THE MARKET PLACE:
Metal Prices 669
BOOK REVIEWS 670
'Petroleum Industry of California,' by R. P. McLaughlin.
MINING DECISIONS 670
COMPANY REPORTS 671
American Telephone and Telegraph Company; North Star Mines Company; Iron Silver Mining Company.
NEW MACHINES AND DEVICES:
Conveying, Elevating, Screening, and Mechanical Power Transmission Machinery at the Exposition 672
Commercial Paragraphs 672

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Motor Agencies in all Large Cities and Towns. 5475

EDITORIAL

T. A. RICKARD - - - - Editor
THOMAS T. READ - Associate Editor

OVER-SUBSCRIPTION of the Alaska Juneau issue indicates that money is readily available for sound mining enterprise.

FROM the Southwest we hear of young men outfitting parties for mineral exploration. This is a fresh sign of renewed mining activity, and it is one of the best.

PROSPERITY among the farmers is a better omen of expansion in business than a favorable trade-balance. When both point the same way, the future is assured.

ONLY 1% of the Mexican people is engaged in warfare. It is incorrect to assume that the continued disturbance is due to an unslaked popular desire for constitutional reform.

HUERTA gave the press a description of the kind of patriotic hero that Mexico needs at this juncture. We infer that he was facing a mirror at the time he spoke to the reporters.

MEXICO has had 8 presidents since Diaz. The average is higher than that of the 50 years preceding Don Porfirio; during that half-century the change of régime averaged once per annum.

THE invitation to a conference on Pan-American finance has been well received, and a representative gathering at Washington next month is assured. Extension of banking facilities must precede any increase of commercial intercourse between the Americas.

LEADVILLE is profiting from the high price of zinc, due largely to a curtailment of Australian production. Among new developments, we note the employment of electric pumps for the unwatering of the Down Town district, as the first step to a resumption of exploratory work below the old workings, which reach to 760 feet.

ILLUSTRATIONS showing the outside of mill and smelter buildings are common in technical papers. Indeed, such photographs of exteriors are often the only ones available at the time of publication. Usually, however, they have no value whatever, even from a decorative point of view. It is the machinery inside, not the box, that is of importance.

STEAMERS of large tonnage and first-class equipment are soon to ply between New York and San Francisco, through the Canal. In May the *Kroonland* and *Finland,* formerly of the Holland-America line, are to be employed in this service. As they are each of 22,000 tons displacement, they will ensure space and comfort. When conditions in Europe return to the normal, we may expect the establishment of a similar passenger traffic between San Francisco and Liverpool, London, Cherbourg, or Hamburg.

OUR New York correspondent refers to the Minerals Separation *v.* Miami suit now being tried at Wilmington. Behind the Miami Copper Company stand a number of the other big copper-producing companies. Hence the decision is awaited with keen interest.

COLORADO gives signs of a certain liveliness in mining, but accurate news is scanty. Time was when this state was well advertised by resident engineers, who wrote articles in the technical press concerning its mineral resources and industrial progress. We shall be glad to hear from our friends at Denver, Central City, Leadville, and Cripple Creek.

DISSOLUTION of the Amalgamated Copper Company is pending. The details of the plan to effect the change are likely to be announced shortly. Another case of unscrambling the eggs that have lost their savor. This dissolution may seem intended primarily to allay public distrust, but it is more likely to be merely a step taken to promote convenience in business.

SHANTUNG is already beginning to be of value to its Japanese captors. According to the *Japan Times* the iron ore deposits near Ching-ling-chen, in that province, have been investigated and 30,000,000 tons of ore containing 65% iron is estimated. The mines are only five miles from the railway. A Japanese company will proceed at once to exploit them to supply the Japanese Government iron-works, at Wakamatsu, which now derive their supply of ore from Hupei and Korea.

FROM a newspaper published in one of the belligerent countries of Europe we note that the service of geologists is recommended in warfare. It is argued that scientific advice regarding the nature of the soil and rock is necessary to the proper emplacement of guns and trenches. Perhaps it is, but we sympathize with the geologist, who lives in a world far detached from human strife, in a world of silent forces working during periods so vast that the worries and anxieties of this fleeting present seem inconsequent. That ought to be one of the advantages of being a geologist.

KAOLIN is a mineral of much economic importance, since it forms the basis of the ceramic industry, the handmaiden both of domestic utility and of fine arts. The name is based upon a misconception. Early

travelers in China asked the natives from what material they made their porcelain, and were told that it came from *kao-ling*—a high ridge. *Kao* should be pronounced 'gow'; both the spelling and pronunciation have therefore undergone metamorphic action in the process of absorption into the English language. As to the origin of the material itself, there have lately arisen two schools of opinion. The older concept is that it is a product of the weathering of feldspars. About ten years ago Rösler advanced the theory that it is rather the product of pneumatolytic processes. This met with strong opposition, and Stremme was able to prove that the large deposits at Meissen are the product of weathering. Experiments made by Lemberg, and later confirmed by Thugutt, show that when solutions of potassium and sodium salts are allowed to act on kaolin at temperatures between 100° and 200°C., the kaolin is converted into silicates resembling sodalite, nephelite, and analcite. The logical conclusion is that kaolin could not be formed in mineral deposits originating at temperatures above 100°, such hydrous silicates as sericite being the normal product. In this country Mr. Waldemar Lindgren is a vigorous supporter of the weathering theory, and in a recent number of *Economic Geology* he has set forth the reasons for the faith that is in him. The burden of proof seems to be on the shoulders of the advocates of the pneumatolytic theory.

Copper

In one of his delightful books Stewart Edward makes the epigrammatic observation that the surest way to success in any enterprise is through the elimination of the obvious. It is reported in New York that the producers of copper are endeavoring to prevent the price of that metal from going above 18 cents per pound in the next few months. At first sight this seems irrational, but by eliminating the obvious it becomes evident that this is a wise course of action to pursue. The present demand for brass and copper in the manufacture of ammunition is a purely temporary phenomenon, and at the end of the War, which may come at any time, copper consumption will probably be sub-normal, at least until the work of repairing war's destruction gets into full swing. On the other hand, a considerable addition to copper production is about to be made. The Chile Copper Company, operating the famous mines at Chuquicamata, expects to have its plant operating within a few months, turning out copper at the rate of 500,000 pounds per day, at a cost that, it is estimated, will permit its delivery in Europe for 6 cents per pound. The Inspiration Copper Company has its plant nearly ready to begin production; before long the Anaconda will increase its output greatly by the aid of its new flotation and leaching plants; the Utah Copper is about to increase its production by leaching the oxidized ore removed in mining the sulphide orebody; the Calumet & Hecla plans to treat its old tailing by concentration and leaching; and numerous smaller companies are prepared to increase their output. If the delivery of this new copper on the metal market should coincide with a period of abnormally high prices a violent collapse of the market might ensue. The best interest of everybody concerned seems to be served by maintaining a price for copper not much above normal, lest it be followed by a price much below normal. Stability is essential to industrial success.

Alaska's Great Goldfield

The big-scale exploitation of the schist range on the mainland behind Juneau has reached an interesting stage. The Alaska Gold Mines, the company now controlling the old Perseverance mine and its extension toward Sheep creek, has begun production, crushing 1800 tons per day. The plant already erected can crush 10,000 tons per day, so that its ultimate capacity is estimated at 3,500,000 tons per annum. As to yield, the original report by Messrs. D. C. Jackling and A. F. Holden gave $1.50 as the recovery and 75 cents as the cost, indicating a profit of 75 cents per ton. Later forecasts of $1 profit per ton have appeared in the circulars of Hayden, Stone & Co., the promoters of this interesting enterprise, but we are not aware of any confirmation of the higher figure by the engineers. Of the two sponsors, Albert F. Holden died two years ago, so that Mr. Jackling is now the principal factor in the technical administration. Not many mining engineers have had a career so productive of big and useful work. His success in low-grade big-scale copper mining has given him just the mental grasp that was needed for this work in Alaska, where he has applied many of the mechanical methods of ore reduction evolved in the exploitation of the disseminated chalcocite deposits of Utah and Arizona. But gold deposits differ from the chalcocite enrichments in one important particular: they are more sporadic as regards the distribution of metal; they are more difficult to sample; and therefore involve a larger factor of uncertainty. Despite the systematic development and testing in progress during the last two or three years, the work done by Mr. J. R. Mitchell, formerly superintendent of the Perseverance mine, constitutes the most reliable evidence in regard to the grade of the ore. He stoped the lode for a width of 70 feet and a length of 900 feet during a period of 6 years, supplying a 100-stamp mill with material that yielded $1.50 per ton, at an operating or local cost of 90 cents per ton. An enormous extent of development work has been done since then, not only in the Perseverance mine, but in its neighbors westward, the Alaska Juneau and the Ebner. Nevertheless even today the average grade of the output to be obtained when operating on a bigger scale remains the one uncertain factor. As to cost, there is no doubt. The experience at Treadwell, on the adjoining island of Douglas, together with several years of actual operation on the Juneau side, suffices to assure a total cost of 80 cents per ton, on a basis of 6000 tons daily. In regard to metallurgical extraction also there

is no uncertainty, for the gold-bearing quartz is eminently docile, yielding over 90 per cent of its precious content readily. The grade, of course, depends upon the character of the lode and the system of mining required to extract its valuable portions.

In the Perseverance ground the lode-channel is more nearly uniform as regards the distribution of quartz, which, it may be noted, is roughly proportional to the gold in the ore. The more quartz the lode contains, the more gold it will yield. Clean quartz usually assays about $6 per ton in gold. In the Juneau the lode-channel widens to 900 feet; it consists of a belt or sheer-zone of slate between a foot-wall of greenstone and a hanging wall of schist. The lode-channel is traversed by dikes of meta-gabbro and by stringers of quartz, irregularly distributed, with a tendency to form wide bands of ore, separated by waste, so that selective mining is imperative. A 50-stamp mill has been in operation for a year, crushing about 1000 tons daily, and proving that the ore, after some underground sorting, can be made to yield an average of nearly $2 per ton. The cautious character of this statement reflects the fact that the evidence does not, as yet, warrant definite assertions. The Ebner is an old enterprise that was re-organized in 1913 preparatory to an arrangement whereby the United States Smelting, Refining & Mining Exploration Company undertook to explore the property systematically, finding the money for the work on condition that it became a first lien on the assets. Moreover, the exploration company agreed to find the additional capital required for further development and equipment if the exploratory work showed $15,000,000 in ore. Since then this company, under the direction of Mr. Sidney J. Jennings, has tested the ground and has come to the conclusion that while large reserves of ore have been proved, they do not justify the formation of a new company on the terms set forth in the re-organization plan of 1913. More than 8000 feet of underground work has been done, the sampling of which has given assays "varying from a trace up to $13.71," as stated in a circular recently issued. Inexperienced persons may assume that the average lies half-way between 0 and 13.71, but, of course, it does not. In such statements the truth inclines at a high angle from the upper limit; it merely means that the yield varies so widely as to render it dangerous to assert an average. It is stated, however, that while no such reserve as $15,000,000 has been uncovered, the ore assured is "many times in excess of the indebtedness" to the exploration company. This indebtedness amounts to $408,921, of which $162,590 represents liens and other obligations incurred during the earlier period of disorganization. We understand that the committee of bondholders, headed by Mr. E. R. Chapman, of New York, is prepared to liquidate existing debts and proceed with the development of the enterprise on a big scale. Meanwhile the exploration company has forced a foreclosure sale, to the terms of which the bondholders are offering opposition. Concurrently the Alaska Juneau company has issued 400,000 shares, out of 500,000 now in the treasury, at $10 per share, making a total issued capital of $14,000,000. It is estimated, by Messrs. F. W. Bradley and John H. Mackenzie, that, by the aid of the plant to be built with the proceeds of this additional capital, the profit from the mine will be $1,400,000 per annum. We understand that the profit is estimated at the rate of 70 cents to $1 per ton, indicating a tonnage of 1,500,000 to 2,000,000 annually. Thus the three mines, covering 4 miles of lode, from Gold creek to Sheep creek, west to east, will be crushing 5,000,000 tons at an early date. This tonnage should be doubled ere long. As the three companies constituting the Treadwell group, on Douglas island, are crushing 1,600,000 tons per annum, to be increased to 2,000,000 tons, the total output of this gold-field tributary to Juneau will be about 12,000,000 in tons of ore and $25,000,000 in gold produced. This means the creation of a local industry that will bring southeastern Alaska into the front rank of the mining world. It will have another effect, to which we attach considerable importance: the increase of population and the enhancement of interest in this part of the Coast will incite intelligent exploration throughout the Alaskan schist range, rendering probable the discovery of other deposits suitable for profitable operations.

On the Threshold

In this issue we publish the larger part of an address delivered by Mr. James F. Kemp, professor of geology in the Columbia School of Mines, to the graduating class in the Michigan College of Mines. Our friend's admonitions must have been received with keen interest by the young fellows in the Copper Country, and they will be read also with pleasure by many of the older fellows in other parts of the world. We need such reminders of the human side of the mining industry and of the profession that ministers to that industry. An engineer must be a real man if he is to make good, not merely a specialized machine for collecting the shekels. A professor must be a friend, as well as an instructor, to his students. Both engineer and professor must have post-graduated in the philosophy of Life, besides acquiring those sundry suffixes that mark unusual proficiency in the arts and sciences. We like to picture the scene of that address at Houghton. The speaker made mention of more than one 'Life and Letters.' We commend young men—and those that desire to remain young in spirit—to read such biographies and autobiographies. Therein, more than in any other form of literature, is given the experience of the individual and the philosophy of living. Experience unfortunately is not cumulative; but it should be suggestive, at least. Even as an education in science, it is well to read the records of the old worthies in order to understand the successive steps by which fundamental concepts and accepted theories were evolved. But the larger lesson, undoubtedly, is that emphasized by Mr. Kemp. We agree with him in rejecting the half-truth that men are machines. That

notion is one of the weak points in most schemes of technical training. It is also a mistake made by many industrial organizations. In peace, as in war, discipline is necessary, but not at the entire expense of initiative. In professional work the personal equation continues to be the incalculable, yet dominating, factor. To know things is important; to know men is more important.

Mr. Kemp referred to the welfare movement, whereby a systematic effort is being made to improve the conditions under which employees live as well as work. The fact is becoming more fully recognized that while the workman physically is a machine, he is not merely a muscular device capable of a given number of foot-pounds of energy. To the mechanical must be added a psychical factor. As Pascal said long ago, "Man may be only a reed, but he is a thinking reed," not an automaton. Therefore any young man expecting to be in charge of laborers, whether in mines or smelters, will do well to study human nature on the job, as it were, so that he and they together may become an efficient economic unit.

Incidentally, we can say to graduates on the threshold of a career, that personal acquaintance with those engaged in their profession is tremendously useful. It is well for a young man to cultivate a large acquaintance, out of which in due time will come to him the opportunity to play his part. Whatever is done in this world is done in the last resort not by machines but by men. It is well to be interested in other people, to be willing to be helpful generally. Co-operation is a characteristic of civilization. The man that plays a lone hand has a poor time in the game of life. This is one of the first lessons to be learnt by the young man fresh from college. We lay stress upon it, so that the habit may be acquired while it can be applied to the greatest effect. For the rest, it remains only to second the admonitions of all true friends of youth and say for the *n*th time that "man does not live by bread alone." The collection of shekels gives luxury and power, it affords exhilaration in the pursuit, but usually proves a Dead Sea apple in the capture, unless it be accompanied by the development of the man's other and higher faculties. In the end, a happy marriage, a few friends, good health, a competence, and some purpose honorably achieved are the desiderata amid this flux of phenomena we call Life.

Courtesy in Discussion

A correspondent writes making a protest against, what seems to him, the frequent lack of courtesy shown by engineers when engaging in printed controversy. We hope he exaggerates, for, if his criticism is to be taken at its face value, it reflects upon the editors as well. The latter are under obligation to defend any contributor from anything verging upon impertinence or insult. The pages of a respectable technical journal invite the exchange of ideas only on the assumption that any discussion is to be conducted in a spirit of decorum and kindly feeling. Whenever a contributor transgresses the canons of good taste and gentlemanly conduct, it behooves the editor to refuse him admittance, as it were, so that those of gentler mental bearing may not suffer from his gaucheries. However, anything of this kind is extremely rare, so that disciplinary interposition is correspondingly infrequent. We publish the letter from Mr. Sommer Schmidt rather as a suggestive warning, as indicating that a detached onlooker has formed an unpleasant impression, which we deprecate.

This is not the first time that the amenities of printed controversy have formed the subject of discussion. It is not easy to be both penetrating *and* polite. The free thrust of trenchant wit and the outspoken disagreement of personal opinion occasionally entail clashes of a kind likely to trespass on the good temper of a disputant. Fortunately, in America more than anywhere else, independence of opinion and directness of statement are no social crimes. It may be that with the ampler play of personality there is a danger of over-stepping the line that divides frankness from rudeness. The only rule is to put yourself in the other fellow's place. Another is to recognize that the purpose of science is to elicit the truth, neither illuminating nor scorching the truth-seeker. Indeed, it is light without excessive heat that needs to be generated. And it can be done so as to promote the good of all.

As is stated in the sub-heading of our Discussion department, considered criticism is better than casual compliment. Indeed, the greatest compliment to a writer is not an unctuous Amen but a discriminating criticism likely to further the purpose with which the original article was written. Not infrequently a contribution of a modest or even of a fragmentary character will elicit such comment and supplementary information as eventually to render it more useful than the more pretentious essay or monograph. Furthermore, the reader of a technical paper like ours may occasionally see an error of fact or inference in an article. It is the editor's duty to guard against such blunders, but it is human to err and it is divine to forgive. And the best way to forgive is to rectify. This can be done effectively by writing promptly, correcting the mistake, and adding a little supplementary information, as a sugar coating to the pill. We are confident that the Discussion department of this paper, for example, serves a most useful purpose. By affording an opportunity for men at a distance from each other to exchange ideas, compare experience, and to make mental acquaintance, it promotes the solidarity of the profession. We are aware also that many engineers are willing to send a contribution to discussion when they are too busy to write complete articles or too diffident even to try to do so. We hope they will give way to the occasional impulse to correct an unwitting mistake, counter an opinion with which their knowledge disaccords, or to emphasize the fruitful idea of a fellow-practitioner. And it can all be done with the spirit and manner that makes friends, even of those that are controverted. Therefore, we invite the profession to use our columns as a clearing-house of ideas and experience.

DISCUSSION

Readers of the Mining and Scientific Press are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this Journal.

Life and Property in Mexico

The Editor:

Sir—Referring to your editorial on this subject in your issue of April 10, my own experience in that country, covering nearly six years, fully endorses your point of view.

The present factions do not represent any real policy in government, and they have no respect for life or property. Mining property that I owned in the southern part of Mexico has been inaccessible for three years and a half. Nevertheless at the start I continued to pay taxes. The taxes were then doubled. The fighting faction in this particular region also demanded taxes, and also doubled them. Private intimations were then given to me by the *de facto* Government that paying taxes to rebels was giving them support: fines and worse trouble might result. Similar instructions were received from the rebels, who said that paying taxes to a wicked usurping and unconstitutional government was a crime, etc. As in no case was any guarantee or protection afforded, and it was impossible to work the mines, I abandoned the property.

Several friends of mine have had similar experiences. Truly one is between the devil and the deep sea, when if you don't pay your taxes the property is lost, and if you do pay, you pay double to two different governments and then get into trouble for paying.

AMERICANUS.

San Francisco, April 13.

Assay of Ore Containing Metallics

The Editor:

Sir—In your issue of October 24, 1914, in the 'Concentrates' column, you had an article, with illustrations, on a method of figuring metallics contained in samples for assay, which I read with interest.

This seems to be a subject of great annoyance to a number of men and boys doing assaying work, and the method published by you was a great help to many, I have no doubt. Being interested in this subject, I am wondering whether or not the method used here in the assay-office of the Omaha plant of the American Smelting & Refining Co. would be of interest. It has been used for seventeen years, to my knowledge, and I think it will be found shorter than any other.

The main point of the method lies in the fact that 10 assay-tons of the sample must be taken, bucked down, and all its metallics must be reduced to find the total amount of silver and gold contained therein. In the following example of the method the metallics were not as rich as the pulp, and necessarily reduced the average assay. After bucking down 10 A. T. there is obtained 4.723 A. T. of metallics. The pulp carries 1187.28 oz. Au per ton. The metallics contain 862.23 mg. Au.

```
10.000          1187.28
 4.723             5.277 A. T. of pulp
------          -------
 5.277           831096
                 831096
                 237456
                593640
                -------
                6265.27656
                 862.23     mg. Au in metallics
                -------
                712.7506 average assay
```

The reciprocal of this would be:

```
1187.28          11872.8
   4.723          5607.5
-------          -------
 356184           6265.3
 237456            862.2
 831096          -------
 474912           712.75
-------
5607.52
```

An instance where the metallics increase the assay is as follows:

```
10.000
 0.012
------
 9.988
 96.8
------
 79904          Reciprocal
 59928          96.8          968.
 89892          .012          1.2
-------         ------        ------
966.8384        1936          966.8
 97.83          968            97.8
-------         ------        ------
106.466         1.1616        106.46
```

From 10 assay-tons there was secured 0.012 assay-ton of metallics, which contained 97.83 mg. Au. The pulp assays 96.8 oz. Au per ton. The foregoing illustrations will doubtless serve to make clear the method followed.

GEORGE C. MCINTYRE.

Omaha, March 26.

Amalgamation in Hardinge Mills

The Editor:

Sir—I wish to compliment Mr. Girard on his contribution to 'Discussion' on this subject. He seems to have expressed the scruples of most of us who are interested in this phase of amalgamation. Anticipation of the troubles described by Mr. Caetani has deterred me from trying the experiment, although I would have tried it anyway if there had been sufficient excuse in bad extrac-

tion or saving in cost in our 40-ton mill using Hardinge ball and pebble-mills and counter-current decantation with Dorr machines.

It has always seemed to me that amalgamation in fine-grinding plants has never received sufficient consideration, as fine grinding gives an ideal product for amalgamation. I know that many of us old amalgamators do not like to lose an opportunity to use this old and simple process and have been rather too hard to convince that fine-grinding plants would do just as well without it; in any event, we still have scruples, and there is an army of us who are anxious to hear what anyone has to say about it.

Has anyone tried amalgamation in cyanide solution in pebble-mills? If so, what has been their experience? Would the troubles caused by the flowing of quicksilver on plates when amalgamating in cyanide solution be an advantage in pebble-mill amalgamation by preventing flouring? Cyanide keeps the mercury lively and cleans it to a certain extent. If a great excess of mercury were used thus, the amalgam would be in very thin solution, preventing the draining of mercury from the amalgam as mentioned by Mr. Caetani, or would it be so lively that it would drain all the more quickly? Would the use of a great excess of mercury when grinding in water prevent the discharge of amalgam? The loss by flouring in the latter would no doubt depend on the character of the ore, as discussed by Mr. Girard.

Guamoco, Colombia, March 7. K. C. PARRISH.

'Rock' or 'Ore'

The Editor:

Sir—What is the proper designation for the material which the copper mines of the Lake Superior district hoist from their shafts and send to their mills, and from which copper is extracted? Should it be called 'ore' or 'rock'? That is a question which frequently is discussed. In a magazine of such high standing as the *Mining Press* the word 'rock' is used with quotation marks, indicating that the copy-reader on your highly efficient technical publication considers the use of the word as a localism. In the latest edition of the Webster International dictionary I find the first meaning of the word 'ore' to be a "native compound containing one or more metals." Farther down, as a 'mining' definition this is given: "any material containing valuable metal constituents, for the sake of which it is mined and worked." From this second definition one would be justified, I presume, in calling the output of the Lake Superior mines 'ore.' From the first meaning there may be some doubt about that usage, for the reason that the copper here is not "compounded" with the material that comes up in the skip, the 'copper rock.' But if the use of the word 'ore' is permissible it seems reasonable to believe that the use of the word 'rock' may likewise be quite correct without even the taint of colloquialism or localism attaching to it. The same dictionary gives the first meaning of 'rock' as, geologically, "mineral matter of any kind occurring naturally in large quantities." The eighth meaning under a mining sub-head is "a large lump of ore." This is where the localism comes in, for this meaning is credited to Cornwall, England. And our mining vocabulary in the Michigan district is loaded with Cornish terms.

While such an authority as T. A. Rickard has taken the stand that the gross product of Lake Superior operations should be designated as 'ore,' and has expatiated at considerable length to prove the correctness of his assertion, it seems to me that there is nothing in error in calling this material 'rock,' and that the use of the word 'rock' does have an added advantage in discrimination. 'Rock' here is quite different from 'ore' in Montana copper mines or Arizona copper mines, where a chemical separation is necessary to secure the copper. While it may be correct to call our mine output 'ore,' certainly it is not incorrect to call it 'rock.' When we here speak of 'copper rock' we know it means the mine product that, when separated, yields native copper; and when we speak of 'copper ore' we know it means a product that requires chemical treatment to secure the copper.

HOMER ARAGO GUCK.

Houghton, Michigan, March 21.

[As Mr. Guck says, this is an old question. Having "expatiated at considerable length" on the subject on other occasions, the Editor is disinclined to trespass on the courtesy of his readers. As we understand this new defence of the use of 'rock' as a synonym for ore, it is argued that the copper in Michigan is native and therefore "quite different" from copper 'ore' in Montana or Arizona. But the gold in quartz veins is native also; why not call it 'rock'? The purpose of restricting terms to specific usage is to secure precision of language. The word 'rock' belongs to geology and covers any part of the earth's crust; the term 'ore' belongs to economics and involves the idea of profitable exploitation. In describing a Lake Superior mine, if 'rock' is to be used interchangeably for the substance of the copper-bearing lode and also for the enclosing country, it is likely that confusion will arise, especially in the minds of those unfamiliar with this localism. Whatever terms our good friends at Houghton may adopt for their local use, it is not for us to say; but it would be wrong for a technical journal to employ localisms likely to prove confusing in localities far from Lake Michigan. In other words, we try to use terms understandable, or likely to be understood, wherever the English—not the British or the American—language is spoken.—EDITOR.]

The Editor:

Sir—The subject 'What is an Ore?' has been reviewed and discussed in detail by Mr. James F. Kemp in a paper read before the Canadian Mining Institute, March 4, 1909, and published in the *Mining and Scientific Press*, March 20, 1909. I quote Mr. Kemp as follows:

"It is a time-honored conception of an ore, that it should consist of a metal in composition with some non-metallic substance, such as oxygen or sulphur, which disguises its metallic qualities and which is called a 'mineralizer.' Native metals are not 'ores' according to this

view. The copper of Lake Superior is therefore obtained from 'copper-rock,' not from ore. Gold is yielded by 'gold-quartz,' not by gold ore. But I think we must all feel that this old-time usage is no longer sharply observed and that it may well enough drop out. Thus in T. A. Rickard's interesting little book on 'The Copper Mines of Lake Superior' we certainly find the output of the mines referred to as 'ore'."

Mr. Waldemar Lindgren, in his recent book on 'Mineral Deposits,' says: "Local usage has adopted several terms as substitutes for 'ore.' In the lead-zinc district of Missouri crude ore is called 'dirt,' while concentrates are called 'ore.' In Michigan the ore is called 'rock' and the concentrates are termed 'mineral'."

Mr. T. A. Rickard in 'A Guide to Technical Writing' writes in his interesting style as follows:

"One more bungling term may be instanced, namely, rock, which is used among the copper mines of Lake Superior to designate ore. Not only do the Finns, the Hungarians, the Swedes, and the other folk ignorant of the English language employ this term, but the graduates from Columbia, Harvard, and Yale accept the sloppy usage. Ore and rock all over the world—except in Michigan—are set in opposition as signifying respectively, the profitable and the unprofitable product of a mine."

In a recent issue of the *Mining Gazette* here, the editor, Mr. H. A. Guck, brings out clearly the point of this discussion. He says: "When we speak of copper-rock we know it means the mine product that, when separated, physically, gives us native copper, and when we speak of copper ore we know it means the product that requires chemical treatment to secure the copper." Obviously, 'we' refers to the people of the Michigan copper district, and therefore, it may not be incorrect for residents of the Michigan district to use a local term when talking among themselves. But what about the others who live in various mining districts throughout the world and who, therefore, are not acquainted with the localisms of Michigan? Would it not be better and proper to use a term whose meaning is understood by men of all districts?

Numerous other undesirable localisms, such as the Australian 'reef' and 'paddock,' could be cited, but if technical papers are to be useful and clarity of expression is desired, these peculiar and local terms must be cast aside.

Houghton, Michigan, April 10. W. A. HOPPER.

[We are glad to have Mr. Hopper's support. These localisms in technology are only confusing. My old friends in Gilpin county, Colorado, speak of the *concentrate* of pyrite obtained in stamp-milling as 'tailings.' Shall we adopt that absurd localism? The Australian at Ballarat talks of 'rich gold,' when he means ore rich in gold. Is that to be accepted? The miner in Nevada gives the name of 'dirt' to the perfectly clean metal-bearing rock just broken by his pick; and he bestows the same label indiscriminately on rock that is barren and on that which is rich.—EDITOR.]

A Suggestion

The Editor:

Sir—In reading the 'Discussion' columns of your paper a certain thought has from time to time been suggested to me by numerous writers. This concerns itself with the courtesy and consideration that one engineer owes to another, especially in the public print of our journals.

It seems as though some writers wait until they have indigestion before expressing a difference of opinion. It is surprising how often letters of this harsh irritating type come from men whom I know personally to be of very limited attainments. Several letters that have made this impression on me came from men who were not bad fellows at all. The sarcasm, the personalities, the self-assertiveness were calculated to give force, but in reality detracted from the strength and dignity of the writer.

We owe something to each other, not only as engineers, but as gentlemen. Our success in life depends more upon our personality than upon our knowledge, so it behooves us, when advertising our personality in our writings to give some attention to what interpretation may be put upon this side of our contribution.

I refer not merely to the direct insults, which are frequent, but to those less glaring offenses that show a lack of consideration. We should remember that our technical press largely represents the spirit of the profession. I should dislike to have our profession judged by some of the vulgar and caustic letters that occasionally appear. That sort of thing never goes with the scientific frame of mind or any other frame worth imitating.

I have noticed this same lack of consideration for the other man's ideas in the utterances of certain speakers at a recent meeting of a scientific body. An engineer, especially a younger one, may write offering the solution of an interesting problem largely with the idea of drawing out better ideas and learning something new. In a great many cases before the matter is closed, he will be raked over the coals as an incompetent. That this is done by men who have made a special study of the question is only small comfort for the supercilious manner of it.

It also strikes me that this ungentlemanly attitude is never taken by our prospectors or by illiterate people, but by men who know how to handle English, and whose knowledge and understanding in general is worthy of consideration. Taking us as a profession, in our meetings and writings, are we or are we not a little negligent in some of the higher duties we owe each other?

In closing I wish to remark that I am not complaining from any experience of my own.

Salt Lake City, April 10. F. SOMMER SCHMIDT.

[We comment on this letter on another page. As stated there, this letter should not intimidate our readers from taking part in these discussions. We desire to encourage frank and polite criticism.—EDITOR.]

The Human Side of Mining

By JAMES F. KEMP

*All of us who are interested in mining and its fundamental science of geology, must feel that Keweenaw Point is classic ground. We are reminded of the early expeditions of the French, in parties from the lower St. Lawrence valley, consisting usually of a missionary priest, of a gentleman-adventurer, and of comrades not averse from trading with the Indians. Probably you all have seen in Foster and Whitney's report the reproduction of the early map prepared by the Jesuit fathers in the 17th century and sent back to France. Lake Superior, or Lake Tracy, as they then called it, is correctly drawn as regards all its larger features, so correctly in fact, that our admiration is greatly excited by the close and accurate work of these 'voyageurs,' so many thousands of miles from home in the bleak wilderness. We read their reports of copper among the natives and of the hopes of a mining industry in future years. Copper on Lake Superior and lead in southeast Missouri and in the Upper Mississippi valley were no small influences in the early colonial days. But who can say how far back pre-historic mining by the native tribes began, or how many centuries ago the blows were struck with those stone hammers that now from time to time we find on the outcrops of our lodes.

We people to whom mining geology means so much cannot be unmindful of the early work of the Foster and Whitney survey, nor above all and in particular of J. D. Whitney's contributions, since he was the forerunner and father of us all here in America. I wonder if you have read the fascinating book of his 'Life and Letters,' published within a few years past. In it we are taken behind the scenes and actually see the struggles of scientific men amid the forest-trails of the Point, and the storms on the Lake. We sympathize with their lack of maps, as they tried to prepare a good and accurate description of the geology. Whitney was storing up experience and, with the spirit of an apostle to the ignorant, was preparing the data for his monumental work, 'The Metallic Wealth of the United States.' Among his countrymen, ignorant as babes of mining, he sought to spread in 1854 sound information regarding their material resources and the proper and reasonable development of them. While Whitney had done some youthful geological work in New Hampshire and had studied abroad, yet we can readily see that the main courses in the foundation of his later work were laid in the copper and iron regions of the Lake country.

We have had another book within the last few years that is of unusual interest to all concerned with mining on the Point, and I doubt not very familiar to you all. It is the 'Life and Letters of Alexander Agassiz.' In it we learn of the tremendous struggle in the early years to place the Calumet & Hecla on its feet. Far be it from us who have seen the later prosperous days of this queen of copper mines, to be unmindful of the heroic years which marked its development, nor of the courage, faith, persistence, and devotion, which carried it through the initial stages.

I mention these qualities because they are characteristics which must be possessed by an engineer to a degree hardly equaled by the sister professions; and by the mining engineer pre-eminently among the different types of engineers. I wonder if you have ever thought of the contrasts which our profession offers to these other branches of engineering. Almost all of our colleagues, civil, mechanical, and electrical, are set to accomplish definite tasks. They build a railroad, design an engine, construct a dynamo, or a power-station. A problem in construction is theirs, and the elements of it are usually well known and definite. But we often have to discover and develop ore as we go along. We do not always know where it is ahead of us in the rock, or indeed if it is there at all. We are much more like the physician diagnosing an obscure disease. Our medical friend looks the patient over, learns symptoms, and infers causes. X-ray photographs may help him immensely and give him a look at hidden organs or bones, but after all, he needs a peculiar and keen intuitive reasoning power that is a rare and great gift. Medical schools prepare him not alone by information and disciplinary training, but also by clinics, wherein he sees just such cases as he is likely to meet, treated by skilful men who may even give him bedside practice.

We mining people have to deal with cases of abnormal conditions in Mother Earth. We have to treat stoppages of circulation and their results, strongly analogous to varicose veins in the human subject. We must now and then solve compound fractures and dislocations not of a half an inch, as in bones, whose sundered ends cannot slip very far past each other, but breaks and slips in the rocks which may involve movement of tens or hundreds of feet into the unknown. Compared with the surgeon, our one comfort is, that only in our imaginations do we have to put the broken parts back in their old, united positions. We may have only a little stringer to guide us; or the 'trail' of the fault in a fault-zone; or a slickenside; or a bit of gouge. In treating these difficult cases we must call to our aid all the lore of ore deposits. You remember how those old German mining geologists centring about Freiberg and Clausthal have written of the *'Lehre der Erzlagerstätten,'* or the 'Lore of Ore Deposits,' and how we English-speaking peoples from the days of the old workers in Cornwall to the present have passed along, with successive additions, the

*Abstract from address to the graduating class of the Michigan College of Mines, at Houghton, April 15, 1915.

accumulating experience of the past. Always in the back of our minds for the ordinary run of orebodies we have the belief that some sort of solution has found a line of circulation and has brought in the useful minerals. We try to reproduce in our minds the way the old solutions behaved and to explain to ourselves why they followed the special channels that guided them. We constantly seek the cause or conditions that made them drop their burdens of dissolved minerals at some places and not others. Sometimes an intersection of fissures may have led solution and precipitant to mingle. Sometimes an open-textured relatively soluble rock may have itself served as precipitant. Sometimes loss of heat and waning pressure seem to have influenced uprising heated solutions, which Agricola nearly four centuries ago called 'the juice of the earth,' and which we often call today 'the juice of the magma.' These or similar questions are in our minds when one orebody is exhausted and we have to look for others.

Orebodies resemble troubles in the system, for which the physician prescribes in the ordinary run of practice. But there are other cases which call for the surgeon. Let us suppose that our orebody is cut off by a fault, we need to know how faults customarily move and how we may decide where to look for the lost continuation. What are the trail, the drag, the slickensides, the gouge, the fault-breccia, and what do they mean? What do our old-time authorities tell us—Schmidt the Swede, Zimmerman and V. Carnal the Germans, and, in recent years, Freeland, our fellow-countryman? We must not be too much taken up by the machinery used in mining, with its enormous development in later years, and be unmindful of the old accumulated experience of the fathers gained in many years of laborious underground work. Hoover's translation of Agricola has placed at the command of all English-speaking peoples a wealth of ancient learning brought together by Agricola about 365 years ago. You would be surprised, if you have not read the book, to note, on looking it through, how much the ancients were like the moderns, and how very acute they were in their observations and inferences. Even our devices for hoisting, pumping, and ore-dressing are foreshadowed in Agricola's pictures. The miners and metallurgists of his day had no steam-power, nor did they understand chemistry as based on the atomic theory, much less the doctrine of ions, but they utilized the forces at their command with rare skill and they usually left singularly clean slags, when they had reasonably simple ores to smelt.

But I did not mean to digress too far in speaking of our predecessors nor to do more than to urge you to hold them in grateful and appreciative remembrance. We are living in the present and after the preparation in the professional schools we each have a man's work to do in the world.

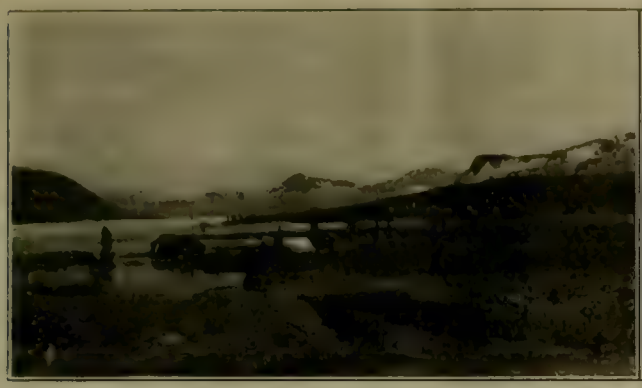
In all our schools we have professors of the various sciences and of the arts involved in mining and smelting, and yet there is one professorship which we do not have, despite the fact that we might almost think it the chief chair of all. I have in mind a chair of that indefinite thing or body of personal experience or attitude of mind toward one's fellows and associates which we sum up in the term 'life.' You see we are not machines whose horse-power can be calculated and which run on their monotonous round until they wear out. Back in the late eighties I passed five happy years in the faculty at Cornell. My old friend and older colleague, Professor R. H. Thurston, the Director of Sibley College in those days, used to rather enjoy defining a man as an engine who could consume a certain amount of fuel under his boiler and deliver a certain amount of work from his muscles and brain. But we know very well that this is only a half-truth. A man has a personality, a spirit, a disposition, a character, a sphere of influence, that are quite distinct from the number of shovels full of ore that he can heave into a car if he is 'mucking'; or the number of traverses he can turn off if he is surveying. It makes no difference to an engine whether its nearest neighbor is 10 horse-power or 10,000, or whether it has a cut-off or simple slide-valve; or whether it was built by Nordberg or Leavitt or Lidgerwood. But it makes a world of difference in a community of people whether a man in power is considerate, just, and sympathetic; or whether he is unscrupulous, selfish, and faithless. Or whether again he who is a leader, is easily discouraged, or disposed to lie down on the job, shirk responsibilities, and to take duties lightly. All these matters are of exceptional importance to a mining engineer, who may, as he gets on in the profession, be not only in charge of the technical work, but, if he is in a remote community, may be mayor, board of aldermen, school commissioner, provider of food and clothing.

Yet with all these provisions for material and intellectual welfare, there is one other side which we cannot overlook, and that is, amusement for idle hours. We never trouble our minds about a man when he is busily at work, but we are justly concerned about him when his day or night shift is over. For miners who are underground during their working-hours in dark and often wet stopes and drifts it is of more importance than for other workers to have some sort of wholesome recreation available whereby to pass an enjoyable evening. If, as we all have seen in little remote settlements, there are only the boarding-house and the bunks, we find the miner storing up his craving for a change until the end of the week or month, and concentrating in a short wild period what should have been taken in diluted and harmless instalments over days or weeks. The Young Men's Christian Association is taking up the matter vigorously and agitating the establishment of club-houses which will supply social centres, often in charge of a specially qualified worker. In the American Institute of Mining Engineers we have the past year been lending a sympathetic ear to one of their officers, Fred W. Rindge by name and engineer by training, who is specially looking after the work in the mining communities.

And yet we must be prepared to have these welfare movements misunderstood and to find our best intentions regarded at times with suspicion and disfavor. Experience leads us to expect it but we must be strong enough, and far-sighted enough, and persistent and unselfish enough, to discreetly and wisely work for the good of a community despite the rebuffs.

I have endeavored to draw the parallel between the mining engineer and the physician. But there are other features of a mining engineer's work which we must not overlook. He is a sort of combination of overalls and dress-suit, and he has to be equally at home in either. He must put on the former if he knows both what lies underground and what goes on underground. Several years ago I was out in Butte one summer with H. V. Winchell, one of your old-time Superior men, and with J. W. Finch of Denver. We were looking over the geology of the Steward mine with great care. Now at Butte in those fault-veins, through which, as channels, have certainly coursed great flows of hot waters, a soft clay-gouge is very abundant. In old and wet workings it makes an emulsion or a thin syrup of fine particles that is first cousin to paint. We three had crawled through the old drifts of this character all day and had come up about 4:30 in the afternoon, and so stepped off the cage just as the 'Seeing Butte' car had deposited its load of Eastern school-marms, and various other kinds of tenderfeet, all in charge of an orator with a megaphone. The Steward was the mine to which they were habitually taken. "Ladies and gentlemen," said the orator, "this is the Steward mine, where many of those wretched miners work far underground, whose little cabins I showed you out on the flat. It is wet and dirty underground and"—catching sight of us, he added, "there's three of 'em now." We certainly looked the part and tried to keep straight faces until we could slip into the change-house. What we had seen, however, embraced three sets of remarkable faults, which had developed one after the other. We had seen the oldest vein displaced by the next; and shifted to one side by the last. We had been so keen in the study of this geological structure that I do not believe it had occurred to one of us that our surroundings were wet or dirty. As my colleague in mechanical engineering at home, once said in my hearing, "When we are working over an engine in our old overalls and in the grease and heat, we never think of either of them. It's the idea that fills our minds. The design or plan that makes the engine go, that excludes all else." And so it is with us amid the discomforts of the work, if we may call them so. We forget them, our minds are so filled with the systematic attainment of results or with the study of the geologic structure of the veins; or with the forecasting of what will happen to our ore on the next level; or with the needs of the community of workers; or above all with satisfying the board of directors on whom, back in the central office somewhere, the manager must always have a wary eye. With the last consideration, the dress-suit side of the profession comes in. Not only must our man in authority look out for his miners, but he must be just as ready to meet his directors on equal terms. He may live most of the months in the remote community, but with the revolving year comes around the time of annual reports, of conferences, of presenting in person the results of operation; it may be also of hospitalities extended and social courtesies; of meetings with the Institute of Mining Engineers and mingling with one's fellows, and then we have to shed the overalls in favor of the dress-suit. One must guard against too much overalls, and not let the stiffly starched bosom choke too hard at the neck, because of disuse. Some young engineers are a little inclined to overdo the overalls phase of the profession, whereas we should be good companions with all sorts and conditions of men.

To my mind, the most trying time with all of us is at the start. Almost every young engineer has several unsettled years before he finds a permanent place. While this experience is not invariable, it is the rule. The new entrant into the profession is getting experience and is taking a course in that subject of life for which we have not and cannot have a professorship. In the long run, however, all the years total up their contribution to the final result and most men of maturity are loath to admit that any of their experiences have been without final use. It is not a bad plan for a young engineer to look himself over and see what value he would really place upon himself to his company. It takes time to get broken in and to learn the routine. No harm is done in assuming the employer's point of view and seeing if, with conditions reversed, we ourselves would give any more for the service. Everyone, and especially the beginner, may properly wish to give full equivalent for compensation received. A subordinate may often wisely in his imagination put himself in the position of his chief. Live his daily round, think over his responsibilities and harrassing cares, and then see what can be done to make them a little less burdensome. Most of the men whom we know, partly from individual characteristics, partly from the pull of outside influences, come to revolve in fairly definite orbits. If we secure and use a sufficient number of observations, we can calculate a particular orbit, just as do the astronomers in dealing with a planet. We can with a little study and foresight know where to find our man at different times of the year and under the circumstances produced by any conjunction of known forces supplied by outside influences. Can a junior thus forecast what his chief will need and be unostentatiously ready; if he can avoid asking too many pestiferous questions of a busy man, he will certainly secure the appreciative gratitude of his chief. Let me whisper to you that even among professors often kept under keen nervous strain by the demands of classes and by the consuming desire to have their subjects understood by the young people before them, the foresight of an assistant who knows where are all the specimens or apparatus to be used in illustration, and has them ready without undue oversight, comes as balm to excitable nerves.



No. 1. THE DAM.

No. 2. THE DITCH.

Hydraulic Mining at Atlin

By A. D. HUGHES

INTRODUCTORY.—These operations in British Columbia are believed to be of sufficient magnitude, and the conditions existing, methods employed, and results obtained sufficiently unusual to warrant the publication of this article. Similar conditions may exist at other places, and, if so, the method worked out here may be of use to others. Actual working costs are given and enough of the data governing them to make possible an approximate estimate of the expense of similar work in other districts.

The description covers the operations of the North Columbia Gold Mining Co., of Cincinnati, during the four seasons from 1910 to 1913 inclusive. The work was carried on under the management of J. M. Ruffner. I was present during the whole of this period, and during the latter three years acted as superintendent. The data given are therefore authentic and represent the result of observations at all stages of the work and under all the conditions obtaining.

Atlin is situated near the northern border of British Columbia, about 60 miles in a straight line southeast of Carcross, Yukon, which is 70 miles from Skagway, Alaska, on the White Pass & Yukon Railway. It is reached from Carcross by boat on Tagish and Atlin lakes between June and November. There is a portage between the two lakes, freight and passengers being transferred on a railroad three miles long. During the winter, dog-teams or horse-stages, depending on the condition of the ice, carry mail and passengers to and from Atlin. The climate is that usual at this latitude behind the coast range.

Gold was first discovered in the district at the time of the rush to Dawson. In the years immediately following there were as many as thirty or forty thousand people in the camp at times. Individual mining was then at its height, work being carried on in the creek-beds and shallow benches. Since that time the population has been decreasing gradually, as individual work has been giving place to large-scale operations. At the time considered there were about 1500 people in the locality during the summer and much fewer, of course, in the winter. The production during the time mentioned was about $350,000 per season. The operations to be described produced the bulk of this output, the remainder coming from smaller hydraulic plants, drift mining, etc., on the various creeks within a radius of 20 miles from Atlin.

Pine creek, the scene of the operations, runs from Surprise lake at the head of the valley, and empties into Atlin lake, a distance of 12 miles. The fall in this distance is approximately 750 ft., of which 100 ft. is gained at a waterfall about four miles from Atlin lake. The average grade of the remainder of the course is therefore about 1%. Midway between the two lakes is situated the Discovery claim and the town of Discovery. Here the valley is broad, with wide benches on both sides of the creek. From a short distance below this point to a mile above there is exposed a section of an old river-channel. It is from this channel that all the gold on Pine creek has come. It is from 400 to 800 ft. wide. The present creek has cut through this for approximately the entire length of a mile and a quarter and a width of 100 to 150 ft. The old channel slopes in the same direction as the present creek with a grade of 1%. The present creek has a grade of a little less than 2% at this point. The level of the bedrock in both the new and old channels is the same at the upper end, although there originally was a difference of about forty feet in elevation between them at the lower end. Early ground-sluicing operations and drifting filled a large part of the available dump at all points.

Bedrock on Pine creek at this point is mostly serpentine, through which there are many dikes, in vari-

ous stages of alteration. Along these dikes and through the serpentine there are many quartz stringers, some of which are known to carry gold. The erosion of similar rock probably furnished the placer gold. The nature of the gold bears out this theory, as much of it has quartz associated with it. Some of these small quartzose nuggets are well rounded and some of them appear to be freshly broken.

The North Columbia Gold Mining Co. came into existence during the early days and acquired ground on the south side of the creek, the area eventually comprising most of the old channel on that side. Operations were then conducted on a small scale. The water system consisted of two small ditches of about 1000 inches each, one on each side of the creek. During the first few seasons a good deal of material was run into the creek, and it became evident that space available for tailing would soon be exhausted. Experiments were tried with different methods of handling tailing, and during this time the method of stacking on worked-out bedrock by means of monitors was tried. Results were better by this method, but the capacity was limited by the small water-supply. There was an abundant supply at Surprise lake, and in 1907 it was decided to build a ditch and dam to make this available.

Surprise lake is a natural reservoir at the head of Pine Creek valley. It is 16 miles long by a little over a mile wide, having an area of about 18 square miles. A crib-dam was built to conserve the flood-water in the spring, the ditch being constructed during 1907 and 1908. This ditch was dug with a floating steam-shovel built by Fairbanks of Marion, Ohio. It is 6 miles long, 30 ft. wide, and has a 4-ft. bank in solid ground at the lower side. The grade is 8 ft. per mile. No fluming was necessary, and good ditching-ground was encountered. The line of the small ditch previously used was followed. Waste-gates were placed at intervals of three-quarters of a mile, one set of these about half-way being arranged so that the entire head of water could be turned out at this point. The cost of this ditch was $6285 per mile, including the dredge, for which there was no further use when the ditch was completed. The dredge cost $13,732 erected and ready to run.

In 1909 the crib-dam was destroyed during the high-water period and was replaced by a pile and earth-work dam that was started at once and was completed in time to save a large part of the water in the lake. The new dam is about 400 ft. long and 12 ft. high at the centre. The piling extends for about 150 ft. at the deepest portion. The width on top is 12 ft., this being used for a roadway. The gates are operated with a screw-stem similar to a hydraulic gate-valve. The apron and spill-way from the gates is 30 ft. wide. The cost of the new dam completed was $8158. It is shown in the accompanying photograph, No. 1, in which a portion of the old dam may also be seen. Photograph No. 2 gives a view of the ditch.

In 1910 the water-system was in good order, arrangements had been made for additional ground on the north side of the creek, and operations were started. The work was conducted from two separate pits, one on the south side of the creek opposite the town of Discovery and the other about a half-mile up-stream on the north side. The water for both pits was taken from the main ditch, which is on the south side. There was about five feet of water above the sill of the gates at the lake, and with the constant supply coming from tributary creeks a steady flow of about 10,000 miner's inches of water was reasonably certain.

Working Conditions.—The conditions existing at this time may be summarized as follows:

The No. 1 pit had been previously worked and was well opened-up. The bedrock had an average elevation of 20 ft. above the surface of the material in the creek-bed. The bank to be worked was in places 500 ft. from the creek. The bedrock had a slope of about 1% down-stream and was practically flat otherwise, although in places there was a slight rim between the creek and the main part of the channel. The average depth of the material to be worked was 60 ft., consisting of 10 to 20 ft. of channel-gravel, 20 to 40 ft. of Glacial clay, and from 1 to 10 ft. of loose soil, surface-gravel, etc. The channel-gravel is hard and tight, contains many boulders, is a bright yellow color, and in places is almost cemented. The Glacial clay is a compact material containing a considerable amount of rock. It is not so sticky as the ordinary varieties of clay. Water, however, will not cut it. It must be undercut and caved. The head on the water from the ditch at this pit averaged about 140 feet.

The No. 2 pit had not been previously worked by the method contemplated, and the work here for the first year was largely experimental. The bedrock had an average elevation of 10 ft. above the surface of the material in the creek. The ground here was shallow, running from 5 to 30 ft. deep, and consisted almost entirely of the channel-gravel. The bench to be worked extended from 300 to 400 ft. back from the bank of the creek. Some of the shallow ground had been worked over by hand and a portion of the deeper ground had been drifted. The bedrock had a slope of 1% down-stream and about the same amount toward the creek. The head from the ditch at this plant varied from 100 to 120 ft. There is no permanent frost in the district.

It is evident from the conditions mentioned that the method of working must not be such that any large amount of the coarse material in the banks would be put into the creek. The grade of the latter made it possible for a small proportion of the finest material to run off at all times under the large head of water employed. From 20 to 30% of the material was thus taken care of, without affecting the condition of the creek. This percentage was greater at the No. 1 pit, as the additional water from No. 2 increased the amount in the creek at this point to about 10,000 inches.

The general equipment and the conditions under which the company operated will be described first, then a typical season's run for each pit, giving the equip-

ment employed, followed by a detailed account of the cost in the two pits as it averaged over the four seasons.

All work was handled from the town of Discovery. The buildings consisted of office, boarding-house, bunk-houses, living-houses, warehouses, stables, saw-mill, and blacksmith and machine-shop. The office was connected by telephone with the two pits and with the cabin of the ditch-tender at the lower end of the ditch. It was not found advisable to keep a man at the dam, as the flow of water was uniform. When the pits were shut-down, while moving plant, etc., the water was shut-off at the lake, but for small variations the excess water was allowed to run to waste at the lower end of the ditch so as to be immediately available when desired. The amount of water in the ditch was kept as nearly as possible to the amount used when both plants were running at full capacity. A driving horse and one work-team were kept all the time. The saw-mill would handle about 2000 ft. of lumber per day. Logs were hauled in during the winter, on contract, or by the winter watchman, sufficient lumber being cut at one time to last for two seasons. It was necessary therefore to have a special saw-mill crew only once in two years for about two months. Rough native lumber costs about $30 per thousand at the mill. The blacksmith and machine-ship contained a 16 in. by 8-ft. lathe, drill-press, hack-saw, emery wheel, forge, etc. Power for this was supplied by a small Pelton wheel. The pipe-line furnished water from the small ditch on the north side of the creek, at 75-ft. head. The same pipe-line furnished water under pressure for the buildings and also for a plant generating electric light. A 15-kw. Fairbanks 110-volt direct-current generator was belted, with counter-shaft, to a 4-ft. Pelton wheel receiving water at 75-ft. head through a $2\frac{1}{2}$-in. nozzle. This plant furnished power for about 100 incandescent lights for the buildings and for three arc-lamps used at the No. 1 pit. Owing to the distance and the consequent loss in voltage, it was not found practicable to run lights from this plant at the No. 2 pit. Another generator was erected at this pit, operated in the same manner, furnishing power for three arc lamps and a few incandescents. These plants gave no trouble when properly equipped with oil-cups on all bearings. The light was satisfactory and the cost nominal. They often ran for 10 or 12 hours without any attention.

MAP OF BRITISH COLUMBIA, SHOWING POSITION OF ATLIN.

Starting to Work.—During the four years considered there was but little variation in the dates of starting preliminary work, namely, April 18, or that for starting sluicing, May 10, and closing down, November 10. One season's work is typical of the others. A start was made from Vancouver about April 5, the party consisting of the manager, superintendent, accountant, foremen for the different pits and shifts, machinist, etc., and a few Japanese for cooks and roustabouts. A few of these were used for work in the pits, an occasional one showing good ability. From Carcross to Atlin and Discovery the trip is made with horse-stages over the ice on the lakes at this time of year. Men were first put to work on the ditch. At one point a glacier forms in the ditch for about 1500 ft., this being caused by a spring on the side-hill above. A trench $2\frac{1}{2}$ ft. wide is cut through this at the centre. This is done with dynamite, supplemented by pick and shovel. A small amount of water was turned out of the lake while this work was going on and allowed to run through a waste-gate above the glacier. This cleared the upper part of the ditch of ice and snow in a few days. When the trench was completed a small head of water was turned through it, this being increased as the ice cut out and was melted by the action of the water. The rest of the ditch cleared itself by allowing the water to run during the preliminary work. When the plants were ready for the full head of water, about May 10, if there was any large amount of ice overhanging at the sides of the ditch this was shot-down and

passed the waste-gates before turning water into the pipe-lines. Otherwise the pressure-boxes or penstocks might have become choked with ice and caused trouble.

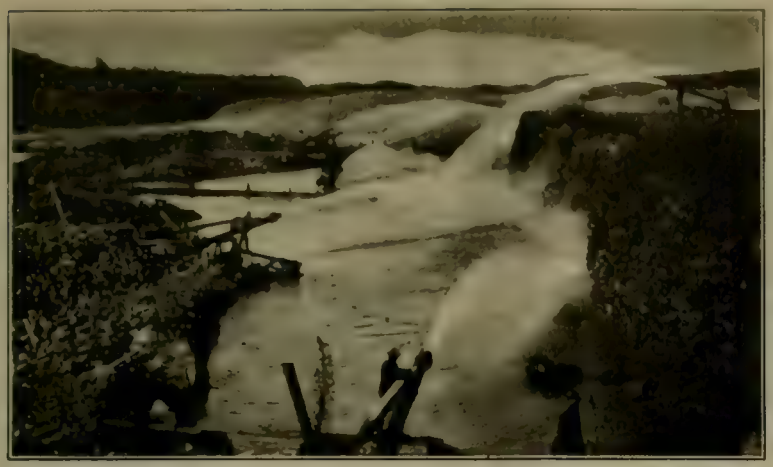
As soon as the weather conditions permitted, 20 men were started to work in No. 2 pit. Usually there was one of the main pipe-lines to be moved. This made a new pressure-box or penstock necessary. As much excavation as possible was done during the preceding fall to avoid excavating in frost in the spring. The remainder of the ditch-berm was now cut through, the intake to the pressure-box constructed, and the gate put in, so that when water was turned into the ditch to clear out the ice no damage would be done. At this plant the pressure-boxes were built as close to the ditch as possible, usually about 30 ft. The flume was made 5 ft. wide and about 6 ft. deep. The pressure-box dimensions were 8 by 16 ft. inside and 12 ft. deep. The sides of the box and flume were brought well above the water-level of the ditch, so that they required less attention. When a monitor was turned-off in the pit the water would back up and run down the ditch to the end, where the ditch-tender could turn it out. In this way it was not necessary to keep a man on the ditch at this plant.

Two main pipe-lines were used, each about 1500 ft. long, consisting of 30, 28, and 26-in. pipe to the main Ys at the pit. They consisted of 12 and 14-gauge slip-joint riveted pipe made by the Hydraulic Supply & Manufacturing Co. of Seattle. These lines were set in a temporary fashion, as there was nothing permanent about the location. One season's run was about all that could be obtained from one setting of the lines. It was necessary to put both of these lines across the creek on trestle-bridges. From the main Ys the pipe was reduced to smaller sizes to run to the monitors. This pipe was of 14 and 16-gauge, mostly 16 and 18-in. diam. Eight monitors were in use, five No. 6 machines, 15-in. intake, and 6-in. nozzles, and three No. 4 machines, 11-in. intake and 5-in. nozzles. Each machine was equipped with a deflector and each pipe-line with a gate. Nearly all the monitors were ball-bearing Hendy machines. Four machines were operated on each of the main lines. The arrangement of the monitors is shown in photographs No. 3 and No. 4. A cut was first made from the creek by blasting and then piping the broken rock out. The flume was set in this with the head-end practically on the level of bedrock. Wing-dams were built at each side, and strongly braced. Before starting to run dirt the machine on top of the bank was used to pipe a reef of top dirt around the unconfined sides of the pit so that no water could escape. The flume used here was 4 ft. wide with sides 3½ ft. high. It was set on a grade of 4 in. to 12 ft. and equipped with angle-iron riffles throughout. The first box was built tapered, being about 6 ft. wide at the head end.

In Full Swing.—With the sluice completed, and the machines all set, water was first turned on May 10. One monitor was always placed so that it could pipe the material directly into the head of the sluice. This was necessary as none of the material would run in the usual way on this grade. The other machines were strung out in tandem about 50 ft. apart, and kept the bank worked back in approximately a straight line, as shown. The quantity of water used would carry the material through the flume on the grade given, and at the end of this three machines stacked the coarse material, as indicated in the photographs. The first of these was placed about 25 ft. from the end of the flume and the others at 50-ft. intervals. The arrangement of the tail-race in an arc increased the space that it was possible to fill with tailing. As stated, the water used was under a head of about 110 ft. The tailing-piles shown are 25 ft. high. They contain about 60% of the original material. The remainder was sand, which ran off to the creek. A portion of the finest of this was carried down the creek and the remainder deposited as sand-bars in the creek-bed below.

Photograph No. 3 was taken during the latter part of the work and shows the tailing-piles on the worked-out bedrock down-stream. They look very much like dredge-tailing. In stacking tailing by this method the best results were obtained when elevating the nozzle three to four times per minute, and elevating and lowering the stream at a uniform rate. The stream is brought down into the tail-race each time and elevated to the full reach of the man. During a portion of nearly every day the water in the pit was turned off. The bedrock was then exposed in most cases. When it would not drain, one machine was turned on and pointed toward the flume. This would draw the water down a foot or more. In the ordinary way of running as shown, the force of these streams would not cut the tight material on bedrock. With the water out of the pit, shallow holes were put down in this material and blasted with a small amount of powder. After being thus shaken up, one machine at a time was turned on; this material could then be cut and piled ahead near the flume, to be put through when all the water was again turned on. During this time also the boulders were broken by bulldozing with 75% powder. There were many of these, and several rounds of from 75 to 100 shots would be fired in a single day. When it was necessary to move the machines, it was also done at this time. In such shallow ground it was necessary to move at least one machine nearly every day. While this work was proceeding in the pit the men on the dump machines (so called) would put up a staging to stand on, elevate the streams higher than under the regular running conditions, and pile tailing back as far as possible, thus making room for more. All the material was put through the flume, the boulders being reduced until small enough to be run through with the other material. No derricks or similar devices were used.

It was found that a pit of about 30,000 cubic yards was the most economical size. This was governed by the tailing-room. The pit was kept as free from loose dirt as possible, the material being cut from the bank and piled ahead toward the flume only as fast as it



No. 3. TAILING-PILES.

could be put through. Some of the gravel was so tight that it was impossible to cut it any faster with water under the pressure available. The actual running-time for a pit of this size was about three weeks. One week would be consumed before the next pit could be started. During this time the clean-up was made, the bedrock around the head of the flume was cleaned by hand, a new bedrock-cut was made to the creek, the sluice moved and re-constructed, and the monitors moved to the new site. Thus each pit took about a month; as the open season lasted six months, six pits on the average were run per season. The actual excavation per season for the four seasons was 178,580 cubic yards.

No. 4. MONITORS IN FULL OPERATION.

No. 5. AT THE END OF A RUN.

To get the maximum efficiency on this work it was necessary to keep the monitors as near the face as possible. Thus the moving became an important factor governing the speed of the work. It was found that this could be done rapidly if the pipelines were arranged so that the moves could be made straight ahead. This was done as much as possible. The No. 6 machines weigh about a ton. Under the best conditions the time consumed for taking down the machine, skidding it ahead, setting it up, and bracing it ready for the water to be turned on was one hour. When elbows had to be placed in the pipeline or other adverse conditions existed, it took longer than this.

THE GOLD in this gravel was nearly all at or near bedrock. Some of it was in the crevices of the bedrock. It was therefore necessary to cut down a foot or two in order to make a satisfactory recovery. The action of the numerous streams piling the dirt ahead toward the flume, thoroughly disintegrated any of the tight material, so that the gravel was well washed by the time it reached the flume. The gold was fairly coarse and was easily saved. Quicksilver was used in the riffles at all times. In cleaning up, about 75% of the gold was recovered in the first 35 ft. of the sluice. About 10% of the gold was recovered from the bedrock immediately around the head of the sluice; that is, within a radius of 40 ft. Tests proved that

it did not pay to retard the work to clean the remainder of the bedrock by hand. No recovery could be made from it except at the time of moving the plant, as it would be covered with tailing when the next pit was started.

The crew for this work was a man for each machine, one flume-tender, and one foreman, making 10 men on each shift. Two shifts were employed, working 11½ hours each, making 20 men on the regular work. When moving plant and for other incidental work, extra men were employed, usually 4 to 6. All except the foremen were originally inexperienced at this kind of work, being the usual class of foreign labor found in similar localities. About half of the old hands returned each season, which made it easier to break in new men.

In No. 1 pit two main pipe-lines 2000 ft. long were used. These consisted of 30, 28, and 26-in., 12 and 14-gauge slip-joint riveted pipe. From the main Ys this was reduced to 16 and 18-in. pipe of 14 and 16-gauge. There were four No. 6 monitors in the pit, equipped with deflectors and 7-in. nozzles. There was a gate on the pipe-line to each machine. Two No. 6 monitors with 6-in. nozzles were used on the tailing. During a portion of the time a No. 4 monitor was used either on the tailing or in the pit as conditions warranted. The usual arrangement of the machines is shown in photograph No. 6. This photograph shows the two monitors on the tailing, and the tailing pile as it appeared near the end of a run. Owing to the greater head on the water at this plant the tailing could be piled to a height of 35 ft. The tailing constitutes about 40% of the original material.

The conditions regarding grade and bedrock, the occurrence of the gold, etc., were similar to those in No. 2 pit, except that owing to the greater distance from the creek, longer bedrock cuts were at times necessary. These were made by blasting and piping the material with the monitors in practically all cases. The flumes or sluices here were 5 ft. wide, 3½ ft. high, and from 125 to 400 ft. long. They were equipped with 10 by 10-in. block-riffles with 3-in. strips between. The grade used was 4 in. per 12 ft. It was found that this was the smallest practicable grade. In places where this grade was not available, the flume was shortened. The material in the tail-race would run on a flatter grade. Some portions of the deposit farthest from the creek had to be left unworked, as sufficient grade was not available even under these conditions.

Water was first turned on at this plant about May 10. The bank was caved by cutting in the gravel deposit as high as possible. As fast as it was brought down the material was run out. The bank of about 60 ft. was very tight and would stand practically straight. Usually the material when under-cut would drop down into the pit near the bank. Occasionally slabs of clay containing 1000 yd. or more would crack from the bank and fall outward into the pit instead of dropping straight down. This was a source of considerable danger. With the pressure available (140 ft.) the monitors would not work effectively at a greater distance than 80 or 90 ft. from the bank. While one of these slabs of clay could not actually fall on one of the machines, the force of the fall in water and fine material in the pit would shoot out a sheet of water, air, and sand with great velocity, sometimes doing considerable damage and placing anyone in the vicinity in serious danger. Fortunately the layer of sand and soil at the top of the bank usually gave ample warning when a cave was about to occur. Unfortunately one fatal accident happened during this period, due to the man remaining at the machine long after ample warning had been given that the cave was about to occur. No other injuries resulted, but considerable delay was caused owing to machines being damaged and pipe-lines displaced.

Boulders were not so numerous here as in the other pit, but much of the clay, remaining in lumps, had to be shot. Owing to the rock included and the brittle nature of the clay, the effect of powder when placed in a hole in the clay was much greater than would be imagined. During a portion of the time in this work, a small Sullivan compressor was operated. Air was used at 100-lb. pressure to run two or three of the small hand-hammer drills. The compressor was belted to a 4-ft. Pelton wheel, which received water from a branch on the main pipe-line. The usual hollow drill-steel was used for putting holes in the largest boulders, and pointed bars were used for putting holes in the clay. These bars were made at the shop on the works, with a shank similar to the drill-steel. Having been driven into the lumps of clay, they were taken out with a wrench made for the purpose. This was much quicker than putting in holes by hand; in the case of the boulders a great saving of powder resulted, as one stick of powder placed in a hole in the boulder had as great an effect as 8 or 10 sticks placed on top. Where powder costs 30c. per pound this is a big item. It was found, however, that it did not pay to retard sluicing long enough to drill all the boulders. Drilling was therefore resorted to when it could be done while sluicing was in progress. This was often possible by working on alternate sides of the pit.

Results.—Five pits, averaging 55,000 to 60,000 cu. yd. constituted the average season's run at this plant, the yardage for the four seasons being 283,300 per annum. The moves from one pit to another were as described for No. 2 pit. The crew here was 18 men on both shifts, with extra men as needed, and work was carried on as continuously as possible throughout the season.

During the progress of the season, usually after the high-water period, the material that unavoidably collected in the creek-bed at both plants, was boomed or flushed out by opening the gates at the lake and allowing a head of 30,000 to 40,000 inches additional water to run down the creek. When the maximum effect had been attained, the extra water was turned off. This operation was carried on as many times during the season as the available water-supply would permit, usually about twice, and for periods of about six days each time. It is worth noting here that although this extra water cut

out and carried away nearly all the fine material that had accumulated, the creek never could be cut down to the level previously existing. This was due to the fact that some coarse material unavoidably worked down into the creek bed. The effect was therefore a gradual increase in the height of the creek-bed, depending upon the amount of coarse material allowed to run into it.

At only one time during the period mentioned was there any shortage of water. During 1912 there was not enough to allow the use of it for flushing the creek, and at the close of the season, with all the gates at the lake wide open, only sufficient water was furnished for the full operations of both plants. However, during the winter the usual rise of about one foot in the level of the lake took place. This was enough to allow operations to be started on the usual scale in the spring, and heavy rains again made an ample supply, both for the usual operations and for flushing the tailing from the creek. Six feet was the maximum variation in the level of the water in the lake during the time considered.

The close of the season for both pits came at the time when ice forming in the ditch and pipe-lines made op-

No 6. MONITORS WORKING ON TAILING.

eration impossible. This usually occurred about November 10 with the temperature around zero. At this time the gates at the lake were closed down tight to avoid any waste during the winter, the plants were dismantled, and pipe, monitors, etc., placed on high ground, so that they would not become ice-bound during the winter.

WAGES.—A variation made in the manner of paying wages may be of interest. The usual wage for the camp is 35c. per hour and board, which is worth $1.50 per day. During the first part of the work it was found that there was a tendency for men to quit about the time in the fall that the weather became severe. This was usually in October when there was about a month's time left available for operating. At this time there were few available men in the camp, and the last month's work would therefore have to be carried on short-handed. To remedy this situation a sliding scale of wages was adopted with a bonus at the end of the season. The first two months was paid for at the rate of 25c. per hour, the next two months at 30c., and the remaining time at 35c., the usual rate. Board was furnished as usual during all the time. To those who remained throughout the season, a bonus was paid, bringing the total amount received by each man up to 35c. per hour for all the time employed. Steady men were desired, for a green man was not of much use on a machine for a month or more. It will be seen that the amount at stake for each man who had worked the greater part of the season was about $100. This proved to be sufficient inducement to remain, and henceforward each season was finished with practically a full crew.

OPERATING COST.—Average operating data, total costs, and costs per cubic yard are given in the following tables. A description of the governing factors is necessary. The scale of wages has been given above. All supplies may be considered as costing twice as much as at Vancouver or Seattle.

AVERAGE OPERATING COSTS, NORTH COLUMBIA GOLD MINING CO., ATLIN, B. C., CANADA. SEASONS 1910 TO 1913 INCLUSIVE

	Pit No. 1.	Pit No. 2.
Possible running time, days per season.	184	180
Actual operating time, days per season.	154	141
Cubic yards worked per season	283,300	178,580
Yards per day for season	1,540	992
Yards per day for time run	1,840	1,266
Miner's inches used per day	4,500	4,250
Yards per inch per day running time	0.41	0.30
Average depth of ground	60 ft. 6 in.	16 ft. 4 in.
AVERAGE TOTAL COST PER SEASON		
Labor	$20,789.53	$23,745.12
Powder	3,968.71	3,490.85
General operations	6,175.86	5,487.47
Ditch maintenance	624.75	624.75
General expense	1,249.50	1,249.50
Royalties, rentals, etc	1,383.95	1,145.77
Total	$34,192.30	$35,743.46
AVERAGE COST PER CUBIC YARD		
Labor	7.34c.	13.29c.
Powder	1.40	1.96
General operations	2.18	3.07
Ditch maintenance	0.22	0.35
General expense	0.44	0.70
Royalties, rentals, etc	0.49	0.64
Total	12.07c.	20.01c.

75% dynamite cost 30c. per pound delivered at the mine.

No boarding-house expense appears separately, as this was charged directly to the different operations each month and therefore is included in labor charges.

General operation includes supplies, wages of teamsters, blacksmith, etc., and other operating expense not directly chargeable to either pit. This expense was equally divided between the two pits at the end of the season, except such charges for supplies as were directly charged to either pit.

General expense includes traveling, office, and other incidental expenses not directly connected with the actual operations.

Ditch-maintenance includes all expense on the ditches in the way of repairs, etc. It does not include the wages of the ditch-tender, as this was charged directly to No. 1 pit.

Royalties, rentals, etc., include the Government tax on gold, and other charges.

The last three items were divided between the two pits at the end of the season.

The costs given do not include any charges for redemption of capital or for depreciation of plant.

To those familiar with hydraulic work, many variations from the method employed will probably suggest themselves. Some of the obvious ones were tried, but a return to the original plan always resulted. Although there is no intention to convey the idea that the method employed would be the most economical under any other conditions, it is thought by those in charge of the work that the costs given above could not have been equalled by any other method in this particular case.

The Anaconda Exhibit

By E. S. BARDWELL

This exhibit of the Anaconda Copper Mining Co., Montana, occupies 3500 sq. ft. in the Palace of Mines and Metallurgy. The centre of the space is occupied by a booth finished in ornamental copper trim; it serves as an office and rest-room. The entire space is surrounded by an ornamental copper railing.

The exhibit has been so planned as to take the visitor step by step through the various processes that the ore undergoes from the time it is taken from the mine until the finished wire-bar, cake, or ingot copper is shipped to the consumer.

As the visitor enters he is first shown something of the geology of the Butte district. Geological notes as taken underground in one of the large mines, together with the plan-maps of each level, vertical sections taken through the mine at different points, and a glass model serve to illustrate the manner in which the geological department controls development work in the mine. Sample recommendation sheets as issued by this department are shown. By reference to the maps and the model, the result of the advice of the geologist may be traced. The Nipper and Ballaklava models are introduced at this point as showing typical vein and skeleton models.

The association of minerals in the Butte ores is illustrated by large specimens that have been carefully selected. Instead of giving the analysis of each specimen, blocks have been placed on each table showing the metallic content of the specimen that occupies that particular table. A single block of coal weighing 3½ tons from the Washoe mine of the Anaconda company occupies a place in this part of the exhibit.

Mining methods are illustrated by means of models. That of the Leonard stopes gives a splendid idea of the tremendous amount of timber required in a large mine. There are also models illustrating the timbering of shaft and pump-stations, and a model of a typical stope-floor showing framing, chute, and manway. A paper model of the new Leonard steel head-frame, the largest of its kind in the world, is also shown. Large framed photographs of the Butte district, of surface plants and of underground workings, assist the visitor who is not entirely familiar with mining to get an idea of actual conditions in the district.

The wet concentration of ores is shown by means of products in display-bottles, with photographs showing concentrating machinery in operation. Models of the round-table plant and also of the new leaching plant at Anaconda are exhibited.

Smelting practice is explained by photographs illustrating various stages of the process and by-products in display-bottles. The result of the treatment of second-class ore by concentration and smelting is shown in a model consisting of superimposed cubical cases containing one ton of ore, the concentrate from this amount of ore, the matte, and finally, on top, a block of copper. Refractory materials manufactured by the Anaconda company are exhibited, as well as arsenic, which is an important by-product of the operations.

The activities of the International Smelting & Refining Co. are illustrated by means of products in large display-jars, and framed photographs showing portions of the company's plant at Tooele, Utah. A typical blast-furnace charge, with the various constituents of which it is composed, is also shown.

The refining of lead bullion as performed by the International Lead Refining Co. is illustrated by a flow-sheet and samples of the intermediate and end products, together with analyses of the same. Large photographs serve still further to illustrate various stages of the process.

The copper produced by the Anaconda company is largely refined at the Raritan Copper Works at Perth Amboy, New Jersey. A portion of the output is refined at the Boston & Montana Reduction Works of the Anaconda company at Great Falls, Montana. The process of copper refining is shown by means of samples of the various intermediate products, with a complete collection of the common shapes of finished copper from each of the above refineries. The refining of silver slime and various by-products, such as nickel salts, selenium, and tellurium, resulting therefrom, is also shown, as well as manufactured copper and brass articles, the latter being contributed by the American Brass Co. and the Bridgeport Brass Company.

The 'safety-first' work of the company also has a place. Copies of *The Anode*, the safety-first publication of the Anaconda company, and of *The Ingot*, which fulfills a similar function at the Raritan Copper Works, are on hand for distribution.

OPERATIONS of the Amalgamated Zinc (De Bavay's) flotation plant on Broken Hill tailing during the 28 days ended January 30, were as follows: tailing treated, 18,608 tons; zinc concentrate produced, 4763 tons, assaying 49.3% zinc, 8.7 oz. silver, and 5.6% lead; and 36 tons lead concentrate, assaying 54.5% lead, 56.9 oz. silver, and 14.5% zinc. The estimated income was $67,000, and net profit $9500.

Leaching of Copper Ores by the Hoffman Process

By FREDERICK J. POPE

*In our first study of leaching work, we had to decide: The solvent we would use; how we would precipitate the copper from the solution, and what we would do with the iron in the electrolyte. Without going into the details of the reasons, we decided that sulphuric acid would be the most satisfactory solvent, and that we would recover the copper from the solutions by electro-deposition. As to how we would take care of the iron in the electrolyte, we had to choose between controlling the iron (keeping it in the ferrous state) in the solution, and eliminating it from the solution. The removal of the iron appeared to offer the more attractive field.

Briefly, the method involved leaching with sulphuric acid, removing a portion of the iron from the solution, and precipitating the copper electrolytically.

Regarding the leaching itself, I do not think I could say anything that would be of any particular interest. There are certain factors which govern the extraction of copper from an ore, and when these factors are given due consideration, I think we can get about the same extraction with one process as with another.

In considering how to remove iron from the electrolyte, we were reminded of the work which had been done by Hoffman at Argentine, where he precipitated iron from bluestone solution. Hoffman accomplished this by heating the solution in a suitable tank, agitating with air, and adding copper in an oxidized form. I think he used a roasted lead-copper matte. This work of Hoffman's gave us our idea for the removal of iron from the solution.

For the copper oxide necessary in this work we have used high-grade copper carbonate ore, oxide formed by the roasting of cement copper, roasted high-grade sulphide ore, also roasted copper sulphide concentrates. In our demonstration plant (10 tons daily capacity of carbonate ores) we used roasted concentrate. The concentrate was roasted in a small Wedge furnace, the results obtained being far better than those attained in our preliminary work when we roasted the same class of concentrate in a laboratory muffle-furnace.

In order to obtain a satisfactory reaction between the copper oxide and the iron, etc., in the solution, it is imperative to have the oxide material very finely divided. The roasted concentrate we used was ground in a small Abbé mill. We found that with a 5 or 6-hours grinding we obtained a product 93% of which would go through a 200-mesh screen. Probably if we had had time to investigate this grinding operation, we might have found that it was not necessary to grind for 5 hours, but owing to the shortness of the period at our disposal for securing results, we did not have the opportunity to bring this operation down to the shortest time-limit.

From the Ajo carbonate ore we removed a little more than 2 lb. of iron per ton of ore treated. In order to keep the iron in the solution below the percentage deleterious to electrical efficiency, it was necessary to treat approximately one-quarter of the solution. We found that by manipulating the solution going on and off the ore in a certain way we could concentrate a large proportion of the iron in a certain part of the solution. This was accomplished as follows: The first solution going on the ore carried about 2.5% free acid and was kept on the ore by circulating until it was approximately neutral. This neutralizing precipitated from the solution on the ore a considerable proportion of the iron, alumina, etc. This neutral solution was drawn from the ore, and after acidification by electrolyte coming off the electrolytic vats was sent to electrolytic vats for precipitation of the copper. As the first solution was withdrawn from the leach it was replaced by fresh solution. This fresh acid solution not only removed some more of the iron from the ore, but also picked up the iron which had been precipitated from the first solution used. This second solution now high in iron was circulated until it was nearly neutral, when it was replaced by fresh solution carrying 4 to 4.5% free acid, which completed the leach. The total leaching period averaged about 80 hours. The solution high in iron, etc., was sent to that part of the plant where removal of iron and other impurities was accomplished.

In purifying the solution it was first heated to 195°-200°F. When this temperature was attained, agitation with air was begun and the finely ground oxide material was gradually added. Maintenance of a temperature of about 195°F. and agitation with air was continued for 3.5 hours. During the first hour all the ferric iron was precipitated. The removal of the ferrous iron was slower and we found that it was not advisable to endeavor to precipitate it all. In 3.5 hours we easily precipitated 90% of the total iron and at the same time removed 65 to 75% of the alumina, 50% of the manganese, and any arsenic, antimony, and bismuth.

After the above operation the pulp was passed through a Schreiber wooden filter-press. The solution came out beautifully clear and was sent to the high-acid electrolytic circulation-system. We anticipated that with the precipitate produced we might have trouble with the filter-cake; that it would be slimy and difficult to handle. We did not find it so. The cakes were two inches thick, firm, washed well, and the amount of copper in the form of unused oxide was well

*This record of investigations made by Messrs. Frederick J. Pope and A. W. Hahn was submitted by the former at the January meeting of the New York section of the American Institute of Mining Engineers.

within commercial limits of metallurgical work.

As chemists are well aware, when iron sulphate, aluminum sulphate, etc., react in the agitation-vat with the copper oxide, they give up their acid radicals to the copper, forming copper sulphate, which in the electrolytic vats yields sulphuric acid, so that the only loss of acid is that due to combination with the alkalies and that due to loss by entrainment in the tailing. This acid loss we found we could easily replace by a proper control of the roasting of the concentrate in the Wedge furnace; that is, we could so control the roast as to maintain in the calcine sufficient copper sulphate either as water-soluble sulphate or as basic sulphate to compensate for the acid-losses to which I have referred.

Regarding the electrolytic part of the work, we simply followed standard vat-house liberator-vat practice. Our anodes were antimonial lead, 4% antimony. We tried both grids and sheets. With the grids our voltage was 0.3 volt higher than with the sheet anode, and we discarded the grids in favor of the sheets.

With reference to the use of a lead anode, I might say we commenced our work with some apprehension, fearing that there might be a serious loss of lead. We made a number of protracted tests and as a result we calculate that the cost for lead anodes at Ajo with lead at 8c. per pound would be less than 0.2c. per ton of ore treated.

In the process I have outlined there is really nothing new or novel. It simply consists of an idea picked up here and another there, and the putting of these various ideas together.

If we were to criticize the process, the pros and cons might be summed up about as follows:

Advantages:

a. Simplicity.
b. Every step in the process has been in use in commercial plants for years.
c. Saturated solutions avoided.
d. Wash water not excessive, and if it should become so, it can be regulated.
e. Impurities that would injure the quality of the electrolytic copper are eliminated from the electrolyte.
f. Acid control very simple.
g. No step in the process is dependent upon fine adjustments.

Disadvantages:

a. High and low acids used. This necessitates more solution-storage vats, more solution lines, and more pumps than if a single solution were used.
b. There is an extra operation: namely, purification of electrolyte, which involves the installation of a roasting-furnace, boilers, compressor, and filter-press.
c. The lead anodes will probably have to be changed at the end of four or five months, since the lead peroxide scale will increase the voltage.

J. Parke Channing, commenting on the foregoing, said: The problem presented in the Miami district is a little different from that in the districts mentioned in this discussion, inasmuch as the ore to be treated there is one which is a mixed chalcocite and carbonate. The gangue is particularly free from any impurities that go into solution, but the fact that both chalcocite and carbonate are present makes it a difficult problem. The particular ore deposit upon which we worked was that of the New Keystone, but the same class of ore existed in the Miami and also in the Inspiration. The problem therefore presented to us was either a straight leaching one, which would have to be preceded by dead roasting, or else it would be a mixed process, water-concentration followed by leaching, or possibly leaching followed by water-concentration; and then finally, if flotation came in, we might have to make three bites of the cherry, that is, use water-concentration, flotation, and leaching. You can readily see there would be a great many combinations; whether it would be desirable to leach first, then concentrate by water, and then float, or whether it might be desirable to make the sequence different, we do not know. This Keystone ore averages about 2¼% copper, of which anywhere from 30 to 40% is oxidized. After making a number of concentration tests we decided upon attempting a dead roast; in other words, converting all the copper into a soluble form and leaching it.

R. C. Canby said: The only thing I can think of which has not been mentioned is the circulation of the electrolyte. In our electrolytic work I designed the cells so that the solution, instead of flowing lengthwise against the flat surfaces of the anodes and cathodes, flowed crosswise. In that way, in the use of sulphurous acid gas, I had hoped, by having a rapid circulation, to use a much smaller quantity of both copper and the depolarizing element in the electrolyte, with a correspondingly stronger current, and also to be able to precipitate the copper without heating the electrolyte. I was able to use a current density as high as 10 or 12 amperes per square foot with the temperature of the electrolyte about 18° to 20°C., and get a satisfactory coherent deposit. I think that was the only novelty in the electrolytic work.

As regards roasting in an oil furnace, the problem was to use our 14°B. fuel-oil, to be burned at a temperature of 2000°, and yet keep our ore-bed at not to exceed 800° to 1000°C. I accomplished this by using a furnace similar to that used for the Huntington & Heberlein process at El Paso, and at three other American smelting plants, the hearth revolving past the flame, so that I was able to roast the ore without at any time bringing the temperature of the roasting ore above the desired 1000°C., whereas the fuel was being burned at about 2000° or a little over. The furnace was entirely of reinforced-concrete construction and stood well.

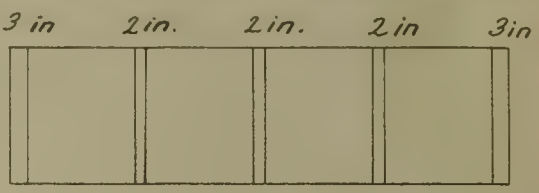
It would be much better if all of the oxides could be treated in the present plant, and we are now working to that end, so as not to have a separate installation for the semi-oxidized ores.

A Temporary Zinc-Box

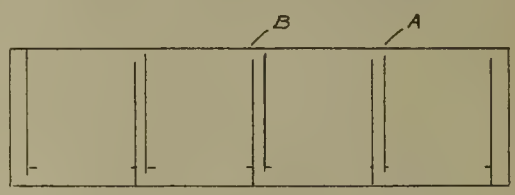
By A. W. ALLEN

The following description of a simple type of zinc-box refers to an instance when the operation of a newly erected plant in an outlying district in South America was delayed on account of the non-arrival of the necessary equipment. The only material available for the purpose was 18-gauge flat galvanized iron in 3 by 7-ft. sheets, and the boxes were made at the rate of two a week by two (native) tinsmiths, two helpers, and a 'handyman.' When completed and in position they were neat in appearance, and conveniently proportioned with regard to dressing and cleaning up, and had a capacity of 18 cu. ft. per box.

The two pieces forming the bottom and sides are first riveted together, allowing an inch overlap. A centre line is then drawn lengthwise of the sheets and parallel lines made on each side at distances of 11½ in. from the centre line. The sides are then bent up at right angles, keeping exactly to the marks. The two ends are next cut and bent (Fig. 1); one of them having a hole for a discharge pipe cut in it about 8 in. from the top. The discharge arrangement is best and easiest made by taking a short 2-in. nipple and using backnuts on each side with rubber washers. The nipple should screw into the discharge hole. The ends are next riveted on. A slip-ring of ⅜-in. round iron is next made the exact outside measurement of the box, the loose ends being welded together. This is then slipped over the top of the box, and the inch at sides and ends allowed for the purpose is then hammered around the iron and finally soldered. All points on the outside of the box are then soldered. The inside box is now carefully marked for the division plates. The sides and bottom of the division plates must be all bent one way, and the rivets necessarily come inside the compartments and not in the divisions between the latter. Angle iron 1 by 1 by 20 in., made from the same galvanized iron, is used to support the screens, and is fixed to the division plates before the latter are put in position. Their position on the plates is shown in the section. Holes for ½-in. bolts are next cut 1½ in. from each end on both sides of the box, about four inches from the top and four inches from the bottom of the box. A pair of holes are also cut in each side of the box at the centre, and also four inches from the top and bottom. These holes are for the legs (see drawing in perspective). The holes are filed down evenly, and any projecting edges are hammered flat. The legs are made from 2 by 3-in. Oregon pine, the outer pieces being 38 in. long, cut down ½ in. deep on the broad side for a distance of 22 in. Below this point a cross-piece 22 in. long (also 2 by 3 in.) is simply nailed on with 5-in wire nails. The legs are then placed in position and marked for the bolt-holes, care being taken that the box sets well on the stringer. The legs are then bored and replaced. Twelve bolts ½ by 2½ in. are needed for each box, each with two iron and one ⅜-in. rubber insertion washer. The washers should fit tight on the



PLAN.



SECTION.

FIG. 1.

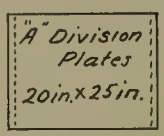


FIG. 2.

FIG. 3.

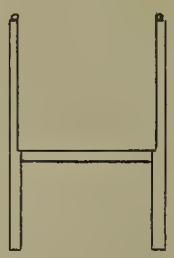
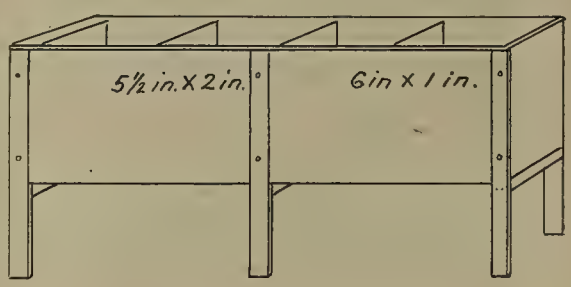


FIG. 4.



PERSPECTIVE DRAWING.

bolt, and are placed next the box on the inside, an iron washer coming inside them and then the head of the bolt. The extra iron washer is used outside, and a tight joint results if ordinary care be taken. The *B* division plates are then put in and riveted, and the joints soldered. Finally, the *A* division plates are put in and the joints soldered.

For the discharge arrangements a number of plates, one for each compartment, of $\frac{3}{16}$-in. iron were taken, $2\frac{1}{2}$ in. square. In the centre of each of these a hole was punched and tapped for 1-in. pipe. At the corners of each plate a small hole was punched to take a galvanized-iron roofing-bolt. Iron plug-cocks, 1-in., were used with a short nipple in each. This was screwed tight into the plate and the pipe projecting was sawed off and filed down smooth. One-inch discharge-holes were made in the bottom of each compartment, preferably near one side of the box. The plates are bolted on from the outside, the semicircular screw-heads of the bolts being inside the compartment. The plates should be perfectly clean and free from grease, and be soldered in together with the head of the bolts.

To arrange the box on a sloping floor, possibly sloping in more than one direction, cut a number of wedges of varying thickness, about $1\frac{1}{2}$ by 2 in. Place these under the legs of the boxes when the latter are where they will be eventually required, so that the plates are level and the boxes have a slight fall from head to discharge in the length. Take a block of wood slightly more than the amount the highest leg is off the ground and then mark all the legs, keeping the block on the ground and against the leg. The legs are then cut at the marks and the box replaced.

Sociological Work by the Phelps-Dodge Companies

The annual reports of Phelps, Dodge & Co.'s subsidiary companies contain the following notes on the interest taken in employees' welfare:

Copper Queen, Arizona. Accidents causing loss of time during 1914 were as follows:

	Bisbee.	Douglas.
Fatal	7	none
Serious	121	19
Minor	1320	175

The first-aid and safety department, under the management of Wallace McKeehan, safety inspector, did conscientious and efficient work.

The annual report of the state mine inspector for the year 1914 shows a smaller percentage of injuries of all kinds among employees of the Copper Queen than among the men of any other of the large mines of the state.

As applicants for underground work are now required to pass a physical examination, the higher physical condition of the men, combined with the rules of prudence and scrutiny which the safety-first practice imposes, not only on the men but on the companies, will certainly in time reduce the death rate and accident list below its present appalling figure.

The Employees' Benefit Association had an income of $43,172, of which members contributed $35,296 and the Copper Queen company $7500. Deaths absorbed $17,640; accidents, $13,290; sickness, $20,945; and general expenses, $3099. The year started with a balance of $17,503, and ended with $5700. The Company will increase its payment to $12,500 per year.

Nineteen employees have taken advantage of the pension system offered by the Company. During the eight months of its operation, $6182 has been paid to old employees.

Dr. F. E. Shine, superintendent and chief surgeon of the hospital department, submits the following report of work during the year: Income from fees, $88,783, and expense of maintenance, $89,380, leaving a deficit of $596. The work at Bisbee consisted of the following: patients admitted, 618; patients cared for, 980; births, 58; deaths, 43; total meals and diets, 53,358; hospital operations, 246; dispensary operations, 320; house calls, 12,451; dispensary calls, 39,488; examinations for Employees' Benefit Association, 2055; and X-ray pictures taken, 472; and at Douglas: house calls, 9615; dispensary calls, 20,023; operations, 61; births, 60; and deaths, 23. The staff consists of 10 physicians and surgeons, seven being stationed at Bisbee and three at Douglas. Outside of the regular practice of the department, the staff continues to make examinations for the benefit association and reports under the compensation law. During the year physical examinations of all applicants for work in the mine department has been made and recorded. A new dispensary building was completed and turned over to the hospital department by the Company on October 1.

At the Copper Queen smelter, safety work has been of great interest to everyone on the plant, and a great many devices have been installed, most of them suggested by the men themselves.

Detroit, Arizona. The general health of the camp was good. There was an epidemic of scarlet fever in the spring, but no fatalities. Only two cases of typhoid originated in Morenci during the year, and both of these were mild. The improved sanitary condition is due to the extension throughout the property of a sewer system.

The first-aid class for 1914 was started in January with an attendance of over 50, but it is difficult to sustain the interest of the men at large in its movements.

The average number of employees in the various departments for the year was 1438.

Stag Cañon Coal Mine, New Mexico. Lessons and practice in first-aid work are made compulsory with certain employees in each mine. The men, of course, are paid for the time they are employed in practice. A monthly dinner is well attended by the heads of the various departments, mine bosses, inspectors, and others, as a preliminary to the reading of papers and a general discussion on local and general technical subjects.

CONCENTRATES

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Babbitt metal contains 67% tin, 22% antimony, and 11% copper.

Zinc-shaving consumption in Western Australian cyanide plants amounts to about 75 tons per month.

Gasoline being short in Germany, sugar-beet alcohol is being produced for use in automobiles and aeroplanes.

Contractors in the Broken Hill South mine last year earned $4.36 as miners, and $3.48 per eight-hour shift as trammers.

Normal faults are those in which the rock forming the hanging wall of the fault has moved downward along the foot-wall of the fault.

Sectionalized rolls are made up to 12 by 24-in. size. The spare shells for this size would weigh about 350 lb. each, which is almost a limit for mule transportation.

Blood poisoning may easily be caused by having some skin knocked off any part of the body, and then rubbing the wound with dirty hands that may be infected.

Cost of filling stopes at the Broken Hill South mine in 1914 was 90c. per cubic yard of filling, and 20c. per ton of crude ore extracted. This included all charges on handling 25,698 tons of residue and ash.

Oil shales in Scotland yield from 20 to 30 gallons of crude oil per ton, and those of New South Wales yield from 60 to 120 gallons. The distilling-retorts used in Scotland are not suitable for the richer Australian shale.

Corrosion of brass is due to dezincification, the chemical and mechanical action being subsequent. Such deterioration proceeds faster in unannealed than in the annealed alloys. Iron and lead in small quantities stimulate corrosion.

Many unusual mining methods are practised in the Joplin zinc-lead district of Missouri. One of the latest is the idea of L. C. Morgan, at Duenweg, who owned a drill-rig, and during sinking placed it against the shaft and used it as a hoist.

Gold production of the North Star mines, Grass Valley, California, from May 1884 to the end of 1914 amounted to $16,360,776 from 1,248,534 tons of ore, an average of $13.104 per ton. Of this total, $6,219,236 was profit, and $4,537,040 was distributed in dividends to the shareholders.

Of the total recovery of gold at the North Star mill, Grass Valley, California, in 1914, 79.04% was by amalgamation, and 20.96% by cyanidation. The tailing from the cyanide plants assayed 30.5c. per ton, making a total loss of $30,500, or about 3% of the total gold content of the ore.

Locators of coal-lands in Alaska under the laws prior to the passage of the Leasing Act approved October 20, 1914, are permitted to carry their claims to a final determination in the proceedings now pending before the Department of the Interior. The act provides that no lease shall be made of a pending claim until after it is finally disposed of by the Department adversely to the claimant.

Lead poisoning sometimes occurs in manufacturing storage batteries. An ordinary storage battery consists of plates of lead, or of lead grids, covered with a lead oxide paste. In making the plates or grids the worker is exposed to the dust of the metallic lead and to its fume when melted. By using hoods and exhausts over kettles and by keeping the work-places strictly clean, these dangers can be much reduced. Making and applying the paste involve handling lead oxides, which are much more dangerous than handling metallic lead. The oxides must first be mixed, which is a dusty job, and then made into paste. Both these operations can be done by machinery under cover, thereby greatly reducing the danger to the worker. In most of the plants recently investigated in the United States, according to the Department of Labor, however, either such protection was not furnished or it was used so carelessly that it was of comparatively little effect. In the United States there are five large factories making storage batteries, one in Ohio, two in New York, and two in Pennsylvania. A great many smaller plants, employing from 5 to 15 men each, are scattered about the country. The investigation dealt principally with the five large plants. The cases of lead poisoning found in storage-battery work are usually acute, with colic and, in severe cases, encephalopathy, but not paralysis. The severer forms of plumbism are not common. In comparison with Germany and Great Britain the storage-battery industry in this country makes a bad showing. In the largest German factory the rate of lead poisoning is less than 1 per 100 employees, and in Great Britain it is about 3 per 100. In the five largest factories here the rate, based on reports known to be incomplete, is almost 18 per 100. The difference is due to the neglect in the United States of factory sanitation and of personal care of the men employed.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

KALGOORLIE, WESTERN AUSTRALIA

Relief Fund for Miners.—Rain and Prospecting.—Edna May Mine.—Great Boulder Reserves.—Future of the Associated.—Ivanhoe and Horse-Shoe.

The Mine Workers' Relief Fund has now been placed on a working basis with a board of control of five members, consisting of two representing employers and employees, respectively, and one representing the Government. The annual contributions are expected to reach $72,000. The subscription for the first half of February amounted to $2880, so that it looks as if the estimate of revenue is on the conservative side, as, when a canvasser starts work, new members are likely to be enrolled. There is no doubt that the scheme is a good one, and will ensure provision for every worker without any semblance of charity.

Owing to the unprecedented rains of the last four months there is water everywhere, even the so-called salt lakes being real lakes, many of them for the first time since the discovery of Coolgardie (1892). As a consequence there is a good deal of activity in prospecting. The Government and Chamber of Mines are co-operating in supplying camels and tools to any genuine prospectors who apply. Already 50 parties have been equipped, and there are more to follow.

Owing to the great success of the Edna May at Westonia, Melbourne speculators are as excited as during the Bullfinch boom of five years ago. Already a dozen companies have been formed to take up areas within a radius of five miles, which, so far as known, contain neither lodes nor gold. In every case the shares offered are over-subscribed, and almost immediately rise to a premium. The market valuation of the group is $1,500,000, of which the Edna May alone accounts for half. Since its formation in February 1913, this company has produced 45,000 tons of ore, yielding $981,000, of which $428,500 has been distributed in dividends. Three levels only have been opened, at 75, 150, and 225 ft. The main shaft is now down to 300 ft. There is still a good deal of controversy as to whether the lode will persist, or be cut off by granite, as happened in the case of the lode of the adjoining mine, the Greenfinch. Already two floors, or spurs, of granite have been passed through, one 18 in., and the other 8 ft. thick, and whether solid granite intervenes, as in the Greenfinch, remains to be proved. The position is interesting both from a geological and a speculative point of view.

The two eastern lodes in the Great Boulder, at Kalgoorlie, are still being tested by diamond-drilling from the Perseverance workings. Average ore has already been found by trenching on the surface at various points, covering a distance of 1200 ft., and bores have been put in at 1100, 1250, 1450, and 1800 ft. The drill is now operating at 2200 ft. The manager, Richard Hamilton, appears to be sceptical as to the persistence of the lodes, but, judging from the steady rise in the price of the shares, the market takes a different view. Until cross-cutting and driving is started the real value of the discoveries will remain in doubt, as in few cases have diamond-drill results proved trustworthy on the 'Golden Mile.' Reserves in the Great Boulder on December 31, 1914, are estimated as 627,900 short tons, worth $13.62, against 688,900 tons, worth $13.26 a year previously. Since shaft-sinking was stopped, in 1911, 641,800 tons has been milled, giving an average yield of $12.72, equivalent to an extraction of 95.87% of the estimated gold content. During this period the ore reserves have fallen from 782,400 tons, worth $13.26, to 627,900 tons, worth $13.62, or 154,500 tons. This shows that 487,300 tons has been developed in the old levels without reducing the value of the ore, or of the profits. The present reserves are sufficient to keep the mill running three years, but, if ore continues to be found, as in the last three years the life of the mine will be prolonged beyond that period, even if the eastern lodes provide no ore at all.

Since Malcolm Maclaren stated in 1913 that it was useless for the Associated company to look for ore in the bottom,

GEOLOGICAL MAP OF WESTERN AUSTRALIA. THE EDNA MAY MINE IS JUST SOUTH OF THE 'D' IN YILGARN GOLDFIELD.

or calc-schist zone, work has been devoted entirely to the upper levels, and to sinking prospecting shafts. The result, unfortunately, has proved unsatisfactory. The grade of ore now available is too low to be profitable, and the mine is not likely to last much longer. To meet a deficit every month can hardly be expected of any group of shareholders.

The Ivanhoe main shaft in the middle of January was down 3226 ft. Sinking is still in progress. In February the mill treated 18,127 tons of ore yielding $8.14 per ton. The profit was $48,000.——On March 9 the Horse-Shoe main shaft was down 2982 ft. At 2480 ft. No. 4 lode is 8 ft. wide, assaying $8.12 per ton.

The gold yield of the state in January was $2,097,000. Dividends amounted to $509,300. The totals to date are $602,686,000 and $125,771,0000 respectively.

TORONTO, ONTARIO

Changes in Dome Officials. Dividend Talk. Diamond-Drilling. Larger Mill Capacity.—Vipond Affairs.—Smaller Porcupine Properties.—Nickel Mining.

The recent strong advance in price of some of the Cobalt and Porcupine mining shares has served again to draw the attention of the public to these securities. Brokers are doing their best to stimulate this interest and to make capital out of it. The most interesting rise was in the Dome. This jumped from $6 to $14 per share in a few days. This movement immediately followed the announcement that Ambrose Monell had resigned the presidency of the company and was succeeded by J. R. De Lamar. Several other officers and directors also resigned. The new president is one of the best known mining men in the United States, and the market excitement is generally credited to his influence. Apart from this, the impression among brokers and mining men is that in the future some shares will have a more stable market at higher prices than prevailed before the recent advance. Persistent rumors are to the effect that a dividend would shortly be declared at the rate of 10% per annum; but they have been quieted by the semi-official statement that such is not contemplated at present. Recent encouraging developments on No. 4 and 6 levels have been responsible for shareholders thinking this. From the No. 6, 544-ft. level, a horizontal diamond-drill hole passed through 157 ft. of ore assaying $16.48 per ton. This is the greatest width of any such grade of ore that has been found below the 100-ft. level. While it is too early to say what the full extent of this discovery may be, it is considered as being indicative of important developments in the future. It also has stimulated the belief that the grade of the ore in future will be higher than was estimated in last year's report, in which the reserves were given as 3,000,000 tons averaging $3.80. Plans are being prepared to increase the capacity of the mill from 23,000 to 28,000 tons per month, and underground development will have to keep pace. Underground electric haulage will be installed. A large crusher is now being erected on the bottom level. At the present time the company is operating its reserve steam-plant on account of the small supply available from the hydro-electric plants on the Mattagami river, which is low.

The annual report of the Vipond company shows that it is emerging from its difficulties satisfactorily. Liquid assets amount to $41,275. A good profit is being made each month. It is expected that the bonded indebtedness of $65,000 will be paid off within six months. Ore reserves are estimated at 48,300 tons, having a gross value of $430,000. Vipond shares advanced over 30 points in three days. This, however, is supposed to be the result of squeezing the 'shorts,' and the move seems to have succeeded admirably. At 89c., which is the last quotation, the property has a market value of over $700,000, against a net profit of about $125,000 contained in the ore reserves. This is after deducting losses, working costs, and bonded indebtedness.

Several of the smaller properties in Porcupine are receiving more attention. The Apex company is to be reorganized. ——Efforts are also being made to finance the West Dome.—— The Gold Reef has been leased to a new company. It will pay a royalty of 15% of the gross output.——The Schumacher is breaking ground for a new mill. It will use rolls and ball-mills.——The Rea, with only four months' ore reserves, is diamond-drilling.——The Miracle company will increase the capacity of its mill from 40 to 150 tons per day.——The Lally mine, a few miles west of the Hollinger, will do a considerable amount of work this year. A cross-cut on the 100-ft. level has shown about 12 ft. of $5 ore.

The publication during the past few weeks of the annual reports of a number of Cobalt companies emphasizes the fact that the district has passed its best days, and is now declining rapidly. Almost all of these reports show decreased production, ore reserves, and profits. Lower prices were obtained for silver, while higher production costs ruled.

The demand for nickel is such that the Canadian Copper Co., at Copper Cliff, is making every effort to increase production. It is gratifying to note that a large part of the demand is for industrial purposes. Blast-furnace practice has progressed to the stage where it is no longer necessary to use the reverberatories to treat the 'fines.' The large demand for nickel necessitates the installation of a new blast-furnace. At the Creighton mine, a new inclined five-compartment shaft is being sunk. A complete new hoisting and rock-crushing equipment will be erected. A large number of workmen's houses will also be built. It is estimated that the cost of all these improvements will be about $750,000.

NEW YORK

On 'Change.—Alaska Juneau.—Copper.—Amalgamated Copper.—Inspiration.—Flotation Suit.—Lake Copper Costs. —Tin.

After having had the extinguisher placed on the early efforts to make trading capital out of the anticipated allotment of Alaska Juneau shares, the allotment has been finally made. The issue was several times over-subscribed. Open-market quotations have been made this week as high as $16 per share. This enabled a good many of the subscribers to reap a quick and substantial profit. It is fortunate for the mining sharemarket to have a leader of the caliber of Alaska Juneau, especially just at this juncture, when apparently all faces have been turned toward the rising sun of—to use the phrase of the Street—'a primary bull market.' It has been, literally, years since Wall Street has seen anything like the scenes of activity now being enacted. The trend of talk has changed. The old atmosphere is coming back. If those who make up the population within earshot of Trinity's chimes could dictate, there certainly would be no dampening of the current growing enthusiasm. Alaska Juneau, under the conditions outlined, may possibly develop a market behind itself for other issues, so that presently it may be possible once again for a mining property to secure some reasonable support and distribution through the market. This is a consummation much desired. A rather queer situation has developed in arbitrage in mining shares between New York and Salt Lake City. There has been a good deal of booming of the camp of Alta, Utah, of a kind not altogether above criticism; but it has created a considerable public demand. The Salt Lake City brokers are getting the money, much to the disgust of the New York contingent, with the exception of a few with wire connections.

No small part of the strength of the recent market has been in the copper stocks, reinforced by the avidity with which the metal is being absorbed. Prime Lake is quoted at 18c. per pound, at which level it shows no evidence of any curtailment of consumption. Trade gossip is to the effect that enormous sales of electrolytic are being put through at a fraction under 17c. It is hardly necessary to add that mines, smelters, and refineries are all under orders to get back to normal capacity as quick as possible. Whether or not it is a case of making 'hay while the sun shines' is hard to tell. The present insatiable demand for copper is due to requirements for ammunition. The more remote, but equally important, question is, what will be Germany's position when peace is made? Germany was our best customer for copper, and that country's position when the struggle ends will be important as to whether there is immediately to ensue a period of reconstruction or whether there will be a more or less prolonged period of prostration. Should the latter be the case, reliance will have to be placed on the producers so to handle the situation as to prevent the piling up of large stocks.

It is stated that within 30 days some definite plan to dissolve Amalgamated Copper will be announced. What a passing it will be, and what a fund of reminiscence will be uncovered! Rogers, Lawson, Heinze, and 'the days that were, the days that were.' In the meantime the shares have risen on the strength of the announcement of impending dissolution.

Inspiration is getting a great deal of publicity just now. Its career as a producing mine is soon to begin, and it is entirely natural that interest and enthusiasm should increase at this time. As an instance of how rapid this forward march has been, it was stated in a discussion concerning Inspiration recently that only 12 years ago the original owners of Inspiration were trying to sell shares at 10c. each. Now the property has a market value of $22,900,000, not including bonds of $10,500,000. It is to be the second largest single copper producer in the United States. Operating costs at the Inspiration will be interesting to follow. The Miami company has just published its costs for 1914. They were 9.29c. per pound against 10.60c. during 1913. Inspiration will handle much larger tonnages than does Miami, and as the properties are physically one Miami's results may be taken as a close guide for approximate results to be obtained at the Inspiration.

Evidently the suit being heard at Wilmington, Miami *v.* Minerals Separation, is of much greater importance than would appear simply from the record. Technically the Miami is defendant in a suit for the infringement of the Minerals Separation company's patents. As a matter of fact, the Miami is fighting a case in which nearly all of the low-grade milling copper companies are interested. For instance, Anaconda has developed a flotation process which is expected to add 50,000,000 lb. of copper to its annual output. This has hitherto been lost or impounded in the mill tailing. One of the interesting points of the fight of the Minerals Separation to uphold its patents has developed by reason of the fact that the decision of the Supreme Court in the Hyde case, which was adverse to the former, is in direct conflict with the recent decision of the Privy Council in England. This conflict is to be made the basis for a petition for a rehearing in the Supreme Court, on the ground that conflict of the decisions of the two Courts, both of last resort and of equal dignity, has created an intolerable situation, which should be recognized and in some way cured.

One of the interesting developments of the moment in the copper situation is the passing to the head of the list of low-cost producers of one of the Lake mines. The Champion, of the Copper Range group, is producing copper at 6c. per pound. Ahmeek has been the cheapest operated of the copper country, but never got its costs down to so low a figure. The Champion mine is yielding about 30,000,000 lb. of copper per annum.

Arizona Commercial, which has had a long up-hill struggle, is about to become a regular shipper to the Old Dominion smelter.

The tin market has been peculiar. American dealers found themselves unable to secure tin which should have been forthcoming. Investigation revealed the fact that Germany was getting large quantities of tin through certain channels in England. This resulted in England placing such restrictions on tin shipments as to make it difficult to replace stocks. The supply of tin now in the United States is lower than it has ever been, and an unstable and erratic condition has been created. Price of the metal has moved between 45 and 58c. per pound.

Reports of the Chino, Miami, Nevada Consolidated, Ray, and Utah Copper companies have been issued. As usual, they are excellent examples of what annual reports should be. They contain enough information to satisfy all interested. The plans and photographs show what is being done on the surface and underground. Abstracts of the reports will appear in future issues of the *Press*.

VICTOR, COLORADO

Golden Cycle Mill.—Cresson.—Ajax Mill Closed.—Drainage Adit.—Portland Mine.—Stratton's.—Vindicator Mill.

The Golden Cycle Mining & Reduction Co. has made its appearance on the market, and shares are now offered for sale. Quotations on April 17 were $1.88½ and $1.90. In the recent merger the Vindicator Gold Mining Co. acquired the Golden Cycle mine. It paid $1,500,000. This settled the Christmas lawsuit against the Golden Cycle, in which the Vindicator claimed $1,000,000 for ore unlawfully extracted. The balance of the Golden Cycle holdings, the mill at Colorado Springs, and the coal mines there, together with various properties in the Cripple Creek district known as the United Gold Mines Co., are merged into what is now known as The Golden Cycle Mining & Reduction Co. The new company is capitalized at 1,500,000 shares of a par value of $1. The directors are A. E. Carlton, E. P. Shove, H. G. McGarry, Irving T. Snyder, Richard Roelofs, Spencer Penrose, and J. F. Burns. They are all well known in Colorado, especially in the district. Dividends of 24c. per year are predicted. In the prospectus some interesting figures are given of the operation of the mill:

	Ore treated. Tons.	Bullion recovered. Value.
January	27,194	$ 571,063
February	27,056	721,799
March	29,000	1,305,000

The average value of the ore treated in 1914 was $19.16, compared with $16.28 in 1913. Ore treated from 1908 to April 1, 1915, totaled 2,440,770 tons. Bullion extracted amounted to $43,739,385.

The development made on the No. 12 level of the Cresson in December last has yielded a gross value of $1,500,000 to date. A good deal more is in sight.

The Ajax mill stopped on April 10. Apparently this was due to lack of ore. This mill started operations in November 1911. The Clancy process was used. The plant had a checkered career. It was altered and re-altered a number of times until, at the close, it was conforming to standard practice of concentrating and cyaniding. It is reported that the shaft of the Ajax mine is to be sunk.

Bids are now held by J. F. Burns for the extension of the Roosevelt drainage adit from its present heading, approximately under the Gold Dollar shaft, to the Elkton shaft. The new hoist at the El Paso main shaft, replacing the one destroyed by fire some time ago, is now at work. Air will be supplied and waste hoisted through this shaft. The adit is at present discharging about 12,000 gal. of water per minute. Water-level on Battle mountain is 8473.29 ft. above sea-level, making a total recession to date of 391.21 feet.

Construction of the Caley mill at the Jerry Johnson mine, on Ironclad hill, is rapidly nearing completion. This will be a 100-ton cyanide mill, suitable for the oxidized ore which occurs in that property.

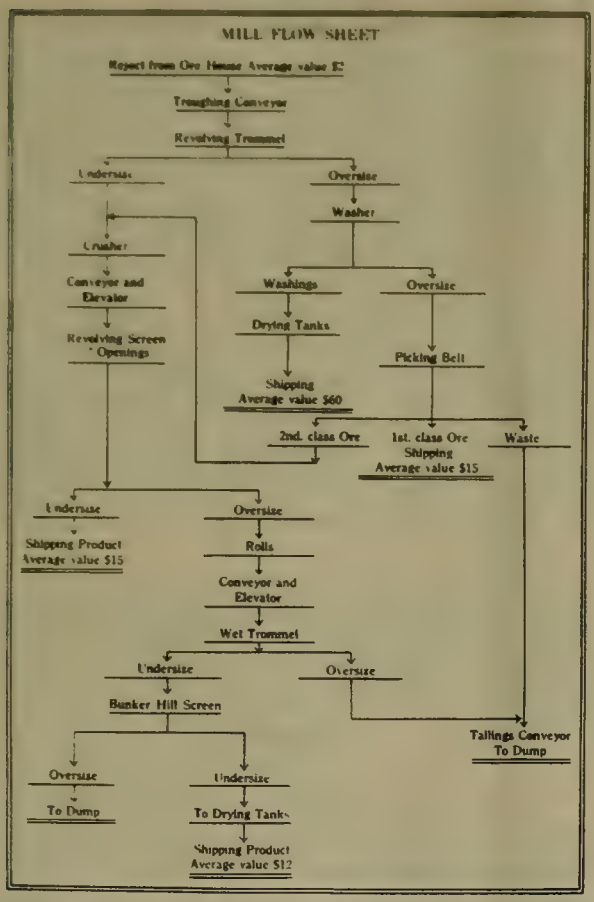
The 1750-ft. level of the Portland mine still continues to show rich ore. Development proceeds vigorously.

At Stratton's Independence the Mill vein system has produced well during the past year. It is now better than ever on the 500-ft. level, though a distance of 500 ft. into the granite. On this level, 300 ft. south of the shaft, the heading shows an eight-inch streak of manganese-colored mud assaying over $600 per ton. In the stopes, over 2-oz. ore is broken, and heavy shipments are being made. The dump at the mill is getting small. Probably not more than six months more will be required to clean it up. After that the mine will have to keep the mill in operation if it can.

The Vindicator screening and washing mill is working steadily. It deals with about 300 tons per day, and returns

a fair profit. The mine is shipping a good tonnage of $60 ore. With its additional area in the Golden Cycle, it must be regarded as the big mine of the district. No changes in the casting system have been made so far.

A 'Greater Cripple Creek' edition has been published by



MILL AT VINDICATOR MINE, CRIPPLE CREEK, SAVING $12 TO $60 PRODUCTS FROM ORE-HOUSE WASTE.

The Daily Mining and Financial Record of Denver. It consists of 20 pages with illustrations, covering all phases of the Cripple Creek district.

BOSTON

THOMPSON, TOWLE & CO.—STOCK EXCHANGE AND CURB.—THOMAS W. LAWSON.—SOUTHWESTERN MIAMI.—NEVADA-DOUGLAS.—LAKE SUPERIOR COPPER.—FORTUNA MINES.—BOSTON & MONTANA.

The most important change which has taken place in Stock Exchange circles here since the first of the year has been the long-expected dissolution of Thompson, Towle & Co. W. B. Thompson, the head of the firm, retires from the brokerage business, probably on account of his official connection in New York with the Federal Reserve Bank. George N. Towle becomes a special partner with Joseph N. Lovell, formerly a member of Thompson, Towle & Co., who has formed a new firm under the name of Lovell & Co. W. F. Pillsbury becomes a general partner. W. F. Bartholomew, for 17 years one of the chief associates of C. W. Barron on the *Boston News Bureau* and for five years a member of Thompson, Towle & Co., has entered the firm of Tucker, Hayes & Co., the new name of the company having become Tucker, Hayes & Bartholomew.

It has been more than five years since the Boston and New York stock exchanges have transacted the business they have recently. The activity, which is both professional and of a public character, is putting new life into financial circles here. The 'coppers,' 'zincs,' and 'golds' are all doing well here. The usual thing is for brokers to assemble at the ring of the gong in the morning, expecting to see an overbought market, only to witness another flood of buying orders. It is really a remarkable situation, which bids more or less defiance to war conditions in Europe, showing that the American people have at last turned themselves loose, and have determined to once more do business. It is nothing unusual for the Stock Exchange to turn over from 60,000 to 75,000 shares in a session. The curb total is from 35,000 to 40,000 shares. Several new issues have appeared on the Curb since the first of the month, among them being Alaska Juneau, Alta, Emma, and Calumet & Montana. The active Curb list is more than twice as long as it was a few months ago. The change which has taken place in the share-markets is so apparent that many people who have held aloof from trading are at last won over, conceding that undoubtedly a genuine revival of interest has taken place.

The absence of Thomas W. Lawson from market activity is freely commented on here. There has been a little doubt as to his whereabouts. Some people say he is still enjoying ranch life in Oregon, while others say he is back in seclusion at his Dreamwold estate. A recent newspaper article suggested that he was abroad. Rumor has also been busy to the effect that he is a sick man. At any rate, nothing is happening in the market which can be traced to Mr. Lawson, and his newspaper puffs and Street 'tissues' are conspicuous for their absence. About a month ago Mr. Lawson lost by death a younger brother, John L. Lawson.

The return of Miami to dividend payments, and the activity of Inspiration Consolidated, caused Southwestern Miami to re-appear in the trading column of the Boston Curb recently. It has been active there from time to time. The prospects of this property appear to lie in its profitable absorption by the Miami or Inspiration interests.

The revival of interest in Lake Superior coppers is resulting in a number of Boston brokers and financial writers visiting that region to note the changes which have taken place since the strike was settled and the mines resumed operations at full capacity. The labor situation is better than it has been for a number of years. James F. Sheldon, the financial editor of the *Journal*, is now in the copper country writing-up the situation. Eugene Cronin, of Hornblower & Weeks, is also on a trip there. Several of the officials of various Lake companies, and those close to the managements, have also recently visited the district. It is said that the mines are now producing 850,000 lb. per day, valued at $125,000.

Considerable disappointment has developed here over the reaction in the stock of the Fortuna Mines Corporation of Yuma Arizona, which was listed for trading on the Boston Curb early in February, and had for a while a sensational market run. The stock was manipulated to $3 per share, and then allowed to slump to $1.25. Since then it has failed to regain its loss. The slump was coincident with the announcement that Charles D. Taylor, at one time a mine operator in Goldfield, had bought the controlling interest in the Fortuna property, succeeding Frank B. Keever as manager. Taylor is a cousin of Todd C. Woodworth, consulting engineer of the Fortuna company, and it is believed that from now on the control of the company will be in the hands of Woodworth and Taylor, supplanting Keever. It is thought in Boston that a lot of shares of the company are held on the Pacific coast, and fear of this stock coming on the market is said to have depressed the price.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press.

ALASKA

Philip S. Smith and A. G. Maddren, of the U. S. Geological Survey, examined the quicksilver deposits of the Kuskokwim basin in the summer of 1914, and a bulletin has been issued describing the deposits. The Parks and Kolmakof deposits are close to the Kuskokwim river, on which ocean-going steamers can ascend within 150 miles of the farthest west prospect. Small timber suitable for mine use is fairly plentiful in the better-drained lowland areas. The Parks claim has been opened by a cross-cut adit 200 ft. long. A good tonnage of cinnabar has been found, but development has not been extended far enough to block out any body of it. The country-rock consists of shales and sandstones, cut by dikes of granitic intrusive rock. In the oxidized parts of the deposit the cinnabar is almost unrecognizable, being coated with iron oxide. The Kolmakof ore has been known for over 25 years. A few shallow pits have been sunk. The country is similar to that at the Parks. Cinnabar is abundant in quartz stringers and lenses, the latter being 6 in. wide and 24 in. long. Cinnabar has also been found 2½ miles northwest of the Parks and near Iditarod. Proper prospecting is essential, and the deposits warrant this being done.

Juneau

New York and Seattle people, headed by Makeever Bros., of New York, on April 8 completed the purchase of the old Nelson-Lott property. This adjoins the Gastineau mine near Juneau. The new owners will spend $225,000 this year in development. A. B. Dodd, mining engineer for Makeever Bros., has gone north to start work. The new corporation, which has taken over the mining property, has a capital of $1,000,000, and will be known as the Alaska Gold-Belt Company.

Ketchikan

(Special Correspondence.)—A petition has been sent to the Territorial Legislature at Juneau asking that a memorial be sent to Congress for a milling and smelting plant of 200-ton daily capacity in the Ketchikan district, to be operated under direction of the U. S. Bureau of Mines. Some of the benefits to be derived from such a plant would be the recovery of the iron that goes to waste in smelting magnetite copper ores, large bodies of which exist in this district. It will also benefit the prospector and small mine-owner in many ways, and will give reliable data on which to base future estimates as to the advisability of installing a larger plant or plants by private capital.

The Granby company has made its first shipment of ore from the Mamie mine, consisting of 1000 tons, to its smelter at Anyox, British Columbia. The same company is repairing the dock at Karta bay, in preparation for shipping ore from the It and Dean mines.

Last month's shipment from the Rush and Brown mine was 250 tons of fair-grade ore. The amount to be shipped this month will be about 1000 tons.——The Goodroe mine has just been examined by W. L. Polson. His report is said to be favorable. The mine probably will be re-opened shortly. Platinum was detected. Concentration tests made by Polson showed that the amount saved by this method may increase the value of the output. Edward Brown, assayer at Ketchikan, has detected platinum in a number of samples taken from this district.

Ketchikan, April 12.

Nome

The annual all-Alaska sweepstakes dog-race from Nome to Candle and back, 412 miles, was finished on April 17. Five teams entered. The winner was Leonard Seppala with 16 Siberian wolf dogs. The time was 78 hours 44 minutes 37 seconds.

ARIZONA

Gila County

The Old Dominion smelter at Globe was started again last week, having been closed since March 16. The plant was stopped on account of the mine being flooded. The present quantity of ore being mined is 250 tons per day. The normal output is 800 tons.

The report of the Miami Copper Co. for 1914 shows that ore reserves are as follows: high-grade sulphide, 19,500,000 tons at 2.40%; low-grade sulphide, 75,000,000 tons at 1.21%;

FAIRBANKS DISTRICT IN APRIL.

total 36,500,000 tons at 1.85%. Not included in the above is 6,000,000 tons partly developed mixed sulphide and oxide ore containing about 2% copper. The output was 1,096,633 tons of ore yielding 33,296,010 lb. copper.

Mohave County

(Special Correspondence.)—The west drift from the winze sunk 125 ft. below the 950-ft level in the Tom Reed mine has been extended 100 ft. in ore. The vein is from 6 to 10 ft. wide, the ore broken being sent direct to the mill. Stoping is to begin in a short time. Where opened at 1075 ft., the orebody shows a marked change in formation to that obtaining on the levels above. No water is flowing in the bottom level, although above it requires continuous pumping, according to the manager, S. S. Jones.——The United Eastern company's shaft is down 135 ft. A hoist is to be erected. Then the shaft will be sunk to 400 feet.

Oatman, April 12.

ARKANSAS

The North Arkansas mining district is having a boom. More ore has been shipped this year than in any previous full year. The district practically adjoins the Missouri-Kansas-Oklahoma region. John T. Fuller, state geologist, after an examination of the zinc and lead mines in Boone, Marion, Newton, and Searcy counties, thinks that success will only be obtained by means of a number of small properties.

CALIFORNIA

Amador County

The Plymouth Consolidated company's preliminary report for March is as follows: Ore crushed, 11,000 tons; value of gold, $56,814; working expenses, $23,764; development charge, $9231; and surplus, $23,819. During 1914, August to December, the output was 44,773 tons of ore averaging $4.35 per ton. The residue assayed 57c. per ton. Recovery was 88.24%. Costs averaged $3.26 per ton. The operating profit was $33,600. This was reduced to $980 with development and other capital charges.

Butte County

Permission has been asked by L. Gardella, well known in Oroville, to be allowed to dredge certain areas within the city limits, and surrounded by improved property. This is against the regulations, but it is hoped that the request will be granted.

Calaveras County

On April 5 the Calaveras Copper Co., at Copperopolis, shipped 30 tons of 9.87% ore. Net proceeds were $545. On the same day lessees received $1417 from a car of ore which averaged 17.6%. Some concentrate has to be settled for. Experiments show that when the mill is equipped with a flotation plant, a higher recovery will be made than originally anticipated. It is stated that monthly earnings in a few months will be about $40,000 per month.——San Andreas people are re-opening the Ford quartz mine. It has been closed for 15 years.

Inyo County

Production of the Cerro Gordo mines in 1914 was as follows: Ore, 4278 tons; gold, 312 oz.; silver, 303,086 oz.; lead, 1,195,000 lb.; and copper, 283,068 lb. Mining of zinc ore has been resumed. Reconstruction of the aerial tramway to Keeler is being done by A. Leschen & Sons, of St. Louis. When completed, the two sections will be 29,118 ft. long.

Thirty men are now employed at the Bishop Creek mine. The workings were unwatered in three days. Stopes are being opened. The mill should be producing bullion in May.

Kings County

In the Kings Quicksilver Mining Co.'s property, 18 miles southeast of Coalinga, is showing an extensive orebody on No. 1 level. A Scott furnace is treating 10 to 12 tons per 24 hours. A 6-ft. Huntington mill and concentrators are being erected. This plant will be ready about May 15. A. A. Lewis is manager for the Canadian controlling interests.

Nevada County

A new head-frame is being erected at the Polar Star mine, which adjoins the North Star on the west. At 300 ft. in the shaft there is 4 ft. of ore.——An abstract of the annual report of the North Star Mines Co. appears on another page of this issue.

Shasta County

Work is to be resumed at the Shasta Belmont copper mine in May. The property is between Copper City and Heroult. Nevada people are interested.

Tuolumne County

Los Angeles people have acquired a large area of gravel northwest of Shaw's Flat. The Buckeye mine is nearby. A large quantity of gold has been extracted from the district in the past.——The Atlas mine is being unwatered, and the 10-stamp mill is to be started soon.

COLORADO

Dolores County

(Special Correspondence.)—An important gold discovery was made in the Pro Patria adit of the Rico Consolidated Mines Co., about two weeks ago. Two lessees had been working in the adit for some time with poor results, and had asked merchants in town to extend their credit. This was refused. The miners decided to have assayed a peculiar-looking ore they had been working on for about a week. Metallics were visible on breaking the sample, and it returned $15,000 per ton in gold. The lessees had thrown nearly three narrow-gauge cars of this ore over the dump. This they shipped.

Jesse Knight and others of Salt Lake City, Utah, are making regular shipments of silver-lead and zinc ores from the Rico Wellington.

Rico, April 15.

Lake County (Leadville)

Great interest is being taken in Leadville in the arrival of the pumps for the Down Town pumping scheme. They were made by the Providence Engineering Works of Providence, Rhode Island. H. S. Arnold has arrived to supervise installation.——The new zinc oxide plant is in operation again.——Reports from the Twin Lakes and Lackawanna districts continue to be favorable.——The report of the Iron Silver Mining Co. appears on another page of this issue.

Teller County (Cripple Creek)

Increased leasing is to be done at the El Paso mine. Lower royalties will be charged so as to induce lessees to take blocks of ground. The new plant, in place of that burned, is in operation.——Since the new compressor was started at the Dexter mine on Bull hill, ore shipments have shown an increase. Lessees are doing fairly well.——In February Stratton's Independence made a net profit of $5000. There was 4788 tons of $6.76 ore mined. The mill treated 9668 tons of low-grade mine and dump ore.

IDAHO

This state has a large exhibit of minerals at the Exposition. In a future issue of the *Press* it will be described.

Lemhi County

(Special Correspondence.)—After several months' idleness the Bohannon dredge resumed work with three 8-hr. shifts last week.——The Musgrove mine and mill, west of Leesburg, was closed in January on account of the water freezing, but re-started on March 15. Good profits were made in 1914, and there is plenty of ore ready for treatment.——The Strahan mine and mill has been leased by John M. South.——Work has been resumed on the Gold Dust claim north of Leesburg.

Leesburg, April 8.

SHOSHONE COUNTY (COEUR D'ALENE)

The Hecla Mining Co., of Burke, reports that during 1914 its output was as follows: ore mined, 123,857 tons; ore and concentrate shipped, 20,151 tons; lead content, 18,957,823 lb.; silver, 509,200 oz.; operating profit, $246,551; and dividends, $220,000. Lower prices for metals affected the revenue. The shoot at 1600 ft. is producing rich ore. There are 170 men employed, in charge of James F. McCarthy, the general manager.

The Federal company's Morning mine has resumed work after several weeks' shut-down. Over 400 men are employed. ——A cross-cut from No. 4 adit of the Interstate-Callahan company's Callahan claim has passed through 10 ft. of 25 to 35% zinc ore. This shoot is 350 ft. under the original Callahan workings.——From 10 to 36 in. of rich antimony ore is being opened on Pine creek by the Antimony-Silver Mining Company.

MISSOURI

JASPER COUNTY

Forty acres of the Schifferdecker land, three miles from Joplin, was sold recently for $40,000. The ground has been prospected, ore occurring at 190 ft. A mill will be erected. ——Motor-driven pumps are draining the 770-acre tract south of Carterville, and the eastern part should be dry by the first week of May. The Zinc Corporation has this ground under lease.——A 300-ton mill has started work in the Prosperity portion of the Webb City-Carterville district. Ore is mined at from 190 to 210 feet.

Joplin men have organized the Joplin Ore & Smelting Co., with a capital of $100,000, to acquire the North smelters at Pittsburg, Kansas. Oronogo Circle people are largely interested. The plant has been idle for 18 years. It will require considerable expenditure for improvements.

MONTANA

SILVERBOW COUNTY

It is estimated that by the beginning of May the following men will be employed in the Butte district: Anaconda, 8000; Butte & Superior, 1100; North Butte, 600; East Butte, 500; Elm Orlu and Timber Butte, 500; and other mines, 800; a total of 11,500. The payroll will be about $1,150,000 per month. Employed in other work will be 3000 receiving $350,000 per month. The total number employed will be 14,500, receiving $1,500,000.

MINES AT BUTTE.

The Mountain Con. mine of the Anaconda group was reopened last week. There will be about 350 men employed, and the output over 600 tons per day.

During the shut-down of some of its mines, the Anaconda company accomplished a lot of shaft-sinking and development on the lower levels. The shaft of the High Ore mine has been sunk from the 3220 to the 3400-ft. level; Diamond, from 2960 to 3080 ft.; Stewart, from 2500 to 2800 ft.; Mountain Con., 2530 to 2750 ft.; No. 2 shaft of the Leonard, from 2069 to 2241 ft. Nearly 100 ft. has been added to the Belmont, which is down 2100 ft.; and the West Gray Rock from 1622 to 1770 ft. The depths of other shafts of the Anaconda company are: Anaconda, 2660; Neversweat, 2450; St. Lawrence, 2550; East Gray Rock, 1639; Original, 2764; Badger State, 2054; Moose, 500; West Colusa, 2039; East Colusa, 770; Leonard No. 1, 2154; Tramway, 2350; Silverbow, 1003; Parrot, 2150; Moonlight, 1725; Pennsylvania, 2237; Mountain View, 2306; Modoc, 2525; Buffalo, 1500; and Greenleaf, 1030 feet.

NEVADA

ESMERALDA COUNTY

Rich ore continues to be opened in the shale, and below the contact, at 1017 ft. in the Jumbo Extension.

HUMBOLDT COUNTY

A number of well known mining men have visited the new Willard district. Gold has been found in four groups of claims. Several leases have been let. About 75 people are living in the township.

A 100-ton mill is to be erected at Kennedy, 60 miles from Winnemucca. It will treat ores from the Virginia, Ida. and Hazel Belle claims of the Roylance Reduction Company.

LINCOLN COUNTY

Shipments of zinc ore from the Amalgamated Pioche have been curtailed, as the smelters do not require more for the present.

NYE COUNTY

Eight mines at Tonopah produced 10,760 tons of ore, worth $219,640, during the week ended April 17.——The following are March yields: Belmont, 16,375 tons, for 3169 oz. gold and 290,897 oz. silver, with a profit of $88,520 (the annual report of this company is to hand, and will appear in another issue of this journal); Jim Butler, profit of $25,167; and Tonopah Mining, 11,945 tons for 221,640 oz. bullion, and a profit of $70,560.

WHITE PINE COUNTY

(Special Correspondence.)—The Nevada Consolidated company is again operating full time, and the mill is treating between 10,000 and 11,000 tons of ore per day. It is reported that the company has an order to supply 25,000,000 lb. of copper. The Ruth mine is being prepared for underground work. This property contains many million tons of 2.1% copper ore. During the curtailment of operations since last August, the company learned many methods of economy, and it is doubtful whether as many men will be employed as formerly to mine and treat the same tonnage. There are plenty of men out of work at present.

Ely, April 5.

During March 1460 men were employed by the Nevada Consolidated company. At Copper Flat there were two disabling accidents, resulting in the loss of 11 or 12 days' time; two minor injuries at the mill, and six at the smelter, where four men lost a total of 13 days, one 23 days, and another several weeks.

The Consolidated Copper Mines Co. is preparing to resume

ore extraction at the Ora claim. This is at the entrance to the Nevada Consolidated's Liberty pit. One steam-shovel will be employed, and the latter company will mine and treat 24,000 tons per month for the controlling company. E. F. Gray is general manager.

OREGON

Baker County

A syndicate of California dredging people is examining ground near Clark's creek, below Bridgeport. F. J. Estep is in charge with eight men. Drilling is to be started as soon as possible.

TENNESSEE

Polk County

The report of the Tennessee Copper Co. for 1914 shows that ore reserves are estimated at 4,010,661 tons, exclusive of the Eureka orebody. The output of metal was 12,871,113 lb., a little less than in 1913. Acid production totaled 210,163 tons.

UTAH

On account of the metal market and the large quantities on hand, smelters are not buying any zinc ores from Utah mines at present. The exceptions to this are a few lots of carbonate ore and sulphide ore contracts.

Beaver County

The Four-Mile Springs gold district is attracting some attention just now. It is not far from Fortuna.

Juab County

Ore shipments from the Tintic district last week totaled 127 cars.——Lessees in the Yankee Consolidated are shipping up to 41% zinc ore. One car yielded $1435 net. Lead-silver ore is also being extracted.——The Knight-Christensen mill is to be rebuilt. Some of the steel buildings at the Tintic smelter will be used.——A winze is being sunk below 1700 ft. in the Eagle & Blue Bell. It is in ore all the way. An electric hoist, costing $25,000, is to replace the old steam-engine.——Four cars of silicious ore are being shipped daily from the Sioux dump at Mammoth to the A. S. & R. smelter at Garfield.

The Knight-Christensen mill at Silver City was destroyed by fire on April 4, damages amounting to about $75,000. The plant was a useful one for the Tintic district, and was treating 100 tons daily of Iron Blossom ore at the time of the fire, and the Traylor Engineering & Manufacturing Co. was installing additional machinery.

The annual report of the May Day Mining & Milling Co. for the year ended March 31, 1915, shows that receipts from lead and zinc ore amounted to $106,614. Expenses totaled $84,959. Dividends paid were $40,000, and the year ended with a cash balance of $14,778, against $21,656 at the beginning of the term. Recent development has shown some high-grade silver-lead ore, according to the general manager, J. C. Dick. Eleven sets of lessees are at work.

Salt Lake County

The Alta Consolidated Mining Co. was organized at Salt Lake City last week with a capital of 1,000,000 shares at 25c. each. Its purpose is to drive an adit along the quartzite-limestone contact in the Big Cottonwood district, to cut several veins which intersect the contact. The Wasatch mine will also be opened 1400 ft. below its present workings. A Karns tunneling machine will be tried in the adit.——A 75-stoping drill was carried by two miners from the American Flag mine at Park City to the Alta adit in the Big Cottonwood cañon. The distance is about 17 miles, and the ground was covered with deep snow.

Weber County

Molybdenite has been found in the Southern Pacific Gold & Copper Mining & Milling Co.'s mine, eight miles north of Ogden. J. W. Burnham is manager.

CANADA

British Columbia

In *Bulletin* No. 2, 1915, of 24 pages with illustrations, of the B. C. Bureau of Mines, W. M. Brewer discusses the mineral resources of the Atlin mining division. Mining operations in 1914 were confined almost entirely to the creeks that have been regular producers of placer gold since 1899. Save on O'Donnel river and Spruce creek, all work was done by hydraulic methods and by corporations. It would seem that dredges ought to be successful in certain parts of the district, especially near the head of Spruce creek, on Slate creek, and between the headwaters of that creek and the O'Donnel river, as well as bars on that river. This area is not suitable for sluicing. Considerable detail is given regarding the O'Donnel river, Fourth of July creek, Taku arm, and Rainy hollow properties.

During March the Rambler-Cariboo company at Three Forks shipped 10 cars of lead-zinc concentrate, and silver-lead ore. The net yield was $1500 per car. The new ore-shoot at 900 ft. is high in silver and lead.

Ontario

Thirteen mines shipped a total of 1348 tons of ore from Cobalt during March.

The report of the Nipissing Mines Co. for 1914 states that the output of silver was 4,689,333 oz. The average price received was 55.36c. per ounce. Cost of production was 19.8c. Dividends amounted to $1,235,000. The previous surplus was $1,259,061, while that at the end of 1914 was $1,602,776. Ore reserves are estimated to contain over 10,000,000 oz., an increase of 500,000 ounces.

The McKinley-Darragh-Savage Mines Co.'s report for 1914 shows that 45,098 tons of ore yielded 1,396,540 oz. of silver. The profit was $307,652. Dividends paid amounted to $337,154. Ore reserves are estimated to contain 2,132,120 ounces.

In 1914 the Beaver mine produced 908,000 oz. of silver. Of this, 390,000 oz. was sold.

According to the chief inspector of mines of this province, T. F. Sutherland, there were 58 fatalities in all mines, quarries, and metallurgical works in 1914. There were 445 injured. A peculiarity is that most of the fatal accidents occurred in the first half of the year.

In March the Dome mill treated 23,220 tons of ore, yielding $4.22 per ton. This is the highest average in four months.

The power situation at Cobalt is improving. The supply at present is about 80% of normal. By the end of April the Northern Ontario Light & Power Co. expects to be able to supply all demands. Warm rains will melt the snow and ice on the company's territory.

In March the Nipissing high and low-grade mills treated 93 and 5382 tons of ore respectively. This yielded $104,812 and $64,267, a total of $169,079. Bullion shipped was only worth $27,308. Mine development was satisfactory.

Yukon

A telegram from Dawson states that on April 18 the Yukon river ice was breaking up. This is the earliest in its history. The river is already open from White Horse, the head of navigation, to Lake Labarge, 16 days earlier than last year. The ice on Labarge is dangerous to cross.

KOREA

The Seoul Mining Co., operating the Suan concession in Whang Hai province, reports the following results for March: Total recovery from bullion and concentrate, $82,750; operating expenditure, $25,000; and net earnings, $57,750.

The Oriental Consolidated output in March totaled $145,365. In January, 210 stamps crushed 24,080 tons of ore, and from all processes $136,554 was recovered. The profit was $54,277, of which $21,249 was spent in development and improvements. In February there was 20,795 tons treated yielding $125,152. The Maibong tube-mill plant recovery was 72%,

and Taracol cyanide plant 76%. Transport of supplies was interrupted by an epidemic among the cattle.

MEXICO

Chihuahua

A new issue of paper money is to be made at Chihuahua to replace all previous Villa circulation. The new currency will be printed in New York.

Sonora

At its various mines the Cananea Consolidated Copper Co. is employing about 400 men. They are attending to pumping and other necessary work. The resumption of ore extraction is indefinite.

Up to April 14 the Moctezuma Copper Co. had forwarded 210 cars of concentrate from Nacozari to Douglas, Arizona. A large tonnage remains at the mill. This results from the serious interruption to traffic caused by the revolution. Freight and passengers are also being moved.

PHILIPPINE ISLANDS

The mineral resources of the Philippine Islands for the year 1913 are discussed in a recent bulletin issued by the Division of Mines of the Bureau of Science at Manila. The publication covers 71 pages, and is accompanied by a map and illustrations. A review of the year is covered by Warren D. Smith; the Paracale district, by F. T. Eddingfield; the Araroy district, Masbate, by Warren D. Smith; other mineral districts, including Baguio, by F. T. Eddingfield; the Bulacan iron-ore resources, by Wallace E. Pratt; coal mining, by Wallace E. Pratt; Philippine production of non-metals, by Wallace E. Pratt; gold dredging, by William Kane; mine exploitation and the causes of some mine failures in the Philippines, by F. T. Eddingfield; and a preliminary check list of Philippine minerals, by Warren D. Smith, F. T. Eddingfield, and Paul R. Fanning. The total mineral production was worth ₱3,944,581, of which ₱1,736,724 was from gold.

According to *The News of Baguio*, the present season shows a general awakening in the Benguet mining field. Prospectors are busy. More inquiries are being made from the outside.——At the Benguet Consolidated, C. M. Eye reports that a drainage adit is being driven 500 ft., at a depth of 100 ft. below the main workings. It is in over 200 ft., the monthly advance being nearly 70 ft. A new working adit is being driven 250 ft. A 10-stamp mill, with Dorr classifier, 6 by 10-ft. tube-mill, thickener, agitators, and the continuous counter-current decantation system is being erected. A hydro-electric plant, including Pelton-Doble and General Electric machinery, is being constructed about 2000 ft. below the mill. The 14, 16, and 18-in. pipe-line is 6000 ft. long.——After a varied career, the Headwaters mine is producing about 100 oz. gold per week. L. O. Hibberd is operating the property, in spite of previous reverses by other owners.——The Camote mine has three stamps, which produce about 60 oz. per month. ——It is probable that small mills will be erected at the Bua, Acupan, and Antamok.

THE NEW MALAGUIT DREDGE, PHILIPPINE ISLANDS.

PERSONAL

Frank G. Manley is in San Francisco.

L. D. Ricketts is at Warren, Arizona.

Arthur L. Pearse is at the Palace hotel.

Orville R. Whitaker is in northern Mexico.

Leroy Anderson is here from Jerome, Arizona.

William Truran has returned from Elko, Nevada.

John S. Eastwood will visit Alaska in the near future.

Reiji Kanda will spend three months in Burma this season.

C. M. Weld has moved his office to 60 Broadway, New York.

H. P. Henderson is also to be found at 60 Broadway, New York.

Frank H. Probert has returned to San Francisco from New York.

Louis S. Noble and Harry G. Palsgrove are in southern Arizona.

H. Foster Bain sailed from New York by the *St. Louis* on April 17.

Thomas H. Leggett left Los Angeles for New York on April 20.

James W. Abbott, of Los Angeles, was in San Francisco this week.

F. J. Siebert, of Goldfield, is retained as a geological expert in the Tonopah litigation.

J. J. Flannery, president of the American Vanadium Co., is visiting the Exposition.

H. C. Wilmot, manager for the Syndicate mine, in the Philippines, is spending a holiday in California.

F. A. Voorhees, metallurgist at the Commonwealth mine, Pearce, Arizona, is in San Francisco visiting the Exposition.

Schools and Societies

The University of Idaho has lost its president, M. A. Brannon, who resigned on account of reduction in salary.

The Association of Mine Managers of the Transvaal held its annual meeting in Johannesburg during the third week of February. Palmer Carter is president.

The Montana Society of Engineers held its annual meeting in Butte on April 9 and 10. Several papers were read and visits made to mine hoists and zinc mills.

The University of Utah affairs are to be investigated by a committee of 25 representative citizens, according to a decision of the alumni association of that institution.

The South African Institute of Electrical Engineers held its annual meeting in Johannesburg in February. *The South African Mining Journal* published a special supplement for the occasion.

The San Francisco branch of the A. I. M. E. held its monthly meeting on April 13. The paper of the evening was an abstract, prepared and read by E. A. Hersam, of the monograph on 'Electrolytic Precipitation' by the late Samuel B. Christy of the University of California.

The Colorado branch of the A. I. M. E. held a meeting in the new home of the Colorado Scientific Society on April 9. An illustrated lecture on 'Methods and Processes of Pure Iron Manufacture' was given by Howard See of the research department of the American Rolling Mill Company.

The twenty-fourth annual report of the Council of the Institution of Mining and Metallurgy contains the following information: Membership at end of 1914, 2492; increase over 1913, 120; revenue, £5090; and expenditure, £4935. The new president is Sir Thomas Kirke Rose of the Royal Mint, London.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets

Metal Prices

San Francisco, April 22

Antimony	25 —25¾
Electrolytic copper	18 —18¼
Pig lead	4.45— 5.45
Quicksilver (flask)	$80.00
Spelter	10¾—11
Tin	45 —46½
Zinc-dust, 100-kg. zinc-lined cases	16

A useful and instructive chart has been prepared by 'The Steel and Metal Digest' of New York, showing daily price fluctuations in copper, tin, lead, and spelter, from July 1, 1914, to March 31, 1915. The great rise in tin and spelter is a prominent feature

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, April 22. Copper is strong, and higher prices are probable; lead is steady; spelter is excited.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Apr. 15	50.00	Mch. 10	49.81
" 16	49.87	" 17	51.18
" 17	50.00	" 24	50.33
" 18 Sunday		" 31	50 14
" 19	50.37	Apr. 7	50.04
" 20	50.37	" 14	50.06
" 21	50.50	" 21	50.18

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	....
Feb.	57.53	48 45	Aug.	54 35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	....	Oct.	51.12	....
May	58.21	....	Nov.	49.12	....
June	56.43	....	Dec.	49.27	....

There is little change in the silver market. About 50,000 oz. was shipped from San Francisco to the Orient on April 17. The total sent from Cobalt during the week ended April 10 was 360,193 oz. According to the report of the Tonopah Belmont company, on February 28, 1915, it had 1,646,099 oz. stored in San Francisco. There must be other large stocks held by heavy producers in the United States and Canada, and on a rise in price the market is sure to be flooded. Up to April 1 the metal exported from London to India was about 3,500,000 oz. less than in the same period of 1914. Buying from India has been irregular, hence erratic price movements. A shortage of silver coin exists in Egypt. Natives are hoarding it.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Apr. 15	16.50	Mch. 10	14.50
" 16	16.50	" 17	14.59
" 17	16.63	" 24	14.90
" 18 Sunday		" 31	15.37
" 19	16.87	Apr. 7	15.75
" 20	17.25	" 14	16.03
" 21	17 37	" 21	16.85

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13 60	July	13.26	....
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	....	Oct.	11.10	....
May	13.97	....	Nov.	11.75	....
June	13 60	....	Dec.	12.75	....

Exports during the week ended April 17 were worth $909,000, equal to about 5,680,000 lb. In the week ended April 3 they amounted to 10,623,248 lb., valued at $1,568,787. Of this quantity 6,242,436 lb. went to England, 2,713,523 lb. to France, 784,796 lb. to Italy, and 331,157 lb. to Holland. Stocks in England and France on March 31 totaled 17,858 tons. On February 27 they were 21,852 tons. Lake copper has been sold up to 20c. per pound. The Calumet & Hecla company has raised wages of all employees 10%. About 8000 men are affected.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Apr. 15	4.20	Mch 10	3.95
" 16	4.20	" 17	4.01
" 17	4.20	" 24	4.15
" 18 Sunday		" 31	4.15
" 19	4.20	Apr. 7	4.23
" 20	4.20	" 14	4.20
" 21	4.20	" 21	4.20

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3 80	....
Feb.	4 02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	....	Oct.	3.60	....
May	3.90	....	Nov.	3.68	....
June	3.90	....	Dec.	3.80	....

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	....
Feb.	39.76	37.23	Aug.	50.20	....
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	....	Oct.	30.40	....
May	33.29	....	Nov.	33.51	....
June	30.72	....	Dec.	33.60	....

The tin market has been erratic, and on April 21 quotations varied between 40 and 50c. per pound. A good quantity of metal recently arrived at San Francisco from the Straits. Prices of tin-plate in the United States and England have risen owing to the rise in price of tin and uncertainty of supplies. On March 23 the American price was $3.35 per box of 100 lb., and in England, on March 19, $3.89 to $4.02 per box of 108 pounds.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Mch. 24	80.00	Apr. 7	80.00
" 31	80.00	" 14	80.00
		" 21	80.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60.00	Aug.	80.00	....
Mch.	39 00	78.00	Sept.	76.25	....
Apr.	38.90	....	Oct.	53 00	....
May	39.00	....	Nov.	55.00	....
June	38.60	....	Dec.	53.10	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
Apr. 15	9.25	Mch. 10	8.00
" 16	9.25	" 17	7.92
" 17	9.25	" 24	8.59
" 18 Sunday		" 31	8.50
" 19	9.50	Apr. 7	8.75
" 20	9.50	" 14	9.12
" 21	9.50	" 21	9.37

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	5.22	9.05	Aug.	4.45	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	....	Oct.	4.75	....
May	4.91	....	Nov.	5 01	....
June	4.84	....	Dec.	5.40	....

At Joplin, Missouri, zinc-ore prices showed no marked advance last week, but the market has a better tone, and producers have no trouble in selling ore for $54 to $60 per ton, basis of 60% metal. The highest price was $63. A large deal was made on April 16, when W. A. Rhea, of the Mont B mine, sold 1800 tons of lead and zinc ores for approximately $95,000 to the Edgar Zinc Company.

BOOK REVIEWS

PETROLEUM INDUSTRY OF CALIFORNIA. By R. P. McLaughlin, assisted by C. A. Waring. *Bulletin* 69 of the California State Mining Bureau. P. 519. Ill., index. California State Printing Office, Sacramento, 1914. For sale by State Mining Bureau, Ferry building, San Francisco. Price, $2.

This is an important book to those who are interested in one of the greatest industries in the state of California. The folio of maps that accompanies the report was published a month earlier than the book. It was reviewed editorially in the *Press* of March 27, 1915.

Given ample authority to ascertain and present facts of the business as well as the technical side of the oil deposits, and qualified by ample experience, the authors have presented a new idea in publications of this character. Of the newer points, first come extensive graphic diagrams of well-production records, classified by oilfields. These are intended to shed empirical light, as it were, on the important question of how much oil can reasonably be expected to be won from various areas. Since this problem is governed by the influence of a number of complex factors, such as water-encroachment, value of product, production costs, etc., data thereon are welcome. The discussions accompanying the diagrams are inconclusive as to what might safely be gathered from the evidence given. Data on the personal factors in the oil-production, refining, and marketing business in California are intelligently discussed. There is also given the results of some experimental work lately done to determine the evaporation losses in oil-containers; it clearly shows that there is good scope for further research work of similar character.

The treatment of the subject as a publication on a basic industry is excellent. It is known that to cover adequately any single branch would require a volume; judicious selection of subjects as well as material was therefore necessary. Refining of oils, concerning which few are intimately conversant, is passed. The uses and applications of crude oil and gas in commerce, of greatest importance on the Pacific coast, are treated at fair length. The geology of the main producing oilfields is covered by presenting the generalized results, by competent authority, of the more extended geological investigations in recent years, while that of prospective fields is covered efficiently mainly by the original work of the assistant author. On the side of oil-production, the branch that has suffered most from the lack of proper technical guidance, excellent data are given in a rational way on both well-drilling and pumping-costs; the application and cost of the various forms of power, steam, gas, electricity, to these steps in production are described adequately. The cost of pipe-line carriage of oil, as given, directs attention to the profits made in this line of the industry, where concerned with such production and long-lived fields as obtain in California. The menace of water-flooding of the oil measures in many of the fields is forcefully discussed. The self-interest of operators has not been strong enough in this late period of low-priced oil to fight water-encroachment effectively; with poorly constructed state statutes, and with no arm to lean upon from the Federal side, it is most opportune for the State Mining Bureau to stand out strongly for measures designed to arrest further damage from this ever-pressing evil.

The discussion on the price of oil, the goblin that forever casts shadows (whether good or evil) across the slumbers of the oil-producer, seems to lead to but one conclusion, apparently somewhat reluctantly expressed. In effect, it is, that unless some restriction is placed (by statute?) on indiscriminate drilling, at least during periods of flush production, there is not much chance for the price to rise to a level commensurate with the risk, or even to a level high enough to cover cost of production to the average producer. This condition applies with special force to the present situation in California where the large sellers, few in number, and equipped with millions of capital, are in command with larger production of much newly proved acreage of great potential yield, and as yet but slightly drilled.

The book treats of important and interesting phases of the industry, the facts concerning which are not always available to the public. Interspersed with the statements of facts are opinions bluntly and pointedly expressed, which add to the interest of the reader. It might be said that the financial end has not been as fully described as it could have been, particularly the dividends. The folio accompanying the book presents both geologic and field maps brought up to September 1914. The maps are comprehensive, on a good working scale, and are excellently done. The appearance of the publication at this period, when there is considerable legislation pending, both Federal and State, that may affect not only the character of the future development of the oilfields, but the policy of handling the lands, is both timely and important; this aside from its evident value to those concerned with producing and handling the product.—J. H. G. W.

MINING DECISIONS

MINERS' LIENS IN COLORADO—EFFECT OF LEASE

Persons working a mine in Colorado under an assignee of a lessee were not entitled to a lien for their services merely because the lease contained an option to purchase, as the lien law does not apply to an owner who leases insofar as employees of the lessee are concerned. No notice of non-responsibility of the owner is required to protect his property against liens for work done under authority of such a lease.

Grimm *v.* Yates (Colorado), 145 Pacific, 696. December 7, 1914.

MINERS' LIENS—ARIZONA LAW CONSTRUED

Paragraph 3654 of the Arizona Civil Code of 1913, giving laborers on mining claims a lien for labor by virtue of a contract between them and the owner or his agent, trustee, receiver, contractor, or purchaser under option contract, cannot apply to an owner giving an option contract to sell prior to the enactment of this provision, for otherwise the provision would be both retro-active and an impairment of the obligation of a contract in violation of the Constitution.

Foltz *v.* Noon (Arizona), 146 Pacific, 510. February 20, 1915.

UNDERLYING MINERALS—SEVERANCE OF TITLE

The possession of the owner of the surface of land is not adverse to the title of the owner of the coal and minerals beneath the surface; on the contrary, it seems that such surface possession inures to the benefit of the owner of the underground minerals. A conveyance of the underlying coal with the privilege of its removal from under the land of the grantor effects a severance of the right to the surface from the right to the underlying coal, and makes them distinct corporeal hereditaments. The owner of the minerals does not lose his right by any length of non-usage. He must be dismissed to lose his right, and there can be no disseizin (an unlawful dispossession) by an act which does not actually take the minerals out of his possession.

Shrewsbury *v.* Pocahontas Coal & Coke Co. (West Virginia), 219 Federal, 142. November 5, 1914.

COMPANY REPORTS

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

Telephones are used for rapid communication with mining districts, and are used about mines, therefore an abstract of the 1914 report of this great Company is not out of place in a mining journal. It is best shown in tabulated form:

	1914.	1913.
Stations	8,648,993	8,133,017
Length of wire, miles	17,475,594	16,111,011
Underground conduits, value	$194,200,000	$181,500,000
Daily average connections	27,848,000	27,237,000
Plant additions	$ 50,045,300	$ 54,871,856
Gross revenue	225,952,123	215,572,822
Net revenue	59,247,279	58,689,523
Interest	18,940,641	16,652,624
Dividends paid	30,304,186	30,301,705
Depreciation	41,496,240	37,739,991
Employees' benefit fund	8,889,750	8,919,335

NORTH STAR MINES COMPANY

This is the company operating at Grass Valley, California. The report covers the year 1914. The story of this famous enterprise appeared in our issue of October 10, 1914.

Development work in the North Star mine consisted, chiefly, in the extension of drifts and rises on or connected with the 3000 and 3400-ft. west levels, and in sinking the main shaft from 5850 to 6361 ft., and cutting stations at 5600, 6000, and 6300 ft. Work in the upper levels resulted in the discovery of some good ore on and above the 3400-ft. level, warranting the expectation of a considerable tonnage in this part of the mine, not previously counted on. The shaft disclosed, for the most part, a good-sized but barren vein. It is hoped that the levels now started at 5600, 6000, and 6300-ft. will reveal the downward extension of the profitable orebodies found on the 5000 and 5300-ft. levels. The total development amounted to 2053 ft., including shaft-sinking, 511 ft., driving, 954 ft., and rising 588 ft. In cutting the stations, a total of 5183 tons of waste rock, equivalent to about 57,000 cu. ft. of material, was removed and hoisted to the surface. Owing to the nature of the exploration work, a comparatively small amount of development ore was produced during the year, the total being 2117 tons, as compared with 6420 tons in 1913. The additional tonnage developed or indicated on and above the 3400-ft. level will offset to a large extent the tonnage mined during the year.

The output was derived chiefly from stopes above the 3400, 4000, and 4400-ft. levels, and was obtained from 113,502 tons of rock mined and delivered to the mills, of which a total of 6252 tons was sorted out as waste, leaving 107,250 tons of ore crushed, with an average yield of $10.40 per ton. The average cost was $4.92 per ton for operating, and 51c. for development, making a total of $5.43 per ton crushed, $5.14 per ton mined, and leaving a realized profit of $4.97 per ton crushed.

During the year the gross production of the North Star mine was $1,115,587, obtained at a cost for current operation of $527,875. Outlays during the year on account of property purchase and improvement amounted to $12,681, leaving a balance of $520,568. Interest and dividends on invested funds amounted to $39,547, increasing the total net earnings for the year, before deduction of allowance for depreciation, and apart from the result of operations at the Champion mines, to the sum of $560,115. Dividends amounting to $450,000, 10% on the capital stock, were paid during the year.

Development work was actively continued throughout the year on both the Champion and Merrifield veins to the extent of 4047 ft. of drifts and rises, with the further development and promise, principally on the Champion vein, of a considerable tonnage of fair ore. The workings are spread out over a wide area, and it is difficult at present to operate the property to the best advantage. The results obtained during the latter half of the year, however, seem to give promise for the future, and it has therefore been decided, with a view to the more economical opening and working of the mines, to enlarge and extend the Providence shaft, situated some distance south of the Champion shaft, through which work is at present being conducted. The Champion mine produced 15,050 tons of ore averaging $6.684 per ton, totaling $301,103. Expenses amounted to $282,733, or $6.276 per ton, leaving a profit of $18,370. Improvements and purchase of property reduced the surplus to $2433.

At the end of 1913 the company's balance sheet showed a credit of $915,480, and at the end of 1914, $1,019,083. The latter consisted of cash, $319,033; investments, $586,430; bills receivable, $73,000; and supplies, $40,620.

IRON SILVER MINING COMPANY

This company operates at Leadville, Colorado, in charge of George O. Argall. His report for the year ended December 31, 1914, contains the following information:

Development in the Moyer, Tucson, and Blind Tom mines totaled 4914 ft. The main shaft of the first named was retimbered from No. 2 level to the surface, and the old boiler-plant was re-erected in another locality. These alterations resulted from settling of abandoned stopes. The east ore-shoot continued to yield most of the Moyer output, but it is now nearly worked-out. It has been possible also to sell low-grade mixed sulphide ore, and so maintain the yield. Development is being continued, and the area around both shafts to be prospected to the middle of the blue limestone formation. The area below this is receiving systematic geologic study, but diamond-drilling does not offer encouragement. The future of the mine is uncertain. In the Tucson, development was slightly greater than in 1913, covering a wide area, which outlined the main zone of mineralization. All of the known carbonate orebodies were extracted, and prospecting did not reveal others in the oxidized area of the mine. One hundred feet below No. 4. level an important zinc-lead sulphide mass was found. On No. 8 level, 399 tons of silicious silver-bearing ore, with a net value of $66.10 per ton, was mined. This occurs in thin seams and incrustations lining small cavities surrounded by dense quartzite, resulting in small production and high cost.

The output of the property was as follows:

Class of ore.	Moyer, tons.	Tucson, tons.	Blind Tom, tons.	Lessees, tons.
Zinc-lead sulphide	6,781	12,416	...	3,684
Low-grade zinc-lead sulphide	7,134	.....	...	.....
Lead sulphide	9,658	.....	...	422
Iron sulphide	61	209	...	766
Lead carbonate	17	558	...	2,992
Zinc sulphide	....	312	...	281
Silicious sulphide	....	399	...	.....
Copper sulphide	....	38	...	.....
Iron oxide	....	.....	317	437
Zinc carbonate	....	.....	78	5,930
Total	23,651	13,932	395	14,512

Metals contained in these varied ores amounted to 923 oz. gold, 328,027 oz. silver, 10,608,734 lb. lead, 17,396,362 lb. zinc, 12,751 lb. copper, and 5,247,433 lb. iron.

Revenue from sales of ore, royalties, and miscellaneous totaled $421,661. The profit was $174,629, of which $100,000 was paid in dividends. The surplus on December 31, 1913, was $353,539, and at the end of 1914, $428,168.

New Machines and Devices

Information based on letters and catalogues from manufacturers, and staff observations.

Conveying, Elevating, Screening, and Mechanical Power Transmitting Machinery at the Exposition

On account of its position in the Pacific Coast machinery trade, and also by reason of the active work done by its president, Constant Meese, for the Exposition, it was but fitting that the Meese & Gottfried Co. should exert itself to make a noteworthy exhibit in the Palace of Machinery.

Surrounding the exhibit space, 63 ft. 6 in. by 89 ft., is a counter about 36 in. high and 26 in. wide, the top of which is covered with over 200 ft. of plate-glass, under which is placed about 100 photographic enlargements of some important machinery installations made by this firm. The massive rail is of a simple yet beautiful design. The entrances are of black marble mosaic, inlaid with the firm's initials in three-foot Old English letters of deep yellow brass. Within the space, arranged on pedestals of uniform design, are all the standard items which comprise the firm's line of machinery, both manufactured and agency goods, altogether about 100 different units. Here are shown all the various types of shaft bearings, hangers, friction-clutches, collars, couplings, sprockets, friction-drives, gears, and other apparatus.

Material-handling elevators and conveyors are shown in many different designs, such as: overlapping and spaced bucket-elevators, non-spill bucket-elevators, barrel-elevators, slat-conveyors, apron-conveyors, pan-conveyors, scraper-conveyors, and belt-conveyors. One of the last named, 24 in. wide, runs across the entire exhibit. Above it, working both ways, is a large automatic belt-tripper for discharging the load and distributing it evenly along both sides into bins below. This conveyor is driven by means of a motor connected by a Link-Belt silent chain-drive direct to one shaft of a Reeves variable-speed transmission. This latter device enables a variety of speeds to be imparted to the conveyor through the other shaft. Another interesting exhibit is the Link-Belt silent chain-drive set, comprising a nest of silent chains operating at high speeds. Also a slotted viewing-disc, which, by the periodicity relation between chain pitch, speeds and apertures in the opaque disc, allows of a study of the tooth action, and apparently slow meshing and unmeshing of chain and gear teeth, which are actually traveling at a speed of about 1800 linear feet per minute.

Still another attraction is a large M. & G. steel-rim pulley, 108-in. diameter by 24-in. face. The caps of both bearings are removed to show the revolving oil-rings, and though this pulley is revolving at a considerable speed, there is, as far as the observer can detect, nothing to make it go.

Other exhibits of special interest to rock and gravel producers are a large revolving screen 48 in. diameter by 18 ft. length; an installation of conical screens showing arrangement of bearings, drives, chutes, sand-settling apparatus, etc.; rock-bin gates; automatic or reciprocating feeders, and other machines.

Some of the firm's agency goods deserve more than passing notice. One is a Gilbert wood pulley in process of construction. An American all-steel pulley, 24 by 72 in., is shown; also Cumberland ground-steel shafting, from $\frac{1}{2}$ to 6 in. American pioneer pressed-steel hangers and other shapes are shown.

Meese & Gottfried's manufacturing plant and main offices are in San Francisco. It also maintains branch houses with resident engineers at Los Angeles, Seattle, Portland, and Vancouver, British Columbia.

Commercial Paragraphs

The Hecla Mining Co., Idaho, has purchased a 5 by 6-ft. adjustable quick-discharge tube-mill of CHALMERS & WILLIAMS manufacture.

The first of the 10-ft. mills for the Anaconda company was shipped from the HARDINGE CONICAL MILL CO.'S Pittsburgh works two weeks ago.

The TERRY STEAM TURBINE CO. announces that the United States court at Boston, on March 13, sustained the validity of patent No. 741,385, owned by the company.

A 30-page booklet, containing 46 pertinent paragraphs dealing with its telescopes and accessories, has been published by the BUFF & BUFF MANUFACTURING CO., of Jamaica Plains, Boston, Massachusetts.

The Denver office of the SULLIVAN MACHINERY CO. announces that after May 1 it will be at 837 Equitable building, and that it will continue to carry the same stock as heretofore. George W. Blackington is manager.

In *Bulletin* No. 34-M, the CHICAGO PNEUMATIC TOOL CO. describes its class 'O' 'Chicago pneumatic' steam and power-driven compressors. Details are given on frame, bearings, cylinders, valves, regulator and unloading mechanism, and indicator cards from full load to the fourth step in operation.

The LUNKENHEIMER COMPANY, Departmento de Exportacion, Nueva York, E. U. A. Catalogo ilustrado y lista de precios en Español. Ese catalogo comprendiendo valvulas de bronce y de fierro, silbatos, llaves, manometros, inyectores, lubricadores, bombas de aceite, copas para aceite y grasas, y multos otros cosas. El compañía Lunkenheimer han sido estableciendo por muchos anos en ese pais y otros y el catalogo contiene mucho de interes para todos ingenieros y mecanicos que quieren informes sobre mercancias de ese clase.

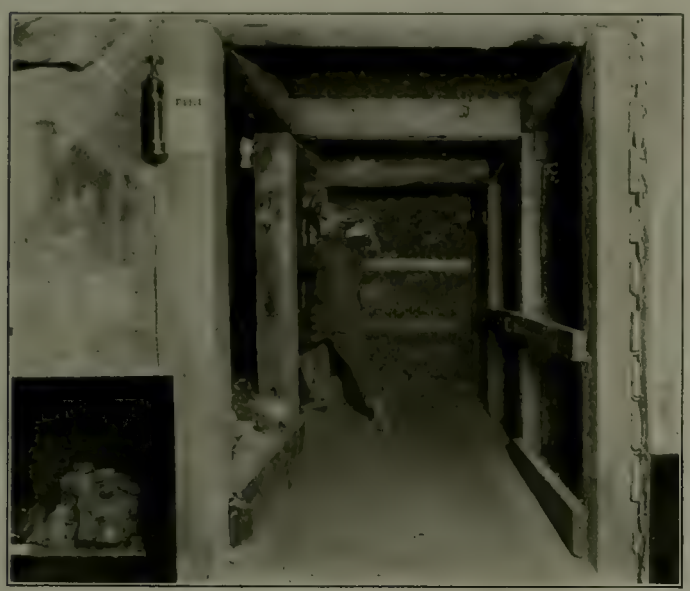
The DEISTER CONCENTRATOR CO., of Fort Wayne, Indiana, recently placed on trial one of its No. 3 tables in the Colburn-Ajax mill, Cripple Creek, and after a short time received an order for seven more slime-tables; and further, four more slime and one sand-table. The Company has just issued a catalogue covering the latest improved No. 3 slimer, which it claims does good work on feeds of 80-mesh and finer; the No. 3 double-deck slimer; the No. 5 Deister ore concentrator for fine and coarse sand feeds; the No. 5 double-deck ore-concentrator for fine and coarse sand feeds; and No. 4 ore-concentrator for fine and coarse sand feeds. Seven pages, with a plate, are devoted to a description of the driving-mechanism used on all Deister reciprocating-tables. The Overstrom single and double-deck tables are discussed, with parts. Also the Deister ore-concentrator multiple-deck slimer, for very fine slime and overflows. An extra list is given of incorporating improved parts, many of which are interchangeable in the older type machines

Thirty additional pages have been published since the above was written. These are to be inserted in the catalogue. Machines discussed are the latest improved No. 3 double-deck slime table, the double-deck No. 5 ore concentrator, and the single and double-deck Overstrom tables. During January a No. 3 Deister machine was installed in the Colburn-Ajax mill, Victor, Colorado. Further orders for the same plant consisted of seven slime tables, and four slime and one sand table respectively.

Mining and Scientific Press

Edited by T. A. RICKARD

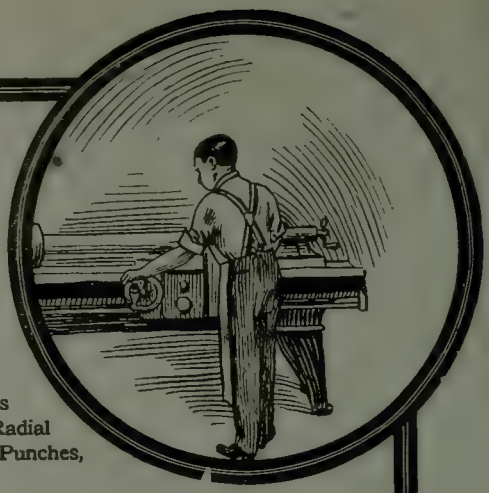
Volume 110 SAN FRANCISCO, MAY 1, 1915 Number 18



Yes; it does look like the real thing. It is part of the model mine at the Panama-Pacific Exposition.

In the model foreman's office you find the PRESS, of course. A description of The Mine appears in this issue.

Machine Tools



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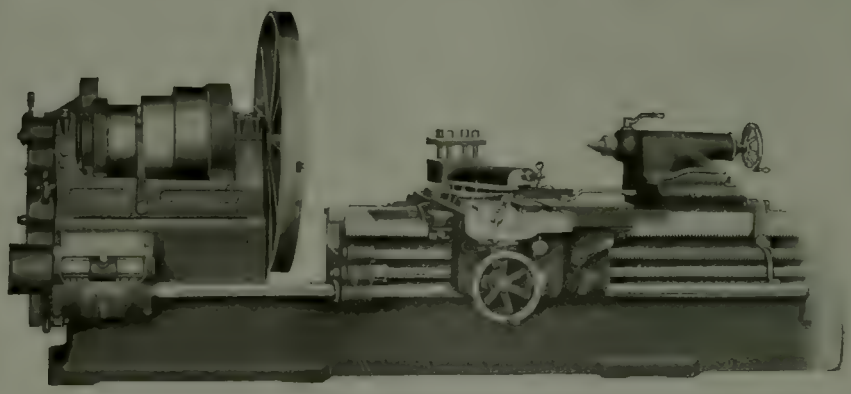

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Buyers Directory—Page 28
Advertisers Index—Last Page

TABLE OF CONTENTS

EDITORIAL Page.

NOTES 673

THE ZINC MARKET 674
Existing conditions are abnormal and therefore an unsafe guide to future development.

OILS AND FLOTATION 675
Oils are substances of great complexity; their use in flotation is an inviting field for research.

THE PLACE FOR ORE 676
Indications as to likely places to search for ore are invaluable guides to the prospector and miner; instances are given.

DISCUSSION

DEMOCRACY AT LAKE SUPERIOR.
By P. B. McDonald 677
An engineer of experience in the Lake Superior region is inclined to agree that the region is less democratic than others in the United States.

THE MECHANICAL WORK OF CRUSHING.
By Algernon Del Mar 677
A contribution to the discussion of Rittinger's law initiated by H. C. Kenney.

WAYS THAT ARE DARK.
By Alfred H. Hale 678
A suggestion as to the material used in salting samples, and further instances of the practice.

ARTICLES

CONSTRUCTION OF UNDERCURRENTS.
By C. S. Haley 679
These devices, so efficient in saving fine gold in hydraulic operations, are easily made. Detailed instructions for the construction of various types are given.

THE FLOTATION OF COPPER ORES.
By An Occasional Contributor 680
Inorganic oils give better results with copper ores; organic oils are more effective with lead and zinc ores. The applicability of various oils to copper ores is discussed, and the methods to be applied in practice are reviewed.

MINERAL INDUSTRIES OF BRAZIL 682
Diamonds and semi-precious stones are the chief mineral products. Some iron ore is smelted, 200,000 tons per year of manganese ore is exported. There is only one small coal mine; the copper industry is at a standstill.

THE MOUNT ELLIOTT MINE, CLONCURRY, QUEENSLAND.
By W. H. Corbould 682
The district is 200 miles long and 40 miles wide, with several scattered mines, of which the Mount Elliott is the most important. This has produced 45,000,000 lb. copper, 36,000 oz. gold, and 28,000 oz. silver. Working costs are given.

KNOWLEDGE AND RESEARCH. Page.
By R. W. Raymond 683
The difference between knowledge and research is the difference between the expert who knows what has been done and the discoverer who has a vision of what may be accomplished. Research must be based on knowledge, otherwise the fancied pioneer may find himself digging in ground exhausted and abandoned by others. And to make his work really useful the discoverer must also describe and define his achievement, otherwise his labor is in vain.

THE MINE—AN EDUCATIONAL EXHIBIT.
By The Editor 686
At the suggestion of the Bureau of Mines and with the co-operation of various mining companies and machinery manufacturers, a realistic exhibit of mining conditions has been made beneath the floor of the Palace of Mining and Metallurgy. The editor records his impressions.

AIR-BLASTS 690
Deep mining in the Lake Superior copper region is complicated by the rock pressure, which leads to crushing of the ground and collapse of the excavations, producing air-blasts of dangerous violence. The means taken to prevent their occurrence are described.

THE KENNEDY DAM.
By John S. Eastwood 691
The feasibility of mining operations, in some regions, hinges on the cost of storage of the tailing produced. Multiple-arch concrete dams are quickly and cheaply built. Full details as to such a dam recently constructed by the Kennedy Mining & Milling Co. are given.

AUSTRALIAN ORES AND METALS AT THE EXPOSITION 694
Australian mineral products are not displayed in the Palace of Mining and Metallurgy, but are housed in the Australian building. Gold, silver, lead and zinc, copper, tin, coal, and gem mining is well portrayed.

DEPARTMENTS

CONCENTRATES 695
REVIEW OF MINING: Special correspondence from Deadwood, South Dakota; Luning, Nevada; Toronto, Ontario; Lordsburg, New Mexico; Boston 697
THE MINING SUMMARY 700
PERSONAL 705
SCHOOLS AND SOCIETIES 705
THE MARKET PLACE:
Metal Prices 706
New York Metal Review 707
Current Prices of Ores, Minerals, Chemicals, Oil and Candles 708
RECENT PUBLICATIONS 709
MINING DECISIONS 709
NEW MACHINES AND DEVICES:
Engineering Specialties at the Panama-California Exposition 710
Commercial Paragraphs 710

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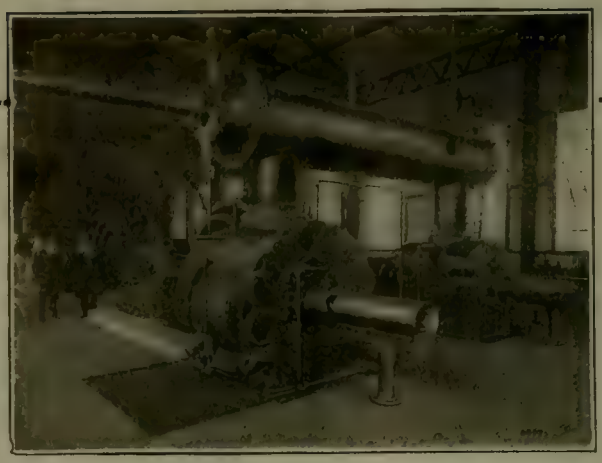

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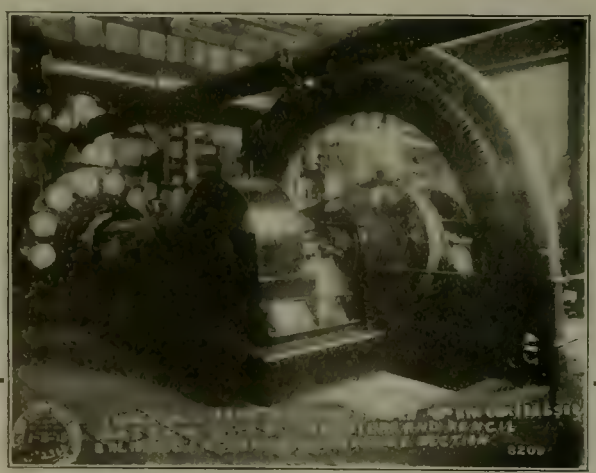


"Ingersoll-Rogler" Class "PRE" installed by the Anaconda Copper Company, Butte, Montana

9046

EDITORIAL

T. A. RICKARD - - - - Editor THOMAS T. READ - Associate Editor

WE are glad to state that our correspondent in Mexico, Mr. Leonard Worcester, arrested at Chihuahua on February 13, on orders from Francisco Villa, has been released, and is now out on bail. Thanks are due to the Secretary of State, Mr. Bryan, whose department made every effort to correct a grave injustice.

IN this issue we publish a description of the mine at the Exposition. For the excellence of this exhibit the credit belongs to a committee consisting of Messrs. H. M. Wilson, of the Bureau of Mines, Charles E. Van Barneveld, chief of the Department of Mines and Metallurgy, W. C. Coffin, Frank Harrison, and H. M. Wolflin.

PROHIBITION is invading every corner of the community. Among other manifestations of the effort to promote abstinence, we may mention that a general meeting of the Mining & Metallurgical Club of London was called recently by its president, Mr. Edgar Rickard, with a view to taking a vote on the proposal to discontinue "the sale or consumption of wines, spirits, beers, or other alcoholic beverages in the Club premises during the continuance of the War." We learn that a lively debate ensued, that many amendments were proposed, and that, in default of the possibility of carrying any resolution unanimously, the project had to be abandoned.

FREDERICK W. SEWARD, who died on April 25, was Assistant Secretary of State in the cabinet of Abraham Lincoln. He was the son of William H. Seward, who, when Secretary of State, in 1867, arranged the purchase of Alaska from Russia for the sum of $7,200,000, of which $200,000 was paid for the property of the Russian company at Sitka. To Seward also the new territory owes its name. At the time of the purchase he was severely criticized, but he had been in the North and knew what he was doing. "What, Mr. Seward," asked a friend, "do you consider the most important measure of your political career?" "The purchase of Alaska," he replied, "but it will take the people a generation to find it out." He was justified long before another generation had come and gone. It was an act of far-seeing statesmanship.

FLOTATION just now is a litigious subject, but the article we publish on another page does not trespass on the respect due to the courts of law. Our 'Occasional Correspondent', who is peculiarly fitted to write on this highly technical subject, describes the various kinds of oil employed. The use of the word 'acid' in connection with oily liquids has puzzled the judiciary of more than one continent. To the average man, 'oil' and 'acid' sound antithetic, the one being synonymous with smoothness and the other with acerbity. In this branch of ore-dressing, however, it is the physical rather than the chemical characteristic that counts. Some of the organic acids—such as crude carbolic acid—have oily properties that render them particularly suitable for the treatment of some ores. No one oil can be used effectively on all ores; indeed, this process illustrates one of the kindergarten principles of metallurgy, namely, the adaptation of the process to the ore. As regards flotation, the ordinary chemical analysis of an ore does not suffice to indicate whether it is amenable; physical conditions, of a character not yet satisfactorily defined, are decisive. Referring to treatment of copper ores enriched by chalcocite, our correspondent expresses confidence that flotation is practicable, as against a statement made by the author of the only textbook on the subject. We are glad to lay emphasis on the fact that this difference of opinion now has only an academic interest, because large tonnages of chalcocite ores are being treated successfully, notably at the Inspiration, Chino, Utah Copper, and Nevada Consolidated mines. On this and other points we invite contributory comment.

HABITUAL inaccuracy of statement is so confirmed a characteristic of the daily press, especially in technical matters, that criticism of them is hardly worth while. However, in a recent issue of an evening paper in this city there appeared a big-type heavily-leaded editorial the text of which was marked by an ignorance

not to be surpassed even by the worst forms of gutter journalism. Under the satirical title 'Generosity of a Copper Company', an attack was made on the Calumet & Hecla Mining Company. An attempt was made to show that this particular company was posing as a benefactor to its employees while in truth it was cynically mean to them. It was stated that the company has 12,000 employees, receiving $600,000 per month, or $50 per man; that the wages had been increased recently 10%, that is, to $55 per month; that this was "no raise at all" but a restoration of wages "to the scale paid before the strike of 1913"; that the company had "taken $14,000,000 from its men's wages during the past two years." This is a tissue of errors. The company normally has 10,000 men on its payroll; the average wage is nearer $100 than $50, miners receiving from $3.10 to $3.50 per shift; in May 1912 wages were increased 10%; the strike of 1913-1914 affected hours of labor, not wages; on September 1, 1914, a 10% decrease in the men's wages was made in consequence of the collapse of the metal market; the salaries of the staff were decreased concurrently 15%; at that time the price of copper was 12 cents per pound, as against a price of 14c. during the first half of 1914. Obviously the $50 per month and the $14,000,000 robbery are fictitious. The whole tone of the comment is grossly misleading and unfair.

The Zinc Market

The arrival of 6000 tons of zinc concentrate by the steamship *Sydic* at Galveston, from Australia, is a significant event. We understand that 85,000 tons of similar material has been consigned to this country from Broken Hill, New South Wales. What does it portend?

The three facts dominating the price of zinc at this time are the curtailment of European and Australian production, the innocuous desuetude of the cartel in Europe, and the demand for zinc in the making of brass to be used in the manufacture of munitions. All three are consequences of the War. The zinc from Broken Hill is exported as a 46% concentrate, most of which, before the War, was treated in Belgium and Germany, only a minor part of the output going to the Seaton Carew smelter, of the Sulphide Corporation, in England. The cartel is a syndicate of metal-merchants organized to control the market for zinc. In this syndicate were Aron Hirsch & Sohn, Beer, Sondheimer & Co., the Metallurgische Gesellschaft of Frankfurt, and the Vieille Montagne. Thus constituted the cartel exercised an unhealthy dominance, of which we may have more to say at another time. Just now its activities are extinguished. Control has passed, for the moment, to this side of the Atlantic. At the present time the production of zinc in the United States is at the rate of 600,000 tons per annum, while the smelter capacity is only 450,000 tons. If the Australian supply is to be diverted hither, it is obvious that the erection of further plant is imperative. But is this diversion temporary or permanent? That doubt has paralyzed many schemes on both sides of the Atlantic. Soon after hostilities began in Europe, an effort was made by the Hoover brothers, Mr. F. A. Govett, and others associated with the Zinc Corporation, to raise funds for the erection of a large up-to-date zinc-smelting plant in England. A representative of the Guggenheims also visited London last November with a view either to joining this enterprise or of erecting a separate zinc smelter in Europe: in Wales or Spain. Money and talent were available, but several obstacles were uncovered. Labor conditions in England are not favorable to smelting enterprise; nor is the fume nuisance a negligible point; but the decisive factor is the existence of contracts between the Broken Hill companies and the smelters in Germany and Belgium. These contracts are suspended, not abrogated, by the War. That is the view taken by the English courts. Wise men do not buy into litigation. There has been talk that the Federal Government of Australia might declare these contracts with enemy-aliens to be contrary to national interest, and outlaw them, leaving the question of compensation for final settlement between Great Britain and Germany when terms of peace are arranged. But nothing of the sort has been done. Obviously it is inadvisable to tamper with international law, which, in this case, is clearly against a hasty denouncement of the contracts rendered inoperative by the incidence of war. Of course, not all of these contracts are for long terms; some of them must expire shortly. But that is not the only trouble, at least as regards the American market. Should the zinc concentrate be shipped to the United States, there is a chance of an embargo being levied, like the export duty that killed the shipment of tin concentrate from the Malay States just as the tin smelter at Bayonne, New Jersey, was finished in 1903. That lifts a warning finger to those thinking of erecting smelters to treat Australian concentrate. The Australian Government might be influenced or coerced by labor leaders raising the cry for the smelting of Australian ore in Australia, which, after all, is the economic ideal, if only the cost and amenability of labor had not rendered it impracticable in the past. Furthermore, there is the duty on imports of zinc ore into the United States. Now the duty is small, it is only 10% on the gross value of the zinc in the ore, but should the market for the domestic output suffer unduly from foreign imports it is more than likely that a prohibitive tariff would be demanded, successfully. Those controlling the bigger mines in Australia might join with the larger producers in the United States with a view to regulating the market; this can be done, for the joint output represents fully 52% of the world's entire production; but the many owners of small mines in Missouri, Wisconsin, and Oklahoma might resent the importation of Australian concentrate and make an unpleasant noise at Washington. In 1914 the United States produced 364,000 tons of zinc and consumed 314,000 tons. Now the production is 600,000 tons, all of which is being consumed, for the output is sold up to September at 9½ cents per pound, as against a price of 4.8 cents in July last. The average cost, including interest on capital expenditure, is estimated at 5.4 cents

per pound. In short, existing conditions, owing to the War, are abnormal, and therefore afford no safe guide for estimating business in the near future. On the whole, the best solution of the question how to dispose of the Australian production is the restoration of the Belgian smelting industry, on the conclusion of peace, by aid of British capital. Meanwhile American mines can produce all the zinc that is required either for peaceful or warlike purposes, for the increase during the past year is more than equal to the whole Australian output.

Oils and Flotation

Oils have been used for centuries for a variety of purposes. The development of flotation as a metallurgical process has led to the study of these interesting substances from a new viewpoint, as their application to this process hinges on properties not previously utilized. Flotation, though complex in its application, is in principle a simple process. It depends chiefly on the fortunate fact that metals and their compounds in their natural state are less easily wetted by water than compounds of the other elements. This is equivalent to saying that the minerals of economic value are less easily wetted than valueless gangue-minerals, whence the process derives its usefulness in metallurgy. Minerals are heavier than water, but particles of them will float on a water surface because of the fact that each one has adhering to its surface a film of air. Similarly, a mineral particle wetted and submerged has a film of water adhering to its surface that bears to it a different relation from the remainder of the liquid, the molecules of water adherent to the surface being in a state of strain, which causes the development of molecular forces of surprising magnitude. The wetting of a dry particle of ore involves the displacing of an adhering film of air by a film of water, and, as we have already remarked, this does not easily take place with certain particles of minerals, to which the air clings with great tenacity. It is probable that such mineral particles, when submerged in water, are not actually in contact with the water but are covered with a film of air, like a diver in his water-proof dress. As the air is much lighter than the water, such a mineral particle has a much less specific gravity than it otherwise would. Presumably the thickness of the film of air is independent of the mass of the particle, hence the smaller the particle the less its actual specific gravity. We are not aware that research has demonstrated this to be a fact, but, if true, it would go far toward explaining the difficulty experienced in ore-dressing in separating minerals of differing specific gravity when the particles are very small.

In common parlance, oil and water will not mix; in other words, a water surface adheres not at all to an oil surface. But oils do adhere to mineral surfaces with considerable tenacity, showing the same preference as air for the economic minerals. Most oils are also much lighter than water, and these two properties have been utilized in flotation in two quite different ways: If crushed ore is mixed with a considerable quantity of oil it adheres to the valuable mineral particles in considerable amount, forming an oil-mineral agglomerate that is lighter than water, and consequently floats, the oil buoying the heavy mineral just as a life-preserver buoys a swimmer. For various practical reasons this property is not of much use in ore-dressing in its simplest form; but if a small quantity of oil is brought into contact with the mineral, it seems to spread itself in an infinitesimally thin film over the mineral surface; at any rate, a minute quantity of oil will greatly increase the tendency of a large quantity of mineral not to be wetted by the water. Nearly everyone is familiar with the parlor trick in which the operator rubs his fingers on his hair and then draws a common sewing needle between his fingers in order to transfer a minute quantity of oil to its surface. The needle can then, by skilful handling, be floated on the surface of a glass of water, to the astonishment of the spectators. The forces involved in causing the water surface to support the needle, which has a specific gravity eight times that of water, are identical with those utilized in the flotation of ore. Agitation, with the resulting production of a froth, is employed because the amount of mineral that an air-water surface will support is comparatively small, while the aggregate surface of a collection of bubbles is great. Furthermore, the curved surfaces of bubbles seem more efficient than the normal flat surface of a liquid.

Oily substances are commonly classified into oils, fats, and waxes, roughly liquid, semi-solid, and solid substances. More exactly, oils are liquid, and fats are semi-liquid or solid glycerides, while waxes are combinations of fatty acids with monatomic alcohols. Waxes are usually solid, but the substance commonly known as sperm-oil is a liquid wax. Even this definition does not cover the case, for crude petroleum and the variety of substances that may be separated from it are not included. These are hydrocarbons belonging to the paraffin series, C_nH_{2n+2}; the olefin series, C_nH_{2n}; the acetylene series, C_nH_{2n-2}; the terpene series, C_nH_{2n-4}; the benzene series, C_nH_{2n-6}; and so on almost *ad infinitum*. Such hydrocarbons are known as the inorganic oils: the organic oils being divided into animal and vegetal oils, according to their origin. Animal oils are produced from the fatty substances found in the bodies of animals. These substances have no direct function in the animal metabolism, and it is generally believed that they represent a sort of savings bank of the excess of food eaten by the animal beyond its daily requirements, which is thus stored away as a safeguard against periods when food is scarce. But the oils formed in plants clearly have no such function, and it has not been explained satisfactorily why the plants produce them. The origin of inorganic oils is shrouded in mystery, the older theory being that they have been produced from the inorganic remains of fossils. The difficulty with this explanation is that inorganic oils are entirely different in chemical composition from organic oils, and the production of them from organic substances would

involve the action of reducing processes under conditions in which it would be more natural to expect oxidation. The advocates of the theory of inorganic origin have recently made a good deal of progress toward establishing their hypothesis.

It is thus seen that the general subject of oils is a decidedly complicated one. The flotation investigators have detected a new complication, since, as pointed out in the valuable article on flotation appearing on another page in this issue, oils of inorganic origin give better results on copper ores, while vegetal oils give the best recovery on zinc and lead ores. Furthermore, different samples of the same oil give widely differing results. This may possibly be due to the fact that all commercial oils are mixtures of several substances of diverse composition. It is not impossible that investigation may prove eventually that it is not the oil which does the work, but some other substance which is present in minute and varying amounts in the oil. On the other hand, there may be some substance present that interferes with good work. This is only one of the many problems connected with the practical application of flotation that are as yet imperfectly understood. The whole field invites research.

The Place for Ore

The miner's search for mineral riches is guided by many considerations, most of which he is rarely able to explain in so many words. Theories, of course, he has. But his best guide is an instinct developed by actual experience. One of them is the feeling that certain kinds of rock are favorable to the existence of the particular ore for which he is seeking. The Cornishman will tell you that 'killas', or clay-slate, near granite is 'kindly' to tin, while the prospector in Colorado when searching for silver-lead ore will look for limestone. As the old miner says: "The nature of the rock is congenial to the formation of mineral." And so it is, even if the man with the pick has to look to Harvard or Yale to tell him the true inwardness of the phenomenon. A sort of empirical geology was evolved long before scientific explanations had been established, if they can be said to be established even now, save in a general way. It has been ascertained that certain rocks are peculiarly associated with deposits of particular metals, for example, silver-lead with limestone, quicksilver with serpentine, copper with schist, gold with slate, and so forth. But the generalization is punctured by exceptions. We find that the favorable kind of rock is not enough; there must be structural conditions indicating a period when thermal solutions were able to circulate and precipitate in the specific locality. And of such structural conditions the contact with an eruptive seems to be decisive; also the presence of a specially permeable or soluble stratum, zone, or band, assisting and compelling the chemical reactions precedent to a concentration of ore.

Among the deposits illustrating these elementary considerations we may instance the flat orebodies in the quartzite at Redcliff, Colorado. These have been described and discussed at intervals for 30 years, from S. F. Emmons before the Colorado Scientific Society in 1886 to Mr. A. H. Means in an interesting article appearing in the latest issue of *Economic Geology*. Near Redcliff the Eagle river has cut a deep cañon, the cliff on the eastern side exposing a geologic section that includes Archean granite, Cambrian quartzite, and Carboniferous limestone, with a porphyry that is probably of Tertiary age. In the limestone are replacement deposits of zinc-blende, associated with pyrite, chalcopyrite, and galena. In the granite are fissures containing gold and silver, associated with pyrite, chalcopyrite, galena, and zinc-blende. We are chiefly concerned for the moment with the ore in the quartzite. This takes the form of flat masses or floors of sulphide ore, largely oxidized, connected with fault-fissures that are rich in the precious metals and extend into the basal granite. Leaving the more obscure features, we note that the rich ore, containing crystalline gold of great beauty, is found on the floor of cavernous spaces in the quartzite, notably where it has been traversed by the fissures that penetrate the rocks both above and below this particular geological horizon. Apparently the enriching mineral solutions, spurred into activity in the wake of the porphyry intrusion, ascended from the granite, forcing a devious passage through the overlying strata until they found conditions favorable to precipitation. The magmatic waters may have been compelled to deposit their metallic contents by reason of reactions with descending waters encountered at this horizon. Similar explanations apply to many districts; but what, it will be asked, was the factor that determined the localization of ore in the quartzite? Here Mr. Means offers fresh evidence It was the existence of a zone, 20 to 60 feet thick, of sericitic alteration, that is, the grains of quartz in the quartzite have been replaced marginally by sericite, a secondary variety of white mica, thus creating interstices filled with sericite, and fine pyrite also. This furnished a zone of relatively greater permeability and solubility. Likewise the overlying limestone, by its solubility, furnished another favorable zone, emphasized by an impervious cover of porphyry. Many analogous cases might be quoted. We shall refer to one, that of the rich blanket-orebodies of Newman hill, at Rico, also in Colorado. There the solutions rising along fault-fissures were brought to a stop by a stratum of shale, which broke the force of the fissuring by changing vertical faulting into lateral slipping. Under this relatively impervious shale there happened to lie a layer of gypsum, a mineral of easy solubility. That determined the place for ore. The flat bodies of sulphides, rich with native gold and argentite, have a strike that conforms to that of the veins, below them, whereby the ascending solutions were conducted to the gypsum. In the Black Hills of South Dakota a similar relation between 'verticals', as they are called, and 'contact' orebodies is observed. In the exploitation of them we obtain some of the most interesting illustrations of the application of geology to mining.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

Democracy at Lake Superior

The Editor:

Sir—Rather startling, but perhaps true, is Mr. Read's suggestion in the *Press* of March 13 to the effect that life in the Lake Superior copper country is less democratic than in any district in the Western states. Most emphatically he is right when he says that the people of the district are not conscious of any lack of democracy. Indeed, so unconscious are the vigorous-minded people of the copper country of a lack of democracy, and so much good is mixed with the bad points of the system, that a not unpleasing semblance of democracy has long prevailed. It was only after fifty years of smooth going that serious labor trouble occurred. It is interesting to note that Mr. Read ascribes the peculiar social conditions existing in the copper country to the influence of early aristocrats (notably Alexander Agassiz) from that famous hot-bed of aristocracy situated on the bleak shore of Massachusetts bay. In this connection, many mining men have remarked at the complete change of social atmosphere experienced in going from the Michigan iron ranges, where a hematite-handed hospitality prevails, to the Keweenaw peninsula, a few miles to the north, where class lines tinge all intercourse, although usually not noticed in the light of other advantages which the attractive copper country offers. The influences, which early set the social standard on the Lake Superior iron ranges, I would call distinctly Cornish. There is one considerable district in the Michigan iron region where, up to a few years ago, one man was the dominant factor; and there never was a happier mining district anywhere, because this man was, and is, a democrat. What is more, he attracts the best miners in two states, and he does not do it by presenting them with libraries, hospitals, or visiting-nurses, or by giving prizes for flower-gardens. It is quite possible, as Mr. Read intimates, that all the paternalism and philanthropy which the copper-mining companies have lavished upon their employees, and of which they (the employers, not the employees) are so proud, has only served to emphasize the difference between master and man, and has aroused the envy of the workmen by giving them tangible proof of the large profits their labor has brought to (as they thought) idle men who seldom see the mines. I wonder is paternalism worth while—particularly in the mining business?

P. B. McDONALD.

Boston, April 2.

The Mechanical Work of Crushing

The Editor:

Sir—Summarizing the limited amount of discussion of the work done in crushing, we find that while the respective adherents of Rittinger and Kick indulge in mathematical athletics, there is a dearth of experimental proof.

Stadler says,* in reference to the statement that the work required to crush rock varies in proportion to the surface exposed: "This 'law' is a myth which has never been recognized by science and it is unfair to Rittinger's memory to connect his name with what is clearly nonsense." At McGill University it is stated that the final results of experiments were to disprove the laws of crushing enunciated by Rittinger and to prove Kick's law. So far is I know, these proofs have not been made public, nor the result of the investigation undertaken by the Mines Trial Committee in South Africa, although it has been hinted that the results favored the Rittinger theory; but one must remember that it would be rank heresy in South Africa to accept this theory. A. F. Taggart by mathematical reasoning proves Kick's law to be true within the elastic limit, and then assumes it to hold good for fracture.† A. O. Gates proves by actual experiments that Rittinger's theory is nearer the truth than Kick's law when the elastic limit has been passed. So the question naturally presents itself, why cannot this subject be decided by experiment, and not left to mathematical jugglery?

In a small way and by a limited number of experiments I have attempted a demonstration, the results of which are appended as well as a mathematical calculation showing how easy it is to prove both theories by mere figures.

I prepared a number of cement blocks of cubic form, with a single plane of weakness through the centre produced by imbedding a piece of tissue paper the size of one face of the cube, the paper being punctured with holes corresponding to half the area of one side of the cube. These were made in two sizes, with 2-in. and 1-in. edges. With a falling weight, to imitate a gravity stamp, I fractured 15 of these cubes and found approximately that a 3-lb. weight was required to drop 20 inches to fracture the 2-in. cubes and 5 inches to fracture the 1-in. cubes. A 3-lb. weight falling 20 inches produces 5 foot-pounds of work, while the same weight falling 5 inches

*Trans. I. M. & M., Vol. XX, p. 426 (1910-11).

†Trans. A. I. M. E., 1914.

produces 1¼ ft.-lb. The area of fracture or the surface exposed in crushing varied in the same proportion as the amount of work required to fracture the two different-size cubes, so that the work in crushing followed Rittinger's law, the formula being represented by the ratio of the original diameter D to the final diameter d, or D/d.

If n is the number of times a cube has been halved by fracture, then $\frac{1}{2}^n$ will represent the proportion of the original diameter, then $D/d = \frac{1}{\frac{1}{2^n}}$, therefore $\log D/d = n \log 2$. But $\log 2$ is a constant, therefore $k \log D/d = n$. But the work is proportional to n, therefore the work done in crushing is proportional to $\log D/d$. So here we have the work proportional to D/d and $\log D/d$, the former the Rittinger and the latter the formula derived from Kick's law. It is easy enough reasoning from first principles to prove that Kick's law applies to deformation within the elastic limit, but it is not necessary for our argument.

In your issue of April 10 is an able paper by Herman C. Kenney, who inclines to the belief that Kick's law applies to deformation without fracture until the elastic limit is passed, when the Rittinger law applies—in fact, that one law ends where the other starts. This he expresses by the equation:

Total work = work of compression + work of fracturing — work given back when the pressure is released. Gates‡ says: "At the so-called elastic limit the first break occurs some place within the body, releasing the energy locally absorbed at the point and allowing a further deformation without a proportionate amount of energy being absorbed. * * * And except as energy has been absorbed in making these breaks and any heating of the material has caused radiation losses, the individual crystals of the rock are allowed, upon release of the pressure, to return to their original form (in conformity with Kick's law, if I understand it aright), and in so returning to their original form they return the energy they contained."

If Kick's law is true to the elastic limit and Rittinger's law for fracture, we must then have some energy dissipated. This may be represented thus:

By Kick's law.		Rittinger law.		
Work done to elastic limit	−	Work of fracture	−	Work of radiated heat
Returned energy	=	Energy consumed in physical changes		

$$x = a + b + c + d$$

At the moment of fracture, heat is generated by friction of the sliding grains, together with the heat of compression, giving the total heat lost, convertible into foot-pounds of work. The pressure being released at the moment of fracture, work is done by the pieces returning to their original state of strain. By this line of reasoning we can show why Kick's law is far from true for fracturing, but to establish the Rittinger law we must show that b, c, and d bear fixed ratios to the size of the particles fractured.

The rise in temperature of any body due to compression or friction within itself is inversely proportional to the size of the particle, so that the smaller the particle the less work expended in compression; as this heat is a constant quantity for any substance, we may conclude that the loss of energy due to heat bears a fixed ratio to the size of the particle to be crushed. The returned energy will also bear a fixed relation because this depends upon the elasticity of the body, while the energy consumed within the body will likewise follow the same rule. I have, I believe, shown that while Kick's law is true to the elastic limit, beyond this Rittinger's law is approximately true for fracture, and the difference between the two amounts of work is made up of several factors that vary with the size of the particle to be crushed.

Los Angeles, April 13. ALGERNON DEL MAR.

‡*Eng. & Min. Jour.*, April 18, 1914, p. 821.

Ways That are Dark

The Editor:

Sir—In your issue of the 10th inst. you say, under the 'Waste of Experience,' that "the composition of the material used in salting suggests a question we should like to see answered by some of our readers."

One of the best 'salting' compounds for gold ore I know of is made, and has been used successfully, by fusing about 96% of gold and 4% of lead. As some mining engineers become suspicious when a gold ore does not show an appreciable amount of silver, 'expert metallurgists' add a few percentages of silver to the charge. The alloy is extremely friable, pulverizing about as easily as chalk. It has an advantage, not possessed by sylvanite, of being very heavy, and in wet ore is not readily washed away. Besides, the exact amount of gold added to the sample is easily determined, which is not the case where the telluride ores are used for salting, owing to the lack of uniformity in their composition. I am quite certain I could fill more than one issue of the *Press* with what I have learned in one way and another—mostly from experience—of the tricks that have been played in the ancient and honorable profession of mining. I have known of cases of the biter actually having a piece bitten out of him, figuratively speaking.

While I think what I have said about 'salting' may interest you, I believe you will agree with me that it would not be advisable to publish it?

Taking the inside out of a block of pay-ore is an old trick. The Telegraph mine in Bingham cañon, Utah, is an example. The mine—I have forgotten its name—that made Coolgardie, Western Australia, famous was secretly prospected by the owners by means of an independent shaft and a drift extending from it to beneath the ore in the rich pocket in which the actual working-shaft was sunk. The secret workings showed they were about to the bottom of the rich pocket. Then, like wise men, they sold out.

Denver, April 13. ALFRED H. HALE.

Construction of Undercurrents

By C. S. HALEY

The efficiency of the undercurrent in saving fine gold has been proved at many hydraulic mines. Some of the more common types of construction in use in different parts of the West, under varying conditions, may be of interest.

In the more remote portions of northern California, where almost everything but wire-nails has to be made on the ground, fir blocks about four inches thick and spaced about three-quarters to an inch apart, are used to make the riffles. The undercurrent-box itself, in a hydraulic mine of average size—say using a 20 to 36-in.

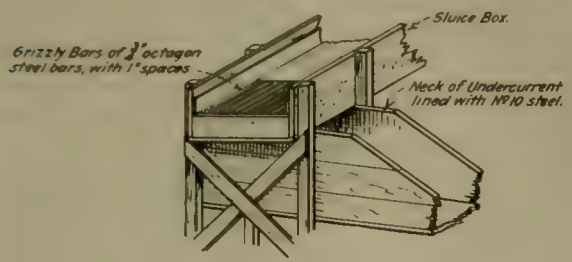


FIG. 1.

sluice—will be six to eight feet wide and from 12 to 24 ft. long. The sides will be of 10-in. boards, leaving a clearance of six inches above the blocks. The bottoms are usually of 16-in. stuff, 1¼ in. thick, and made of white fir or sugar pine. Such an undercurrent is shown in Fig. 1.

The inside of both bottom and sides is planed, and the joints made carefully, the sides being fitted and nailed before the box is put together. After this, soft wood is used for calking, and the cracks are carefully planed off. The blocks are usually cut in rectangles about twelve by six or eight inches, and spaced irregularly about an inch apart, with the sap sides up-stream, if possible, to avoid abrasion. As they do not have the shock and heavy abrasion that the main sluice-blocks do, green blocks will do very well. After the season is over, they should be carefully burned, however, and the fine adhering gold recovered. Spaces between are made with small wooden wedges or stones laid on the bottom as the blocks are put in. Liners are used as in the main sluices to hold the blocks down. The upper end of the undercurrent is usually slightly fan-shaped, to allow the spread of the water and fine sediment to be regular. This is connected to the main sluice by a 'neck' which is directly under a grizzly near the end of the latter. The direction of the undercurrent flow is usually at right angles to that of the main sluice. The construction of the grizzly and 'neck' is shown in Fig. 2.

Another type of undercurrent, used in California and Oregon, consists of a box of about the same dimensions, but the riffles are of the plain Hungarian type, being two-by-fours laid in alternate bands lengthwise and crosswise. These two-by-fours are covered with strap iron and spaced 1½ to 2 in. apart by means of wedges between the ends.

Still another type, but one which I have never used myself, does away with riffles altogether. This is used in some of the eastern counties, and consists of strips of brussels carpet laid across the box, tufted up by means of ordinary 'chicken wire' laid on top of it. While this would doubtless hold some of the fine gold, it seems too easily abraded.

The foundation for the undercurrent is often a difficult piece of construction. It is, of course, very poor practice to lay it on the dump, as a rise in the river some night might carry the whole thing out and cause the loss of the best part of the clean-up in some cases. Where the main sluice dumps directly over a bluff into the river, footings should be carefully cut in the bluff and the undercurrent run out at this point.

I have often saved from one-fourth to one-third of the gold in my clean-up in the undercurrent—gold that had passed over a hundred feet of sluice without lodging permanently in the riffles. The average grade for an undercurrent should be slightly steeper than that for a sluice, as the water is much better distributed. From eight to eleven inches in a 12-ft. box is satisfactory.

The 'neck' should be lined with ordinary No. 8 or 10 B.W.G. steel, as the water pouring down through the grizzly exerts a good deal of erosive action. Also, the lip at the end of the box, over which the undercurrent

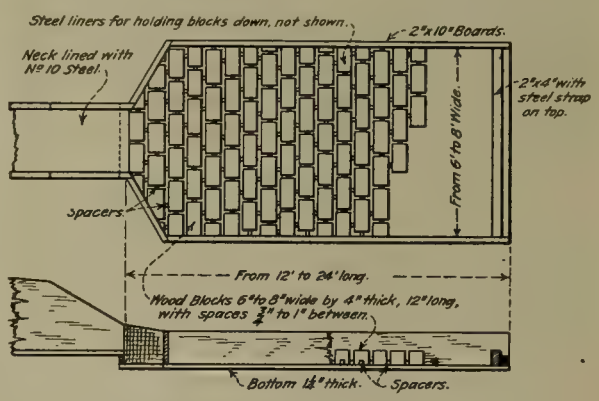

Steel liners for holding blocks down, not shown.
2"x10" Boards.
Neck lined with №10 Steel.
2"x4" with steel strap on top.
From 6' to 8' Wide.
Spacers.
From 12' to 24' long.
Wood Blocks 6" to 8" wide by 4" thick, 12" long, with spaces ½" to 1" between.
Bottom 1¼" thick.
Spacers.

FIG. 2.

discharges, should have a strap of steel over it. This is usually a two-by-four placed square with the end of the box, in such a way that it can be removed after the water has been turned off and the clean-up completed, to collect what fine amalgam may be lodged under it.

The grizzly in the main sluice is best made of ¾-in. octagonal steel bars, spaced about an inch apart. This allows most of the water to go through and practically all the heavy fine sediment, while the boulders bump over the end of the main sluice from their own momentum. In large mines, however, two or three undercurrents are often spaced at intervals along the main sluice, each one taking its quota of discharge.

The Flotation of Copper Ores

By AN OCCASIONAL CONTRIBUTOR

Introductory.—The work of the past two years at many mills in the United States, Mexico, and South America, has done much to prove the suitability of flotation processes to the recovery of the sulphide ores of copper, and to indicate the best reagents. In a general way, it may be said that oils of mineral origin, such as coal-tar and fuel-oil, give better results on copper ores, while oils of vegetal origin, such as the terpenes, pinenes, wood-tars, etc., are better adapted for the treatment of zinc and lead ores.

Coal-Tar Products.—Among these cresylic and carbolic acids are the best known reagents. Commercial cresylic acid is an oily refractive liquid, generally with a red or yellow tinge, has a specific gravity of about 1.044, and consists of approximately 40% metacresylic, 35% orthocresylic, and 25% paracresylic acids, the properties of these three isomers being, according to Lunge and Keane:[1]

Acid.	B.P.	Solubility in 100 parts water, ordinary temperature.
Orthocresylic	191°	2.50 vol.
Metacresylic	203°	0.53 "
Paracresylic	202°	1.80 "

This acid is much less soluble in water than its homologue, carbolic acid, and is still more easily broken down by sulphuric, which probably accounts for the statement that sulphuric acid may not be used along with either of these weaker acids. My own experiments give conflicting results, and I cannot speak with confidence on this point.

I have found a marked difference in the behavior of different brands of cresylic acid, and I suggest that, in conjunction with tests run, the different brands be analyzed to see what bearing the differing amount of the three constituents has on the action of the various acids. I had very poor success in treating a certain chalcocite ore with a dark colored cresylic acid, and on changing over to a light colored brand, I had immediately surprisingly good results.

Lunge and Keane give a method (Rascheg's) for the estimation of the three isomers of cresylic acid. For the benefit of those who may not have access to this book, I give it in full:

On treating *m*-cresol with excess of HNO_3 at 100° it is quantitatively converted into trinitrocresol, while its isomers are completely oxidized to oxalic acid. The following directions, which must be most carefully observed, give reliable results:* Exactly 10 grammes of the cresol mixture are weighed into a small conical flask mixed with 15 c.c. ordinary H_2SO_4 (1.84), then treated for 1 hour in a steam-oven, and the contents poured into a wide-necked flask of 1 litre capacity. The flask is cooled under the tap, shaking it round meanwhile in such a manner that the sulphonic acid, which is a mobile liquid while hot, settles as a thick syrup on the sides of the flask during cooling. 90 c.c. of HNO_3 (1.38) are then first poured into the small flask in which the sulphonation was conducted, in order to remove any sulphonic acid adhering to its sides, rinsed well round, and then poured, all at once, into the larger flask. The contents of the latter are well shaken immediately, so that all the sulphonic acid is dissolved, which takes about 20 seconds. The flask is then placed in a draught-cupboard. After one minute a violent reaction occurs, red fumes are evolved, and the liquid boils; then it suddenly becomes turbid: oily drops of trinitrocresol form and collect on the bottom of the flask; and after five minutes the reaction is apparently ended. The whole is allowed to stand for at least another five minutes, then poured into a dish containing 40 c.c. water and the flask rinsed out with a further 40 c.c. water into the same dish. On mixing with water the trinitro-*m*-cresol solidifies with liberation of nitrous fumes to a crystalline magma. It is allowed to stand for at least two hours while the liquid cools; then it is crushed with a pestle, and filtered on the pump through a filter that has been tared against another one. The crystals of trinitrocresol are washed with 10 c.c. H_2O, dried at 95 to 100° and weighed. If these instructions are carefully followed, 1.74 gm. of trinitro-*m*-cresol are obtained for each gramme of metacresol present in the mixture whatever the composition of the latter. The presence of even 10% phenol does not diminish the accuracy, as the picric acid that is formed remains in solution, but the method must not be applied to mixtures containing large amounts of phenol. This, however, does not often occur in practice. In such samples the presence of phenol is detected by the B.P. and also by the fact that the nitro compound does not remain solid in the steam-oven at 95 to 100°, but melts, or, at any rate, forms a soft paste. But a cresol that distils for the most part between 190 and 200° and, therefore, contains scarcely any phenol, always yields a pale yellow crystalline mass, the weight of which divided by 1.74 gives the weight to within 1% of the *m*-cresol in the mixture. It may be well to repeat that not less than 90 c.c. of HNO_3 is to be used, and poured all at once into the flask as quickly as possible, a flask having a very wide neck being used.

To determine all three isomers Rascheg separates the *o*-cresol completely by repeated fractional distillation: the distillates being composed roughly of 60% *m*- and 40% *p*-cresol in which the *m*-cresol is determined as above. This operation, however, is entirely beyond the

[1] 'Technical Methods of Chemical Analysis,' 1911.

skill and resource of the average chemist. It is rendered unnecessary from the fact that the three acids mentioned bear a fairly constant ratio, as before stated, in any commercial cresylic acid; from the percentage of meta-cresylic acid formed, the others may be calculated. These three acids can be obtained in a pure state. I suggest a trial of them on a small scale, and I venture the opinion here that the ortho-cresylic acid is the one that does the work.

Cresylic acid should be handled carefully, as it gives rise to painful skin-wounds, and may easily splash into the operator's eyes. It is well to keep a bottle of olive-oil handy as a remedy.

Coal-Tar Cresols.—Cresylic acid is an expensive reagent, costing at least $1.25 per gallon delivered at Western American mills in peace-time. It comes principally from Germany and England. A search for a cheaper substitute has shown that crude coal-tar creosote, which is a by-product of gas-works, blast-furnaces, and gas-producers, is promising. Samples from different sources vary greatly in liquidity and chemical composition (proportion of phenols and cresols present); they well merit investigation. Being generally viscous they emulsify imperfectly, especially in the cold, and while some solvent like pine-oil or cresylic acid can be employed, such solvents are expensive and tend to mask the effect of the original reagent. It is probable that the employment of the more liquid blast-furnace creosotes, with preliminary heating, would be attended with good results.

Carbolic acid (phenol) is a homologue of cresylic acid. It is difficult to distinguish between them, the smell and color being so much alike. Carbolic acid has a solubility varying from 4.83% at 11° to 11.83% at 77° in 100 parts of water. It is easily broken down by sulphuric acid, yielding oxalic acid. It appears to be much less selective than cresylic acid in its action on metallic sulphides, and a slight excess brings over a concentrate high in insoluble matter.

Fuel-Oils.—My investigations cover Mexican, Texan, and Californian crude oils. From the known difference in composition, it is not surprising that on any particular ore the results are widely different. The metallurgist should have samples of all three on hand when running tests. Fuel-oils are not highly selective like cresylic acid, pine oil, etc., but are strongly emulsive; they serve the purpose of giving body and mineral-carrying power to the relatively weak but more selective froths; they are cheap, quickly obtainable, and, when used in moderation, bring over little gangue. It is well to increase their fluidity by steam-jacketting the container from which they are fed to mixing-compartments.

Gas Oil (stove-oil).—This is one of the distillation products of crude oil. It is a strong emulsifying agent, which is, at times, most useful. It is worth a trial in running tests. It must be used in very small quantities.

Crude Wood Turpentine.—This is not the ordinary spirits of turpentine. It is a dark reddish-brown liquid with a pungent smell. On gravity-flow machines I have found it of little use, as its action in slight excess is to bring over gangue freely. As an emulsifier, I much prefer fuel-oil or tar-oil. On machines through which the flow of pulp is maintained by mechanical means, it has been found a valuable reagent for the purpose of controlling the levels of pulp, through its physical action on froths, but this result is achieved at the expense of impure concentrate, unless the agent is used in the strictest moderation.

Pine-Oils, Wood-Tar Oils, Fir-Oils, Wood-Creosotes, Etc.—The destructive distillation of soft woods yields a large number of products, and possible reagents. I have found the oils derived from pine and fir to be more selective on chalcopyrite than on chalcocite ores. Wood-tars and tar-oils are excellent emulsifiers, but it appears that the series in general gives better results on zinc and lead than on copper sulphides. I have found pine-oil used in conjunction with crude sulphuric acid to give excellent recoveries on weathered chalcopyrite ores where cresylic acid had been a complete failure. There may be some significance in the fact that the action of sulphuric acid on terpenes (pine-oils) and phellandrenes (crude eucalyptus-oils) is to give in both cases dipentenes and terpinenes.[2] I mention this, as eucalyptus-oils, which are prohibitive in cost in America, are, I understand, universally used in conjunction with sulphuric acid on zinc and lead ores in Australia.

Applicability of the Process.—T. J. Hoover in the latest edition of his book on flotation[3] repeats the statement made in the first edition, that there is a doubt if chalcocite can be recovered successfully by flotation. This surely is an oversight; no one is more cognizant than Mr. Hoover of the recent work done in flotation, and I have only here to refer to the very high recoveries that have been made on a working scale on chalcocite ores, in Arizona, at several large mills.

Cuprite is considered a difficult mineral to recover by flotation. In the case of one ore that has come under my notice, in which the cuprite occurred as a subsidiary mineral, the saving amounted to a small percentage only, certainly not as much as an efficient slime-table would have recovered. On the silicate and carbonate ores there is probably no appreciable recovery.

Mechanical Side of the Process.—In my opinion, the development of what may be termed pneumatic-flotation processes by Callow, Flynn, Towne, and others, constitutes the most distinct advance of recent years. They consist of a directly and cheaply applied supply of air-bubbles in a finely divided state, to assist in bringing to the surface of the pulp the already prepared sulphides. The agitation is cheaply and easily performed, and is quite subsidiary to the action of aeration discussed above. I have found a shallow trough-agitator, with beaters only partly submerged, quite sufficient. The introduction of a jet of live steam

[2] 'Thorpe's Dictionary of Applied Chemistry,' 1913.

[3] 'Concentrating Ores by Flotation,' 1912.

into the mixing compartment is an advantage. The pulp may flow through the mixing and aeration compartments by gravity at the expense of a trifling loss of head-room. This loss is more than compensated by decreased power and labor costs, and simplicity of working. Finely divided air-bubbles can be directly and perfectly applied through many forms of porous media such as canvas, corundum stones, silica-tiles, sandstone slabs, etc. The mineral particles are seized upon and at once removed as concentrate, without having to be repeatedly subjected to a sort of 'fractional distillation' as in the older systems. It is, in a way, the converse of Elmore's vacuum process, and has the merit of being positive in action and under perfect control. Remarkable results have been shown in the economy of reagents, power, and labor, also in the ease with which such machines can be started after any of those sudden stops incidental to milling operations.

Mineral Industries of Brazil

The following report on the mineral industries of Brazil was prepared by Orville Derby, director of the geological department of the ministry of agriculture:

The iron industry consists of one smelting-furnace with a capacity of about 15 tons per day, situated at Esperança, on the Central railway. The ore used is obtained near Miguel Burnier, on the same line. This plant has recently been reconstructed and enlarged. The company has been operating for over 10 years, and the metal that is produced will find a good demand in Rio de Janeiro and Sao Paulo as soon as it is made in sufficient quantity.

The manganese industry is centred in the municipalities of Ouro Preto and Queluz, both in the state of Minas Geraes, where there are several mines in almost continuous operation. The whole production of these mines is exported, the average yearly output being about 200,000 tons.

The mining of copper, which was first started a few years ago at several points in the state of Rio Grande do Sul, and exports of which attained to 1564 tons of ore, seems at present to be at a standstill. It does not figure at all in the customs returns for 1912.

There is only one coal mine, situated at Sao Jeronymo, in the state of Rio Grande do Sul. For many years this mine has produced a few thousand tons per annum.

Diamonds are found and cut at several places in the states of Minas Geraes, Bahia, Goyaz, Matto Grosso, the districts of Diamantina and Bagagem (Minas Geraes), and the Chapada Diamantina (Bahia) being the most productive. The exports for 1912 were $136,457, but it is certain that the total production was much greater. Carbuncles are found in the Chapada Diamantina (Bahia). Exports from Bahia in 1912 were $47,044.

The mining of semi-precious stones occurs in the district of Ouro Preto (Minas Geraes) for yellow topazes; white, green, and blue topaz, aquamarines, and tourmalines being found in the eastern part of the state of Minas Geraes and the adjoining territory of the state of Bahia. Exports in 1912 were valued at $73,140. Rock crystal is found in the state of Goyaz, Serra dos Crystaes. Exports for 1912 were 45 tons, valued at $30,677. Agates are found in several parts of the state of Rio Grande do Sul. Exports in 1912 were 103 tons, valued at $17,580.

The Mount Elliott Mine, Cloncurry, Queensland

By W. H. CORBOULD

*The Cloncurry copper district covers an area about 200 miles long by 40 miles wide, in the northwest of Queensland, Australia. Unfortunately the mines are widely scattered over this area, there being no large groups of them. The Mount Elliott mine is situated about 70 miles south from the township of Cloncurry, and Mount Oxide mine about 150 miles north of Cloncurry. The district has been known for the past 35 years, and in the early stages a large amount of capital was expended with little to show for it; but within the past four years the railway has been extended from Townsville to Mount Elliott and about 40 miles north of Cloncurry, which has made possible the treatment of the ores of the mines on this extension.

The Mount Elliott company within the past few years has smelted and converted on its mine 169,688 tons of ore for 46,040,960 lb. of blister copper, containing 45,644,480 lb. of copper, 35,642 oz. of gold, and 28,841 oz. of silver, at a cost of about £33 (7.07c. per pound) per ton of blister copper, f.o.b. Townsville. This cost included all development, wages, salaries, general management, office, agency, legal expenses, freight, etc. The gold and silver content would practically pay for freight to Europe, refining, realization, and other charges. The costs of supplies are as follows: firewood, $3.60, coke, $18, mine timber, $12.96, and coal, $14.40 per long ton; explosives: dynamite and gelignite, $12 and blasting gelatine, $15.72 per case.

The orebody of the mine outcrops at the surface for about 200 ft., and lies between two slate walls about 40 ft. apart, having a general underlie down to the 180-ft. level of 20° from the vertical; below that depth the ore channel widens out to represent an inverted funnel. The general strike is northwest at the surface, and corkscrews with depth until at the 500-ft. level the strike is nearly due west. The dip follows the strike, and from the surface to the present deepest level is at an angle of approximately 15° to 20°. The copper occurs in oxidized form from the capping down to the 230-ft. level, where the zone of secondary enrichment is encountered, in which the copper is in the form of friable, altered or sub-sulphides. This zone is from 50 to 180 ft. wide, overlying the primary ores, which consist chiefly of chalcopyrites in hornstone. These continue in depth to the present deepest level, 600 ft. from surface.

*Abstracted from *Bulletin* of the A. I. M. E.

Knowledge and Research

By R. W. RAYMOND

*This notable chapter in the history of one of the most ancient American institutions of learning irresistibly recalls the situation of 1787, the year in which the first charter of what is now the University of Pittsburgh was granted. That was the year of the Convention which framed the Federal Constitution. It was notable also as practically the beginning of two other agencies which, though derided at the time, proved afterward to represent the most potent elements in the cementation of that solid union founded by the Constitution. For it was in 1787 that John Fitch ran his steamboat up and down the Delaware; and it was in 1787 that the fierce discussion of the improvements proposed by Noah Webster may be said to have reached its climax. That controversy resulted in Webster's Dictionary and Webster's Spelling Book, which gave us one language throughout our wide and ever wider domain. Thus the bond of political union established by the Constitution was reinforced by the beginnings of internal transportation and of a common speech, without which the growth of our continental empire would scarcely have been possible.

The wonderful changes effected in personal, social, and national life during the century which ensued, would make an easy theme for any orator who might choose to tell the thrilling history of this particular region alone, beginning with the little group of cabins under the guns of Fort Pitt which constituted Pittsburgh, and tracing the conquest and rapid settlement of the Ohio valley (which was never equaled for revolutionary transformation except by the settlement of California under the special world-excitement caused by the discovery of gold), the development of commerce and industry, the accumulation of wealth, and the concomitant advance in education, culture, and fullness of individual and social life. I shall not rehearse to you this familiar story, but I would point out the significance in such a sweeping torrent of change, of the things that abide.

One of these is Pittsburgh itself. Instinctively recognized, even in our colonial period, as a strategic point, to be defended at all costs, it has remained, through the astounding revolutions of its history, always the centre of power and progress, demonstrating in these later days that the wealth accumulated in the service of man through smoky industries is available for man's service also in the fair fields of science and art.

And another thing that abides is the conviction of the value of knowledge which inspired our grandfathers and possesses us. They founded colleges while they were fighting Indians and leveling forests and devising governments. The progress of the world and the eminence of Pittsburgh in that progress are alike due to science. And we Americans recall with just pride that our fathers always provided for education as a part of their social scheme. It would be absurdly superfluous, in this presence, to explain that the wonderful natural advantages of Pittsburgh would have amounted to nothing without the science which has utilized her fuel and her means of transportation. It is not manual labor alone, but, in a much greater degree, the labor of the educated brain, that creates wealth and constitutes power. And it is a peculiar characteristic of this source of power that no one can foretell the scope and value of its results. We know how many foot-pounds of energy a man or an animal can furnish in a given time; but we cannot prophesy what may be done with that energy if applied, under intelligent guidance, to the utilization of the inexhaustible forces of nature. The assertion that "knowledge is power" is an "act of faith"; but this faith has proved itself a thousand times to be well-founded. No one doubts today that the knowledge we now have is power, and must, therefore, be preserved by transmitting it to each succeeding generation—even were there nothing more to know. But we have learned also that the enlargement of the circle of things known increases the boundary beyond which lie the things yet to be known, and hence we attach a practical value to research. We need not claim for our own time alone this recognition of the importance of research. Let us modestly remember that the things we now know are the results of the research which our fathers encouraged and conducted—nay, more: that their faith in knowledge and inquiry was supported by much less evidence of valuable results than encourages us. In fact, we may be said to walk in this path, no longer by faith, but by actual sight.

Nevertheless, it is unquestionably true that the conception of university education has undergone during the last century, an important change. Even so recently as fifty years ago, when I was a student at German universities, the traditional organization of the four faculties of Theology, Law, Medicine, and Philosophy was still maintained, but 'Philosophy' (originally intended to cover metaphysical subjects) had been gradually made the receptacle of everything that was not theology, law, or medicine—including such trifles as mathematics, languages, literatures, and sciences. And the old satire was still current: "Theology yields a man honor but not bread; law, bread but not honor; medicine, both bread and honor; and philosophy, neither

*Principal address delivered at the dedication of the new building of the Mellon Institute of Industrial Research and School of Specific Industries of the University of Pittsburgh, February 26, 1915.

bread nor honor." Yet already it was becoming evident that in the disparaged department of 'Philosophy' lay the studies which were certain to yield both the bread and the honor of the future.

Today, we care little for the old classification. Our notion of a full university is that of the motto of Ezra Cornell, who founded the one which bears his name, as a place where anyone could receive instruction in anything. Toward this all-comprehensive ideal, which no institution, perhaps, has completely reached, we are all striving. And the strength, the inspiration, the fruitfulness of our development is in the increased emphasis which we lay upon research and the function which we assign to it in the modern scheme of education.

I need not make a distinction here between theoretical and practical research. There used to be a vague and uncertain attempt to divide pure science from applied science. But, in fact, they are inextricably blended. It was Sir William Thomson, afterward Lord Kelvin, the profound student of the nature of matter, the weight and movements of worlds, whose acute genius devised the perfect mariner's compass and constructed the apparatus by which the Atlantic cable was able to transmit intelligible messages—turning industrial failure into triumph. When Thomas Edison was perfecting his great electrical inventions, he went to Ira Remsen, the distinguished teacher of pure science, for the mathematical formulas which determined the dimensions, proportions, and relations of his machines. The researches of Hertz and others into what seemed at first to be a sphere of electrical disturbances beyond the reach of human analysis have led already to the miracles of wireless communication and control—messages signaled, or even simply spoken, across oceans and continents, and boats steered by inaudible commands from the shore.

The difference between knowledge and research is the difference between the expert and the discoverer. An expert is one who knows what has been done or is provisionally established in a given science or art. He can say, with regard to a new discovery or improvement, only whether or not it contradicts or transcends what is generally accepted as the result of previous experience. But the discoverer is a prophet, and, if he has not "spoken presumptuously," his message becomes a new revelation, and a part of the science of his day—or the day after.

It seems but yesterday that I read in the newspaper how Charles Sumner, of Massachusetts, had proposed in the United States Senate an amendment to a pending appropriation bill, granting a considerable sum for the conduct of experiments in sending telegraphic messages without the employment of conducting wires. I was an expert then, and, as an expert, I knew (or thought I knew) that the thing had never been done and, therefore, was impossible. I remember reflecting how easily non-scientific people were carried away by the eloquence of fanatics or charlatans, especially when the schemes proposed were such as all the experts declared to be absurd. The common sense of the United States Senate, taking the same view, rejected the amendment; and it is my impression that the distinguished proposer of it (having, perhaps, introduced it at the request of some sanguine constituent) did not fight very hard for its adoption. It is possible that I recorded my opinion of it at the time with sarcastic humor in the columns of the technical journal of which I was editor. I have made no investigation as to that question; and, indeed, I would rather not know the answer!

At a later period, Le Conte, one of the most eminent scientific authorities in America, and one who, in his own department, and in the general exposition of the philosophy of evolution, was a leader and commander, published an essay demonstrating the theoretical, that is to say, the mathematical and irrevocable, impossibility of the navigation of the air by vehicles heavier than air. Now mathematics, as defined long ago by Benjamin Peirce, is the one science which draws necessary conclusions; but the necessity of its conclusions is simply their relation to its premises. Le Conte's judgment was based on the evidence before him. It was the utterance of Science without the testimony of Research. And already another eminent scientific authority, Langley, long of your university, reinforcing science with research, had devised a flying-machine heavier than air, which is now, I believe, admitted to have furnished the first solution of this problem. True, an accident not due to any unsoundness in Langley's theory and design wrecked his experimental machine, and, perhaps, broke his heart, too. But time has vindicated his fame and has given us another instance of the value of scientific research to industrial progress.

But it must be real research, not merely the cloudy anticipation of things to come. Many years ago, I was visited by a seedy young stranger, who desired my assistance in the form of a loan which would pay his fare to Colorado, where he wished to introduce the use of electricity in metallurgy. Under cross-examination, he explained that he expected to get his electricity, Franklin-fashion, from the clouds, and, having heard that there was a good deal of it up in the Rocky Mountains, he thought Colorado was a good place for his process! If that young man has survived (which I doubt, since he did not look like a future survivor), he is doubtless saying today that he was the real inventor of the whole art of electro-metallurgy! He was a feeble specimen of the host of professional inventors who try to pre-empt territory in realms not yet explored, substituting prophetic intuition for patient and skilful research. These are the prophets who "speak presumptuously." The Book of Deuteronomy, after describing such a prophet, adds "Thou shalt not be afraid of him." Yet, in spite of that encouraging exhortation, we are afraid of him; he hangs as an incubus upon every real inventor whose work has been based upon real research; for research is not fruitful unless it is, or until it is, scientific.

The essential quality of Science is that it is quantitative, while mere invention may be in the beginning

only qualitative. After the great blizzard, more than a quarter of a century ago, a storekeeper in Brooklyn undertook to apply quantitatively the qualitative proposition that heat would melt snow. Having a 16-ft. heap of snow in front of his store and a lot of old boxes in his cellar, he dug in the snow a chamber with a chimney, crammed this stove with pine-wood from the cellar, lit the fire, and looked for the mountain to dissolve in fervent heat. Being a qualitative man, he did not know the difference between temperature and heat-units, or dream of the work he was expecting his little fire to do. When he had burned all his wood, he abandoned his faith in science! Yet there is never a heavy fall of snow in New York but somebody berates the authorities for their stupidity in not thawing it away!

And this brings us to the proposition that real research must itself be based upon scientific knowledge. There is nothing more pitiable than the spectacle of an enthusiast, fancying himself a pioneer, laboriously digging in ground already explored, exhausted, and abandoned by others. My friend Clarence King told me once how he set his heart upon the ascent of a certain high peak in the Sierra. With infinite exertion, and no little peril, he scaled the precipitous mountain-side, and reached at last the summit, only to find there an empty tomato-can and a copy of a newspaper, relics left by a picnic party, which had ascended by an easy trail on the other side of the mountain! A little preliminary research would have saved him from this scientific fiasco.

Moreover, the careful and thorough study of science —that is, of what has been done, and has come to be believed already—will often mightily aid research with significant and invaluable suggestions; for the records of scientific experiment contain many observations which were simply noted *en passant* and left for future explanation. A distinguished electrician once said to me that, notwithstanding the amazing advance of his art, he still found in the old, simple, homely notes of Benjamin Franklin valuable hints and suggestions.

If knowledge and research are thus intimately related, each reinforcing the other, the manner in which they are combined in this institution must be recognized as largely novel and wholly admirable; for effective research requires suitable apparatus, and under apparatus we include books. Moreover, research is promoted by definiteness of object. The man who knows what he is looking for is more likely to make discoveries than he who merely launches into space, hoping to make discoveries through accidental collisions. And again, not only motive and apparatus and previous knowledge, but also the capacity of clear and accurate thinking, must belong to the equipment for useful research; and no man thinks accurately who cannot put his thought into words which will convey it to another man qualified by knowledge to comprehend it. We may feel, but we cannot think, unutterable things. What our patent law requires of an inventor, that his invention shall be so stated as to enable anyone skilled in the existing art to practice it, is equally required of every discoverer, whether he seeks the reward of a patent or the recognition of his fellow men in other ways. He must be able to describe and to define as well as to discover.

But this occasion emphasizes to my thought another principle, perhaps the most fundamental and far-reaching of all. In this dedication of a building erected through the intelligent munificence of private citizens, we have another instance of the method and means by which American institutions of learning, as well as of philanthrophy and religion, have rapidly grown in a single century to proportions rivaling those which ancient origin, cherished traditions, and age-long growth have given to such institutions abroad. The generosity of private citizens, since the beginning of the nineteenth century, has surpassed among us all the endowments bestowed upon science and learning by the governments of Europe in modern times, and its results may challenge a corresponding comparison. Our democratic individualism makes mistakes, no doubt: but so does paternal government. The difference is that the mistakes we make we also correct; while the mistakes of paternalism are likely to lie like a permanent, heavy blight upon progress. It is fashionable in some quarters to decry 'foundations' established by private wealth; but we may challenge the critics to adduce a single instance in which, under our American system, an institution of learning or research thus supported has ever been productive of harm. Knowledge and the opportunity to pursue knowledge are the only gifts that do not pauperize the recipient. Nay, more: under free institutions and in the atmosphere of liberty, the recipient of such bounty inevitably returns it in benefaction to society. Long may it be, ere this gracious, wise, and fruitful American habit of great private endowments yields to the assaults of either the demagogue or the doctrinaire!

Perhaps the chief advantage of numerous private institutions of science and research is to be found in the consequent multiplication of independent students and investigators. The victorious advance of civilization and culture is not an organized conquest, like that of a drilled and equipped army under a single head. It is rather like the free, yet invincible, advance of the forest over denuded areas—each tree sending forth its seeds, wind-blown, each seed fighting its own battle with heat and cold or vigorous competitors, and the victorious survivors constituting the forest of the future. Apart from all considerations of government or statesmanship, I thank God for the numerous separate States of our Union, and for the numerous independent institutions in each State which permit the testing of new propositions in science, industry, politics, sociology, or statesmanship on a working scale not fatally extensive.

TIN PRODUCTION of Mt. Bischoff, Tasmania, in the last half-year amounted to 264,320 lb. from 194 tons of concentrate, reduced from 48,354 tons of ore. The smelter at Launceston also produced 1,433,600 tons of tin on custom account. Owing to the war, operations were considerably curtailed.

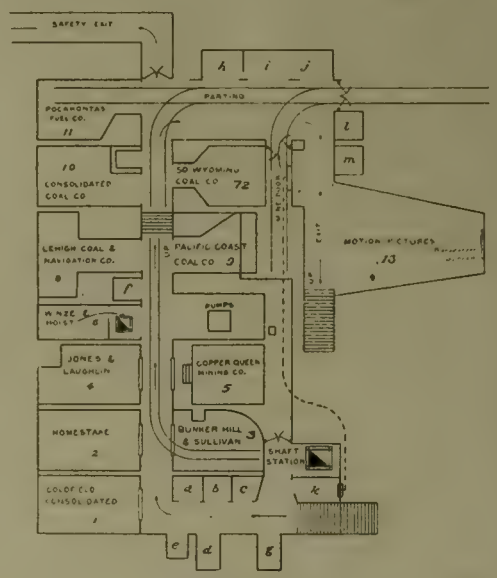
The Mine—An Educational Exhibit

By THE EDITOR

Having seen something of the architectural splendors of the Panama-Pacific Exposition, we went, of course, to the Palace of Mines and Metallurgy, to see The Mine, of which good reports were being passed among our friends. Irvin Cobb, describing the horrors of war, has said recently that it is not the sights but the smell that is characteristic. As the visitor enters the mine he is assailed by the old familiar smell, compact of timber, rock, and damp. It seemed too vivid to be real, so we asked an attendant how it was done, only to learn that it had just happened in the proper way. All the ingredients were there. Indeed, the control of the natural seepage was a difficult problem. The level of The Mine is 15 ft. below the floor of the building, and 6 ft. below high-water mark, San Francisco bay being within a few hundred feet. Two shafts were sunk in quicksand, drains were cut to them, and pumps now work at regular intervals to keep the concrete floor dry, otherwise this underground exhibit would be flooded in a few hours. Great credit is due to those who did this work, especially the U. S. Bureau of Mines, which designed it, and is now operating it with obvious efficiency.

The drift by which we enter becomes an incline; a short cross-cut diverts us into a sub-level leading to the shaft, where a cage hangs expectant. As the engineer apparently has gone to his dinner, we must descend by the ladder, which is alongside, or retrace our steps and proceed down the incline. We do so. The rock through which we pass is not convincing; it is the usual plaster imitation; but it will deceive the tourist. In small chambers to one side are exhibits of Concordia storage-battery electric lamps and Koehler naphtha lamps for the coal-miner; while the metal miner is offered Simmons acetylene lamps. The last mentioned have a cerium igniter, rendering matches unnecessary. A little farther, on the opposite side, is a typical underground powder-magazine, containing cases marked with the Hercules company's familiar name. Dummy sticks of dynamite with imitation fuse attached are shown. The universal danger sign—a red disc on a white plaque—is attached to the timber adjoining. This may be one of the reasons why most of the visitors, particularly the women, seem in an anxious hurry.

Then we come to a reproduction of a stope in the Goldfield Consolidated mine, the famous bonanza in Nevada. The square-set timbering looks natural; so do the Ingersoll-Rand drill and the Waugh stoper. The broken ore is real; it was brought from Nevada. The face of the stope is made out of pieces of rock that have been joined with mortar and then painted. The result is not as convincing as it might be, but it will deceive any non-technical visitor. The timbering and lagging are the real thing, and the rush of air from a 4-in. pipe leading from a Sirocco blower gives a sound that joins with the smell in perfecting the illusion. The Goldfield Consolidated mine includes the Mohawk, Combination, and other claims that were famous during the exciting days of 1906 and 1907. In that part of Nevada, gold is found associated with quartz and alunite in a zone of multiple fracture traversing Tertiary andesites. In places, the lode-channel is 500 ft. wide. On February 9, 1907, one carload of ore, weighing 48 tons, had a gross value of $591,-637; the express charges were $8800; and the check paid by the smelting company, after deducting freight and



MAP OF THE MINE

treatment, amounted to $574,958. During 1914 this mine produced 338,192 tons, having a gross value of $4,340,786, out of which a profit of $1,835,224 was made, permitting the distribution of $1,067,744 in dividends. To the end of last year—seven years in all—the Consolidated has paid $27,398,215 in dividends, or $7.70 per $10 share. The total gross output of the property, including that made by lessees in the early days, has been 2,111,054 tons having a gross value of $63,658,088 or $30.15 per ton. The present manager is Mr. J. W. Hutchinson.

Next we come to a bit of the Bunker Hill & Sullivan mine. The attendant informs us that this mine is entered by an adit or tunnel 10,000 ft. long before it strikes the orebody. From this level it is 1000 ft. to the surface and 500 ft. to the bottom workings. It is the largest lead-producer in the world, the annual production being 36,000 tons of lead, containing 1,200,000 oz. silver. The

miners work on the day shift only, and as they break 1400 tons of ore per day, it is evident that the workings must be numerous and extensive. The ore averages 10% lead and 4 oz. silver before it is concentrated in a big mill. On the track is shown a Baldwin-Westinghouse storage-battery electric locomotive with two cars, loaded with ore

A POWDER-MAGAZINE.

that looks decidedly super-grade. In the real mine this locomotive pulls 17 cars of 5 tons each. At this exhibit the face of the stope is extraordinarily well done, the pieces of rock and ore are so joined that the artificiality is entirely obscured. After the material was in place, it took a month to obliterate the joints. Now it would deceive even an old miner from the Coeur d'Alene. A moil dropped by a careless worker hangs between the lagging overhead and completes the verisimilitude. A Waugh drill ready for use is exhibited, with armored hose. In 1914 the Bunker Hill & Sullivan Mining & Concentrating Co. treated 440,819 tons, having a gross value of $3,362,498, from which $981,000 was paid in dividends. The property represents a consolidation of many claims, the first of which was located in September 1885. Up to the end of last year this mine had yielded 6,462,367 tons, having a gross value of $60,231,542, from which the shareholders had received $15,710,250 in dividends. The manager is Mr. Stanly A. Easton. The ore consists of silver-bearing galena enriching the cracks and fissures of a pre-Cambrian quartzite that has been crumpled and crushed by geologic movement. The silver is associated with the lead in a fairly constant ratio of 1 ounce of silver to 50 pounds of lead. A portion of the concentrate is shipped to the Selby smelter, on the Bay of San Francisco.

Across the main gangway is the exhibit of the Homestake Mining Company. This takes the form of a model illustrating the system of stoping employed in that great gold mine in South Dakota. Three levels are shown, enough to indicate several phases of the shrinkage method. The attendant informs us that excavation begins at the back of the level; as the lode is stoped overhead, the men stand on the broken ore, rising slowly to the level overhead. A timbered passage or manway is maintained so as to give access to the rising stope, and for ventilation. These manways are placed 50 feet apart where the lode is wide. If the ground above is solid, the stope is continued to the level; but if stopes extend above the upper level, then the shrinkage stope is stopped 35 ft. below, the arch thus left being removed at a later stage. Thus the ore between two levels is broken, but not removed, until the operation is completed. Then it is withdrawn at the bottom, the weight pushing downward, so that the small stuff can be shoveled into cars while the big lumps are

A STOPE FROM GOLDFIELD.

drilled and blasted. These shrinkage-stopes are 60 ft. long and are separated by pillars or intervening blocks 42 ft. long, the width being that of the lode, which ranges from 50 to 200 ft. between walls. The pillars are removed by aid of square-set timbering in the usual way. Incidentally, Philip Deidesheimer, who invented this method of timbering on the Comstock in

1860, is still alive, a resident of San Francisco. The model also shows the method of filling old stopes, the waste from one of the big open-cuts being run into the mine by gravity and then distributed as required. The 'filling' and the ore used in the model are both made of the real stuff. Of the ore yielded by the Homestake 25% is mined by square-sets and 75% by the shrinkage system; 2,000,000 tons of broken ore is said to be stored underground. We were also informed that the mine had 30 years of ore in reserve, to which we may add that the last official report states only that the reserves represent "many years' supply" of ore. In the life of a mine, 30 years is more than 'many.' Upon an adjoining table are large specimens of the ore and of the principal minerals. On a chart the analyses of the rocks and minerals are given. The exhibit is excellent, and is rendered more generally useful by the explanations of the attendant. Official records show that the output of gold in 1914 was worth $6,160,161 from 1,587,774 tons. The average was $3.879 per ton; the cost is not given exactly, but it was about $2.50 per ton. Extraction represents 94% of the gold contents of the ore. In 1914 a sum of $2,210,208 was distributed in dividends. To the end of the year this mine, including the smaller companies absorbed, had produced $134,181,596 and paid $33,405,700 in dividends. The Homestake lode is a mineralized gold-bearing zone in schist of pre-Cambrian age, where it is penetrated by intrusions of post-Cretaceous rhyolite. In 1914 Mr. Richard Blackstone succeeded the late Thomas J. Grier as manager.

I have remarked that some of the visitors seem in a hurry, as if intimidated. Perhaps the dynamite, the danger-signal, and the mine-car with its head-light ready to move, are the causes. Not many of them ask questions and even those that do so seem to be half-hearted. Occasionally an intelligent observer comes along and catechises the attendant, who is then in his element. Undoubtedly the value of an exhibit is multiplied many times by furnishing an intelligent explanation of its use. The day of prune horses and pyramids of oranges is gone. If expositions are to recur, they must be more than exaggerated county-fairs. In this Exposition, the finest exhibit, because it is the most immediately instructive, is the working model of the Panama Canal. Next in merit is The Mine.

Proceeding, we come to a sample of the Copper Queen, the famous mine near Bisbee, in Arizona. The section of the lode, with its foot-wall, has been reconstructed with remarkable fidelity. On the posts of the square-sets the average assay is chalked in percentages of copper —7, 14, and 15.5%. A dinner-bucket and a jumper hang on a nail in the corner of the innermost square-set, and in the pocket of the jumper is a copy of the Bisbee *Daily Record*. Our compliments to our contemporary in Arizona. A ladder-way and timber-pass complete this underground picture. Various types of lode-matter are exhibited in the forms of slabs, 1½ by 4 ft., in glass frames. Both here and in the Homestake exhibit we noted an error in the labels, not important, but likely to confuse the uninitiated. The Copper Queen is one of an important group of mines controlled by Phelps, Dodge & Co., of New York. The manager is Mr. S. W. French. In 1914 the tonnage treated was 654,669, from which 76,842,974 lb. copper was extracted, besides 627,612 oz. silver and 14,875 oz. gold. Production was curtailed during the last four months, by reason of the depressed metal market. During the first six months the output of copper was 50,000,000 lb. The company owns subsidiary mines, notably the Moctezuma, bringing the total production to 732,829 tons yielding 86,066,143 lb. copper, 8,889,175 lb. lead, 1,936,677 oz. silver, and 15,769 oz. gold. The total copper output made by the constituent companies controlled by Phelps, Dodge & Co. in 1914 was 140,231,384, of which 8,569,060 came from ore smelted for the Miami company. Dividends of $6,300,000 were paid during that year. The mine was first opened in 1880, on an outcrop of oxidized copper ore in massive limestone. The orebodies occur in large masses at the base of Carboniferous limestone where it is broken by extensive dikes.

Across the gangway is the Lincoln mine, an example of the iron mines of the Mesabi range, in Minnesota. Round timbers and split lagging are in evidence, with the characteristic hematite ore in the face and broken on the ground. The tools, track, and stray sticks of timber are useful accessories.

Next is a chamber marked 'Winze,' which our friend, Mr. R. Arthur Thomas, the manager of the celebrated Cornish tin mine, Dolcoath, would call 'winds,' for that is the ancient spelling of the word. In the cross-cut several Waugh drills are ready for use; also a Westinghouse electrically-driven centrifugal pump and the Leadville drill-column hoist made by Hendrie & Bolthoff, Denver. This last must be a most handy machine. Opposite is a Byron-Jackson pump and an air-compressor furnished by the General Machinery & Supply Co. of San Francisco. An underground primer-room comes next; it is furnished by the Coast Manufacturing & Supply Co., of Livermore, California, and contains a fuse-cutter, with instructions for adjusting safety-caps and using a crimper.

Then the visitor comes to a room simulating the anthracite mines of the Lehigh Coal & Navigation Co. at Lansford, Pennsylvania, showing the thick vertical seam of anthracite, which lends itself to almost ideal mining conditions, and surprises the visitor, who is apt to visualize coal mines as consisting of almost horizontal workings. Apparently coal is easy to simulate by the liberal use of P. & B. paint. It is interesting to note that anthracite coal was discovered in the Wyoming valley by Connecticut settlers in 1762; in 1782 some of it was sent to Philadelphia, but, finding no sale, was used in gravel walks; in 1820 the output was 365 tons; in 1914, 91,448,000 tons.

Across the gangway is a sample of a different type, a representation of the Pacific Coal Company's mine, at Coal Creek, Washington, where a thinner inclined seam of bituminous coal is mined with Sullivan punchers and

Ingersoll-Rand shearing-machines. Adjoining it is a room, equipped by the Southern Wyoming Coal Operators Association, showing the gently-dipping seam of sub-bituminous coal at the Rock Springs mine, which furnishes fuel for the Wyoming division of the Union Pacific railroad. A room representing typical workings of the Consolidation Coal Co. in the Elkhorn coalfield, at Jenkins, Kentucky, contains various other pieces of equipment, including an auger, used in boring holes for blasting. By such machines the arduous labor of the miner is much ameliorated, more coal is produced in marketable form, and the cost of labor is decreased. It is interesting to note that Kentucky produces two-thirds of all the cannel coal of the United States. This variety of bituminous coal burns so freely that when a small piece is ignited it will continue to burn like a candle, whence the name. Finally, we come to a room representing the famous Pocahontas mine of the Pocahontas Consolidated Colliers Co. The Pocahontas and New River fields of West Virginia are really one, the Pocahontas seam being identical with the Quinnemont of the New River, the coal area being 60 miles long by 16 wide, or five times the size of the Connellsville. Pocahontas coal is remarkable for being smokeless, and this, coupled with its high calorific power and freedom from ash, has made it the best fuel for naval purposes, where a trail of smoke is a signal to the enemy. For this reason the Pocahontas seam has held significant place in national economy, though the growing use of petroleum as a naval fuel has lately tended to decrease its importance.

A mine-telephone plant is exhibited by the Western Electric Company. Several examples of the Canton mine-door are shown, and operated. They ensure automatic opening and closing as cars approach or depart; they also prevent interference with the ventilation. Finally we come to the office of a shift-boss as arranged by the *Mining and Scientific Press*. It contains a stope-board with other records; a Johnson's First Aid cabinet and candle-boxes containing lamps and books, the one to guide the legs and the other the mind of the shift-boss. A mine transit is lent by A. Lietz & Co. In a cross-cut we find moving pictures in action, illustrating sundry phases of mining. While we lingered, we saw drill-holes at the Nevada Consolidated Copper mine, at Ely, being loaded and then exploded with great effect.

A BIT OF THE COEUR D'ALENE.

THE HOMESTAKE EXHIBIT.

To make the mine appear thoroughly realistic, a genuine explosion takes place each day at 2 p.m., when the rescue crew, equipped with oxygen apparatus descends into the mine, brings out a victim, and then proceeds to restore animation by standard methods. This is the finishing touch to an exhibit that deserves sincere praise. It is educative and informing. Those unacquainted with mining have their curiosity awakened to good purpose and go away with some understanding of a great industry; those that are not novices will find their memory and intelligence pleasantly stimulated.

Air-Blasts

Visitors to Houghton and Hancock, in the Michigan copper region, are often startled by a sudden trembling of the earth, a rattling of windows, and a feeling of instability underfoot. Very often the first shock is followed a few minutes later by a second. The effect upon the visitor is similar to that of a series of earthquake shocks. When, in a startled voice, he expresses a desire to know the cause of such disturbance, he is informed that it is nothing but "an air-blast at the Quincy." It is generally known that these air-blasts occur in some of the deep mines, but it is not realized by many what the consequences of these movements are. Since mining operations in most districts are not carried on at such great depths as in the Michigan copper district, it might be interesting to engineers elsewhere to know the effects of a series of recent air-blasts in the Quincy mine, at Hancock. The general manager, Charles L. Lawton, in his report for the year 1914, writes as follows:

On March 25, air-blasts occurred throughout the mine and continued intermittently for a week or ten days. As a consequence, various cross-cuts and drifts were crushed and closed up. No. 6 shaft-timbers were seriously crushed between the 51st and 58th levels, and No. 2 shaft was crushed and closed between the 40th and 50th levels.

About 500 ft. of the crushed section of No. 2 shaft had to be entirely recovered and re-timbered at an expense nearly as great as that of sinking a new shaft. In the remaining portion of the damaged shaft, about half of the timbers were replaced. Excellent work was done, and a speed record made in recovering the shaft in the months of April, May, and June.

Below the 50th level, the shaft was not damaged by the air-blasts, though the cross-cuts at the 57th, 64th, 65th, and 66th levels were entirely closed, and the levels north were badly crushed. The 67th, 68th, 69th, 70th, and 71st levels north and south were not injured. The shaft has been entirely repaired and is now in good physical condition.

It was necessary to employ a considerable force of men for several months to renew and repair a large proportion of the timbers in the crushed section of No. 6 shaft, and to strengthen it by filling the old adjacent stopes with rock, while keeping the shaft in constant operation, in re-opening cross-cuts and drifts that were crushed, and in re-opening and re-timbering No. 2 shaft. Thus the cost of production was increased very much during the month following the air-blasts, especially because of the loss of three months' product from No. 2 shaft, and consequently the impossibility of operating the mine, railroad, and stamp-mills as economically at about 65% capacity.

In earlier days, when air-blasts were little understood, it was the custom to stope-out the lode irrespective of the shaft. If the lode was rich in copper, it was stoped-out close over or under the shaft; where the shaft was in the lode, the latter was stoped right up to the shaft without leaving shaft-pillars. Going through the upper portions of No. 2 and No. 6 shafts, is like going down through open stopes, with practically no pillars left to protect the shafts. It was in the lower part of these sections that the caving and crushing took place, with such serious results.

For several years there has been a rigid adherence to the policy of leaving increasingly larger shaft-pillars as the shafts are sunk, in order to sustain the litho-static pressure about the shafts. The air-blasts have never caused any damage to these sections of the shafts. At the present bottom of the mine, these pillars are being left 200 ft. each side of the shaft.

Air-blasts have continued with more or less frequency since July, though they have not damaged or retarded the work to any great extent. There were but three fatal accidents during the year, involving less than one-fourth of 1% of the working force.

In order to meet the air-blasts and prevent as far as possible the damages caused by them, as fast as the mining in each stope is finished, the bottom of the stope along the back of the level is filled with poor rock, constituting what is termed 'rib work.' Experience has taught that these rock-packs are the most effective means yet employed to lessen the damage caused by air-blasts.

After a careful investigation and study of the effects of the series of air-blasts that occurred in 1906, rib-work was employed for the first time throughout what were then the lower workings of the mine to combat the damages caused by these disturbances. For a number of years these rock-packs proved effective, until the series of 1909. Again careful investigation and study readily showed that the rib-work was along proper lines, but had not been carried far enough. Therefore the packs were made deeper in the stopes, that is, doubled in size. For a still longer period of time these rock-packs proved sufficient, until March 25, 1914, when another series of air-blasts occurred. For the third time it has been shown that the rock-packs proved to be the best means of limiting such damage.

In order, however, that the highest effectiveness possible may be secured within the limits of profitable mining at greater depth, this rib-work should be still further strengthened. It is estimated that the voids in the rock give it a shrinkage of about 20% at the present depth of the mine. In order to lessen this shrinkage and strengthen the rib-work, the question of filling the voids with bank-sand, stamp-sand, or crushed rock is receiving serious consideration, inasmuch as provision must be made for better and stronger supports to the back of each level, as fast as stoping is finished. This must be done so as to avoid extended crushing, and thus guard the safety of the employees, minimize the losses and expenses caused by air-blasts, and make permanent the mine's future operations with depth.

During the year, $57,190 was spent for the recovery of the shafts and levels that were damaged by the air-blasts, and $21,487 has been expended in the fight toward preventing damages by air-blasts.

The Kennedy Dam

By JOHN S. EASTWOOD

Dams are used for a greater variety of purposes than most people think. Each of the multiple-arched dams designed and built by the writer to date has been intended for a different service. The Hume Lake dam was built for the storage of water for transporting lumber in a flume and as a logging-pond for the storage of logs for the saw-mills of the Hume-Bennett Lumber Co. at Hume, Fresno county, California. The new Big Bear Valley dam was built to store the excess waters for a series of years, from the drainage-area of Bear creek, as a reserve supply for the intensive irrigation of the citrus groves of Redlands and vicinity. Incidentally, the water is used also for power, on its way from the reservoir to the distribution system.

DAM FOR STORING TAILING FROM THE KENNEDY STAMP-MILL.

The Los Verjels dam is used to store the annual winter flood-waters of Dry creek, a branch of the Yuba river, in Butte county, California, for the irrigation of the olive lands of the Los Verjels Land & Water Co. The Kennedy dam, described in this article, is used for storing the tailing from the stamp-mill of the Kennedy Mining & Milling Co., near Jackson, Amador county, California. Thus, of four dams of the multiple-arched type, now in service, one is used for log and water storage, one for cyclic irrigation water storage, one for seasonal irrigation water storage, and the last for the storage of stamp-mill tailing. The structure erected for the Kennedy company is a multiple-arched dam, especially designed to meet the conditions at the site selected and for the purpose of storing tailing. The computations of loads and stresses are based on the assumption of a liquid load averaging 75 lb. per cubic foot. The tailing, when thin enough to exert complete hydrostatic pressure, will not weigh this much, and before it reaches this density will have become so viscous as to exert a pressure limited by the angle of repose that it will assume as in the case of dryer materials. Practically, the greatest pressure that can be exerted on a débris dam is that due to the full hydrostatic pressure of water; for as soon as the débris begins to settle to the bottom, the pressure will decrease until the dam is merely a retaining wall for a material having a large angle of repose and a consequent loading less than the hydrostatic water load with the full dam. This seems like a paradox, but on closer scanning it will be seen that the angle of repose of the fill increases as fast as or faster than its weight.

The structure is situated about one-half mile north of the town of Jackson, on the property of the Kennedy Mining & Milling Co., and closes the lower end of a small valley. The dam is 30 ft. high from the ground-surface, and forms the base of a structure to be eventually built to a height of 50 ft. The storage-capacity, on the basis of the horizontal contour space enclosed, is 15,804,164 cu. ft., up to the 50-ft. contour, but as the sand and coarser materials lie on an angle of repose varying with their size of particle, usually above 20° from the horizontal, the actual capacity is much greater than this, as the flume carrying the slime from the lifting-wheels enters the upper end of the valley at an elevation considerably above the 50-

ft. contour, and it is therefore possible to utilize the slopes of the valley for disposing of a large amount of the coarser sand. The drainage-area of the whole valley is but 0.13 square mile, and the rainfall not excessive, requiring a very small spillway-capacity at the dam.

The dam is 455 ft. long on the crest; it consists of 11 arches and 12 supporting buttresses, and a small spillway having a 15-ft. opening, placed at the west end of the structure. The span from centre to centre of buttresses is 40 ft.; the slope of the water-face is 10 horizontal to 12 vertical; the slope of the back edges of the buttresses, which are stepped to make the connections for future extension, averages ½ to 1; the angle of arc of the extrados of the arches is 133° 34′; the radius of the extrados of the arches is 21.8 ft.; the radius of the intrados is varied to give the required thickness of arch-ring. The minimum thickness of the arches is 1 ft. at the top, and of the buttresses the same. The buttresses are supported laterally by means of a strut-tie beam running through from end to end and terminating in a counterfort, thus making the buttresses the equivalent of short columns and preventing any lateral vibration. The spillway is situated at the west end of the dam so as to deliver the water to the most convenient point for use for irrigation, and is 15 ft. wide and 2 ft. deep, being provided with flashboards to regulate the flow of the water and to carry it up to the top of the dam.

The country rock is slate, pitching toward the east at a steep angle, and striking almost across the axis of the dam. This bedrock is here overlain by a clay to depths varying from 4 to 20 ft., merging into sound slate as the depth increases, the upper portions being merged into the clay. For the most of the foundation it was necessary to go down only about 6 ft.; but in the trough of the valley it was necessary to go down 20 ft. in one place. In all cases the excavations for foundations were carried down to firm bedrock and the footings of the walls spread to the full width of the trenches, giving a very light base-loading, the maximum in any case being less than 5 tons per square foot. As the arch is a free arch, that is to say, three-hinged, all of the load is assumed to be carried on the buttress-bases. The toe or base of the arch-rings is placed in a tapered trench excavated in the bedrock and the trench filled up to the rock-surface without forms, making a cut-off wall, the wall above the bed-rock-surface being allowed to spread over the top of the rock on the up-stream side, the forms meeting the trench on the down-stream side.

Wooden forms were used throughout except for the hinge-sockets, those for the buttresses being made in panels, using inch boards nailed on 2 by 4 studs framed, the panels being three kinds, angle-panels for the buttress-fronts, full panels for the main walls, and half-panels for finishing the rear ends of the buttresses. The full panels were 4.8 by 8 ft., the angle-panels and half-panels being 4 ft. long, all so planned as to permit of their being fastened to the next by means of dowel-pins of wood, and the panels so arranged as to break joints with each other.

The front edges of the buttresses are made in the form of a corbel, the corbel containing the spring-line hinge-socket of the arch-ring, which was cast by means of a metal form, rolled to the true curvature, the remaining parts of the corbel-forms being made of wood. The forms for the intrados of the arch-rings were made of wood, following the original method used in other dams of this type, these consisting of liners built up of inch boards with 2 by 4 studs nailed between, the whole being covered by ½ by 6-in. boards nailed to the studs and lapped.

The forms for the extrados of the arches consist of panels of such a size that four make up the segment of the exposed arc, the panels being of liners of 1-in. boards cut to the curvature, with narrow boards nailed across, all panels being so designed as to be fastened to each other by means of dowel-pins through the frames.

By the use of a three-hinged arch, all bending in the arch-ring is eliminated, but in order to prevent the possibility of cracks in the arch-rings, old cables were used for reinforcing the arch-ring segments. These are placed on the line normal to the arch-crown line and wired in place one foot apart, being cut to a length to suit the segment. At the spring-line hinge-socket in the corbel a hooping effect was obtained by placing ½-in. twisted rods at a depth of 4 in. below the surface running around the entire corbel and into the buttresses. Short pieces of ¾-in. twisted steel are inserted in the stepped back of the buttresses to tie them to the extension when made, at the time of adding the remaining 20 ft. of top for which the design provides. The strut-tie beams are reinforced as continuous beams with five old hoist-cables, 1¼ in. diameter, these running the full length of the beam and into the counterfort at the end of the beams. All cables were left with their grease coating intact and were wired in place.

The concrete was specified to be of a mix of 1:2:4 for the arch-rings and of a 1:2½:5 for the buttresses, but in fact was richer than this in all cases. The aggregate was obtained from the old placer diggings in the upper end of the valley, and is made up of irregular fragments of quartz-rock of varying sizes intermixed with slate fragments. In its natural state it was so dirty that it was necessary to wash it before using. A gravel-washer was installed, all of the gravel and sand being washed and screened before being used.

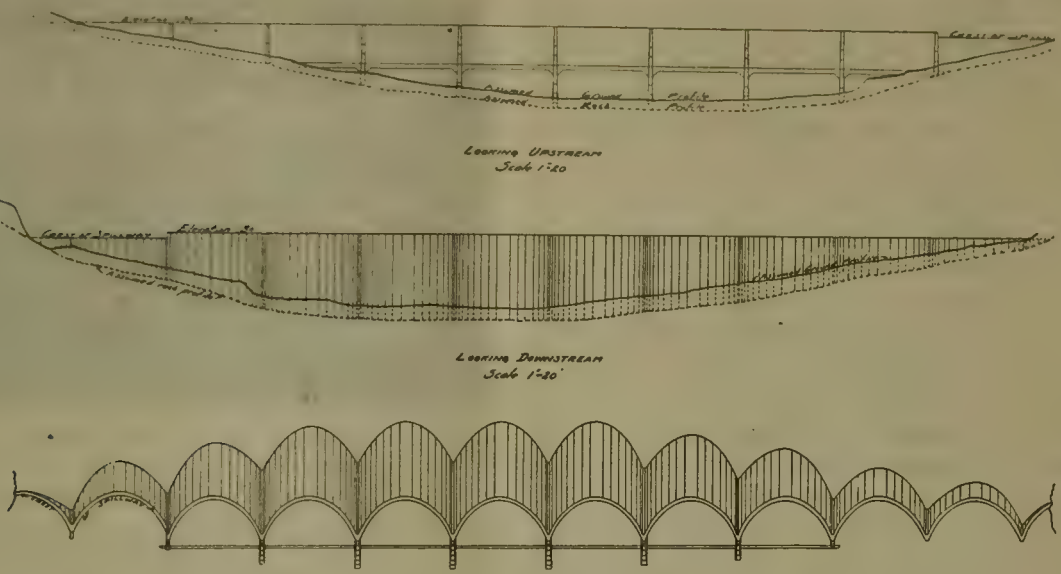
The gravel from the pit was hauled into a stock-pile and was scraped into the boot of a bucket-elevator by which it was hoisted to the top of the washer-tank and dumped into the water, being forced slowly up an inclined wooden tank through the water and finally delivered into the end of a conical screen through a spout, the fine material dropping into a bin

under the screen and the coarse into a separate bin. Water was forced through the end bearing into the tank, and also through perforated pipes lying alongside the screw. This type of washer did not work well with the irregular coarse aggregate, as it would jam under the screw and stop it, requiring a lot of work to find and remove the offending piece, which was usually a flat spall that got under the blade of a screw-flight. The separated aggregates were measured in chutes in the proper proportions from the bins and mixed in a Lansing mixer, operated by a gas-engine.

The buttresses were carried up first and finished to the full height, after which the arch-rings were poured, keeping them all at about the same level. The arch-rings were poured in alternate halves for a small height, using a part of the corbel-hinge form for the crown-hinge form, which was slipped up about half its length on a line and the concrete laid against the finished part. The metal forms used for the hinge-sockets made smooth work except that an occasional small stone pocket would occur, in which case the holes would be filled with mortar, screened smooth and troweled, and when dry a coating of asphaltum was applied to the surface with a flat brush, the excess being removed by using a hot hand-roller for burnishing the surface. When finished, an even and polished surface of asphaltum was shown, this being the form against which the arch-ring was cast. Care was used not to abrade this surface, the concrete being tamped against it by means of puddling with sticks.

The dimensions and stresses in this design were carefully checked, and the plans for the dam approved by Col. W. H. Heuer, U.S.A., of San Francisco. The approval of this type for storage of débris was only given after a very thorough analysis of the stresses in the design and the suitability of this type of structure for the purpose. The multiple-arched dam is the ideal dam for the storage of débris; without doubt it is at once the cheapest as well as the strongest permanent dam that it is possible to devise. Cost plays such a prominent part in the problem that it is almost always the determining factor; for upon cost depends the possibility of the development of a project with profit. There are many hydraulic mining properties in California that are tied up on account of the cost of the storage of the débris, using the type of archaic dam specified by the authorities in charge. The difference in the cost of the types of dams means the difference between the possibility of development and the abandonment of the project for all time.

Work was commenced on the dam, June 10, 1914, and the structure was completed December 1, 1914. The work was done by the Eastwood Construction Co. on the basis of cost plus a fixed sum for engineering and superintendence. The opening in the base of the dam was closed on December 4, 1914, and the pond was full of water up to within 10 ft. of the top on December 17, 1914.



PLAN AND PROFILE OF DAM.

SUMMARY OF DATA

Length of crest	455 ft.
Height above surface	30 ft.
Height above foundations	43.8 ft.
Length of spans	40 ft.
Number of buttresses	11
Number of arches	12
Arc of extrados	133°34′
Radius of extrados	21.8 ft.
Maximum loading	18.85 tons per sq. ft.
Minimum safety-factor	10
Base-loading on buttresses	5 tons per sq. ft.
Cubic yards of concrete	1233
Ratio of cost to that of solid dam	25.2% or as 1 to 3.99
Ratio of yardage to that of solid dam	1 to 6.92

Australian Ores and Metals at the Exposition

In its business-like exhibit of products from the two primary industries of the Commonwealth, namely, agriculture and mining, Australia has a valuable and interesting display of ores and metals. Owing to the War the scope of the general exhibit was considerably reduced and, excepting a few items from Victoria, the states of New South Wales and Queensland occupy the building. This does not detract from what is to be seen, as the minerals of these states are more varied than those from the others. The following notes deal with the New South Wales display:

GOLD.—The gold output of the state to the end of 1913 totaled 14,148,432 oz. The Cobar district is the most important producer of this metal. Exhibits are shown from the Mt. Boppy, Occidental, and Cobar mines. From the Wyalong district are ores from the True Blue, Golden Fleece, and Barrier. Other ores are from properties in the Adelong, Currajong, Lyndhurst, Peak Hill, and other smaller areas.

SILVER-LEAD-ZINC.—Although there are several silver-producing districts, the Broken Hill district is by far the most important. In 1913 the State produced 14,504,889 oz. As silver, lead, and zinc are so closely allied they will be discussed together. Broken Hill has produced metals worth £73,000,000 to the end of 1913, of which £16,177,580 has been paid to shareholders as dividends. An excellent lot of exhibits is shown by the Broken Hill Proprietary (£40,291,900 to date), Sulphide Corporation, Junction North, British, North, Block 10, South, and Zinc Corporation. To those who are interested in flotation processes the mill products of the last-named concern are of special interest. Among the exhibits is an instructive model of the Broken Hill lode. It is 13 ft. long, and represents a length of three miles of workings and its value may be understood when it is said that the model shows the lode in three dimensions at a glance. The R. Broadbent collection of rare minerals from the lode is of great value. These specimens are unobtainable now. Several other districts have sent ores.

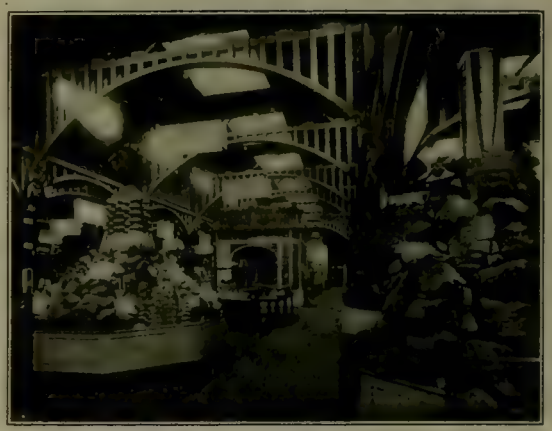
COPPER.—The output of this metal in New South Wales to the end of 1913 was worth £12,382,835. In most of the districts work has been intermittent, owing to the price of the metal. Cobar is the most important and has an output of 235,200,000 lb., 525,000 oz. gold, and 1,500,000 oz. silver. Among the exhibitors from the State are the Great Cobar, Chesney, Gladstone, C. S. A., Burraga, Grafton, Cadia, Mt. Jasper, and three tons of copper ingots from the Electrolytic Refining & Smelting Co.'s works at Port Kembla.

TIN.—The output to 1914 totaled £9,748,901, principally from the New England districts. Lode material, tin 'wash,' stream tin, and ingots are exhibited, the last from the Sydney Tin Smelting Company.

IRON.—Iron ore reserves are estimated at 59,317,000 tons. Iron products manufactured in 1913 amounted to 46,536 tons. The new plant at Newcastle will greatly augment this quantity. The Esbank iron works exhibits ores, fluxes, and coke; pig iron and various shapes. The Cadia-Iron Duke mine sent hematite, limonite, and magnetite.

COAL.—The coal reserves of New South Wales are estimated to contain 115,300,000,000 tons in the four great fields, of which Newcastle is the most important. In 1913 the output was 10,414,165 tons. There are 115 mines operated, employing 18,966 men. Several large cubes of coal draw attention to this part of the exhibit.

KEROSENE SHALE.—Large reserves of this valuable source of oil occur in this state. It contains from 60 to



VIEW IN THE AUSTRALIAN BUILDING AT THE EXPOSITION, SHOWING PART OF MINERAL DISPLAY. LEAD, SPELTER, AND TIN ON THE LEFT, GEM CASES IN THE CENTRE, AND COPPER ON THE RIGHT.

120 gal. of crude oil per ton, against 20 to 30 gal. in the Scotch shales. The output of 1914 totaled 1,668,419 tons. Shale from the Commonwealth Oil Corporation's deposits is exhibited in large blocks.

Other small, but rarer and valuable exhibits, include tungsten ores, molybdenite (this occurring in certain silicious granites, near their contacts with other rocks, in the form of pipes or chimneys), manganese, chrome iron ore, mercury ore (cinnabar), platinum, magnesite, alunite, limestone, and cement (value of cement in 1913 was £402,249, and is making great increases), building stones (cubes and turned pillars), and antimony. The last mentioned ore is of common occurrence in New South Wales, and at Hillgrove contains gold. The output to 1913 totaled 16,672 tons valued at £305,631.

GEMS.—A description of the mineral exhibit of New South Wales would be incomplete without mentioning the display of opal and magnificent gems, for which the State is famed. These include opals, cut and in the rough, from White Cliffs and Lightning Ridge; sapphires, cut and in the rough; beryl, topaz, amethyst, turquoise, zircon, garnet, diamonds from Copeton, and pearls from the northern and western coasts. A skilled lapidary is at work in the building preparing gems for the market.

CONCENTRATES

Readers of the MINING AND SCIENTIFIC PRESS are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

TIN PRODUCTION of the Banca mines in 1914 amounted to 15,319 tons, according to consular reports.

STAMP-DUTY at the Tonopah Belmont mill during the year ended February 28, 1915, averaged 8.88 tons per 24 hours.

TAILING from the flotation plant at Anaconda is to be used for making brick. Samples have been tested and found superior to the ordinary pressed brick.

RESTORATION of dredging ground to agricultural use has been attempted successfully not only in California but in Victoria, Australia. To effect this purpose it is necessary to prevent the liquid loam from being lost.

ANOTHER USE for tin has been suggested, namely, to discard the paper bags in which coffee is sold, substituting tin-plate and tin-foil, so that the aromatic oils of the coffee may not be lost during warm humid weather.

A STEEL TUBE-MILL LINER at the Belmont mill, Tonopah, is giving good results. In 16 months one set ground 35,825 tons of ore. It was considered useful for another four months. The lining charge is reduced from 3.2c. for silex to 1.58c. per ton.

TRIBOLUMINESCENCE is the name given to the property of some specimens of zinc sulphide of emitting sparks when scratched. Not only the mineral zinc-blende but the artificial sulphide exhibits this phenomenon. The sparks do not set light to inflammable gases.

CHARACTERISTICS of the region around Hedley, British Columbia, are the deep glacial eroded valleys cutting the plateau over 5000 ft. deep, the intense metamorphism, and indications of a long period of great volcanic activity in the immediate vicinity of the Nickel Plate mine.

COSTS at the North Star mine, Grass Valley, California, were as follows in 1914: mining, $3.043; milling, 62.1c.; cyaniding, 41.5c.; bullion expenses, 3c.; miscellaneous, 29.9c.; New York office, 19c.; taxes, 25c.; and accident and benefit, 9.3c.; a total of $4.941 per ton milled. Sundry revenue reduced this to $4.922.

REPORTS from Peking at the end of January state that the first drill of the Standard Oil Company, at Yen-chang, in Shensi, had only reached a depth of 740 ft., trouble having been experienced with the rig. A second rig has been set up on the Tan-yang-shui, thirty miles south, and has begun drilling.

OPAL MINING at Lightning Ridge in New South Wales is a peculiarly speculative industry. It is said by the Department of Mines of that state that one miner earned $3.60 in 12 months, another $3 in 20 months, but at the end of that time the latter made up all his losses in a few minutes by discovering rich opal. The opal is found in thin veins or as nodules. The matrix is mainly clay occurring in horizontal layers, differentiated from sandstone.

THE METHOD OF MINING to be used at the Inspiration mine, Arizona, will consist of undercutting, thus caving the ore in blocks of probably 70 ft. vertical dimension. The broken and caved ore will be drawn off through a system of inclined rises delivering to the haulage-ways below. These rises have a sufficient number of branches immediately below the caved area to reduce the interval to a minimum, probably 8 ft., between the heads of the rises that reach the caved ore. The mill is designed to treat 14,000 tons of copper ore daily.

DISCUSSING the legal aspect of the smelter-smoke problem, Charles H. Fulton, of the U. S. Bureau of Mines, says that although it has been in the courts for a long time in a minor way, it has been prominent only in the past ten years. During that time, however, and at present it is attracting nation-wide attention. The cases that have been before the courts may be classified geographically under five heads, as follows: (1) Utah, centring about Salt Lake; (2) southeastern Tennessee, near the Georgia and North Carolina boundary line; (3) Montana, centring about Butte and Anaconda; (4) Shasta county, California; (5) near San Francisco,

in Contra Costa and Solano counties, California. There are cases of minor importance in other parts of the country, but those in the five localities mentioned serve well to illustrate the legal aspects of the smelter-smoke problem.

THE TERM 'CRACKING' OF OIL originated about 50 years ago by the stillmen in the old Pennsylvania refineries, and meant just what its connotation conveys, namely, a part alteration, as distinguished from the more complete decomposition which would disrupt the molecule largely into carbon and permanent gas, according to W. A. Hall in a paper read before the Institution of Petroleum Technologists in England. Cracking simply alters the molecules to an extent that produces an amount of low-boiling fractions that cannot be obtained by simple distillation. It may or may not be accompanied by any considerable production of permanent gas, the product being largely a liquid condensate, but of different character from that obtained by simple distillation.

HOGANAS IRON SPONGE, mentioned in the *Press* of April 3 as one of the exhibits of ores and metals in the Sweden building at the Panama-Pacific Exposition, is a pure iron obtained from Swedish ores of the best quality. It is produced by a reduction process, in which carbonaceous gases are used at a temperature below the melting point of iron. The gangue which is present in the ore is retained in the iron, but as nearly chemically pure magnetite is used in the manufacture, the percentage of iron in the sponge is high, even higher than in the purest pig iron. An analysis of the sponge regularly sold is as follows: iron, 96%; sulphur, 0.01 to 0.02%; phosphorus, 0.013%; gangue (principally silica), 2%; oxygen, 0.9%; carbon, 0.03%; and manganese, traces. The sponge is made in the form of round briquettes, about $10\frac{1}{2}$ in. diameter and 2 to $2\frac{1}{2}$ in. thick. The material is somewhat porous, its weight being only about 2 kg. (4.04 lb.) per litre of volume, consequently it has a great tendency to absorb water, making it necessary to cover it during transit. On account of its high quality the sponge is a good raw material for the manufacture of iron and steel of the best grades.

TELEPHONE line construction and operation meets with serious difficulties in the tropics. The main troubles are due, not to the heat, but to the damp and the many natural effects caused by damp heat. The humidity of the atmosphere in many places varies between 80 and 90%. This damp heat produces a marvelous growth of vegetation, so thick that along the sides of the country roads there are actual walls of green leaves perhaps 80 or 100 ft. high, the growth of which is so rapid that they may be cut back one day and grow as high again in the ensuing 24 hours, according to W. L. Price in a paper read before the Institution of Electrical Engineers in England. Insect life is as prolific as the vegetation. White ants are destructive, and other insects make their homes in the petticoats of insulators. Lightning has a virulence unknown in many countries. Wild animals do their best to increase the engineers' labors. In some parts, for instance, it is not unusual to have a mile or two of lines wrecked by giraffes, elephants, or monkeys. When the giraffes roaming over the wilds of East Africa come up against a telegraph or telephone line they have not the sense to draw back or duck their heads, but push on, carrying wires and sometimes poles with them.

THE BUREAU OF SCIENCE has sent a party from the Division of Mines to Surigao province, Mindanao, for the purpose of a geological survey of the iron ore deposits in that province. The party consists of the chief of the division, one mining engineer, and an assistant, who left Manila on February 7. The area and average depth of the iron ore deposit, a blanket of clayey limonite, will be determined, and a sufficient number of representative samples will be obtained to indicate the average quality of the ore. For the latter purpose two prospecting drills are included in the equipment of the party. It will be recalled that the first report of H. F. Cameron, the engineer who discovered the Surigao iron ore deposit, indicated an immense body of ore comparable in quantity with some of the world's largest iron ore deposits. Notes on this ore were published in the *Press* of October 10, 1914. In addition to the survey of the iron ore deposits, a general reconnaissance of northern Surigao will be undertaken, and, if possible, a brief inspection of the recently discovered gold deposits near Iligan will be made. It is estimated that the party will be in the field two months.

THE FINAL FLOW-SHEET at the new 14,000-ton capacity mill of the Inspiration mine, Arizona, has been a matter of considerable discussion. According to the report of C. E. Mills for 1914, the following has been decided on: The test-mill treated 172,722 tons of 1.52% ore last year. This showed that the concentrate will probably contain from 28 to 32% copper and sufficient sulphur for matte in smelting. Many machines and processes have been tried, resulting in the following scheme of treatment for the new mill: Crushing ore to 4-in. size in gyratory crushers, and $1\frac{1}{2}$ in. in Symons disc-crushers, at the mine; reducing this product at the mill, in Marcy ball-mills, to pass a 48-mesh screen; treatment of the mill product by flotation; separation of flotation pulp into sand and slime; concentration of sand; flotation of slime; and dewatering concentrate in a filter-plant. The recovery of copper in the ore as a sulphide has averaged 86.7%. During February it increased to 90.3%. The extraction will depend on the quantity of oxide ore mixed with the sulphide. If the oxide ore is 0.16%, out of a total of 1.52% copper, the recovery of total copper contained would be equal to about 80%; but 86.7% may be expected from the mill from the copper in sulphide form. There is a probability that the copper in oxide form will be in future satisfactorily floated.

REVIEW OF MINING

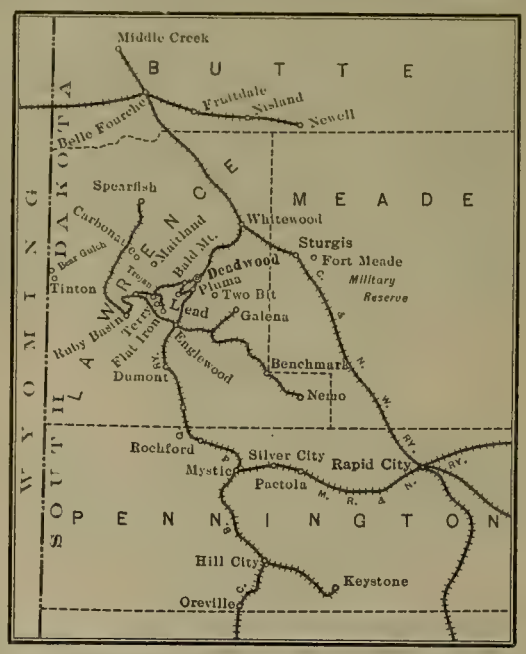
As seen at the world's great mining centres by our own correspondents.

DEADWOOD, SOUTH DAKOTA

BEN HUR MINE AND MILL.—HOMESTAKE NEW MACHINERY.—SINKING AT THE ECHO.

To facilitate handling ore and make a large saving in transport charges, a vertical rise is being driven from the Ben Hur mine, of the Mogul company, to a point near the crusher at the top of the mill. The vertical distance is 485 ft. With the automatic hoist which it is planned to install, ore will be delivered to the mill for a few cents per ton. At present the only means of getting the Ben Hur ore to the mill is to haul it out of the mine through an incline adit over 1000 ft. long, load it into narrow-gauge railroad cars, ship to Englewood, transfer to standard-gauge cars, and then haul up the Spearfish line to the mill. The total distance by rail is 12 miles. Freight costs 65c. per ton. From the point at which the rise has been started, a large tonnage can be taken to it over a grade in favor of the loaded mine-cars. This makes available a quantity of good mill ore, which, by the way, would not yield a profit if handled under present conditions. The rise is being cut 7 by 17 ft., outside of timbers. It will be timbered with square-sets, and divided into three compartments; one about 5 by 5 ft. for hoisting, a smaller one for ladderway, pipes, etc., and a third, still smaller, for a counter-balance. It is proposed to hoist about 5 tons each trip, in a self-dumping skip, using a 2½-ton counter-balance. A 15-hp. motor should handle this load at a speed of about 80 ft. per minute. This would give a capacity of 20 to 25 tons per hour, which is greatly in excess of the mill capacity. Foundations are being prepared in the mill for an 18-ft. tank, to be fitted with a Dorr agitator. It was recently found that the plant could not successfully handle over 120 tons per day with the three 15-ft. agitators at work. The crushing department will easily take care of 150 tons daily. At the present time the bulk of the ore supply for the mill is coming from the North lode, at Trojan, where a 'vertical' in the Cambrian shales, from 6 and 8 to 20 ft. in width, is yielding 75 to 100 tons per day. This property is drawn on to keep the mill fully supplied, after taking care of lessees' ore. At present the Clinton, under lease to William Nicholls, the Mark Twain leased to Thomas Tretheway, and the Alameda leased to Edward Manion, are regular shippers of from 10 to 30 and 40 tons per day. George Salsbury has been granted a lease on the Hardscrabble and will shortly be shipping to the mill. No ore is being taken from the 'Farm,' at the rear of the mill, and it is probable that none will be mined there during the present summer, as other deposits are filling the mill requirements. The Farm is worked by open-cut. Last summer and fall it supplied a large portion of the mill tonnage at a minimum cost for mining. The mill is the first in the Black Hills to adopt the all-sliming method in cyaniding, using Chilean mills and a tube-mill for reducing the ore to a point where only 1 to 2% is coarser than 60 mesh, and 40 to 60% will pass 200 mesh. With continuous decantation using tanks containing Dorr thickeners, and agitating in tanks with Dorr agitators, a satisfactory recovery has been made. The tailing has been discharged from the last thickener without resorting to filtration. Recent experiments with a small filter seem to point to a possibility of saving considerable cyanide and gold-bearing solution by filtering. It is probable that a revolving-drum filter will be installed during the present summer. The executive staff is composed of J. V. N. Dorr, consulting engineer and 'guardian angel'; Charles A. Chase, general manager, who devotes about four days per month to work on the property; E. R. Graham, superintendent, and to whom is entrusted practically all of the details of operation; and L. D. Dougan, mill superintendent.

Construction work at the Homestake is proceeding at a good rate. With the frame of the new hoisting engine at the B. & M. shaft in place, the mechanics are engaged in erection and assembling of the large machine. The steel work of the new head-frame is practically complete. The plant will be ready for operation by the time steam is ready in the new central steam-plant. It is expected that the boiler-plant will be completed by early fall. After its completion the boilers at the B. & M. shaft will be removed. On ground they now occupy will be erected a new air-compressor, one



BLACK HILLS MINING DISTRICT OF SOUTH DAKOTA.

of the largest in the United States, a fitting companion to the hoist, which is stated to be the largest machine of its type ever constructed. It is a vertical type, double-expansion steam cylinders, with the two high-pressure cylinders, in front, direct connected to a shaft to which one of the reels will be attached. The low-pressure cylinders will in similar manner operate a second reel. The engine is rated to handle an unbalanced load of 6 tons from a depth of 4000 ft., at a speed of 85 ft. per second. Two skips will be operated in balance. The skips will dump at the surface direct to two No. 8-K Allis-Chalmers Gates crushers. Belt-conveyors will carry the crushed product to No. 6 crushers. It will drop from them to bins and follow the present practice, namely, transportation to the mills in 4-ton cars drawn by compressed-air locomotives. The addition of the larger-sized crushers

will make it possible to take coarser ore out of the mine, and deliver it to the mills finer than under the present arrangements. At the electric-generating station the building is practically ready to receive the equipment. The building is completed and traveling crane installed. This plant will contain two units of Westinghouse steam-turbines, direct connected to generators. Its maximum capacity will be 4000 kva. The central steam-plant, which will supply steam for the B. & M. hoist and the electric plant, is being erected on a site below the C. & N. W. railroad tracks. The plant will contain six 600-hp. Edgemoor water-tube boilers, three on each side of and facing a steel coal-bunker on top of which the railroad cars loaded with coal will be delivered. Two high stacks will be erected, one for each set of three boilers. The coal-bunker construction is practically complete, and the brick walls of the building are rising rapidly. Foundations for the stacks are finished several feet above the ground-line. At Hanna, where a large portion of the Homestake water-supply is secured, motor-driven pumps are being put in to lift the water over the 380-ft. divide from where it flows down to Lead by gravity. Janesville 3-stage centrifugal pumps, with a total of 550 hp. of motors, are being installed. With the electrification of this plant, and the Deadwood slime-plant, practically all of the Homestake's surface machinery, except the large hoists and air-compressors, will be driven by electricity. Motors are used to drive the stamp-mills, cyanide-plants, machine-shop, carpenter-shop, rock-crushers, regrinding-plant, and for the main mine-pumping system at the B. & M. shaft, as well as for numerous incidental uses.

Shaft-sinking is proceeding at a fair rate at the Echo shaft at Maitland. Since about April 1 some harder rock has been encountered, and it has been possible to drive only about one foot per day, with two shifts of miners employed. In March the shaft was deepened 57 ft. with the same crew of miners. On the 10th, some softer rock was found in one end of the shaft, and if it does not again dip out, an average of considerably better than one foot per day should be made. On the 14th the shaft was 120 ft. deep and in highly mineralized formation. It is proposed to sink to 200 or 300 feet.

LUNING, NEVADA

Renewed Development Work at the Shipper, Luning, Luning Idaho, Mayflower, and Copper Queen Properties.

Since the improved conditions in the copper market there is considerable interest being taken in the properties around Luning.——Joseph L. Giroux has started men working on his company's property. They are down about 800 ft., and propose sinking to water-level before doing much lateral work. It is understood they have a fine body of ore at the present depth.——The Shipper Copper Co. has just had a shareholders' meeting, and proposes starting development at an early date.——The Luning Gold Mine Co. is working away steadily sinking a shaft about the centre of the claims between the principal workings. Timbering the shaft has just been completed, and Mr. Rowland purposes to sink to the contact. Indications are favorable for cutting ore at an early date.——The Luning Idaho Copper Co. has been doing little since the first of the year, but arrangements are now pending for the development of this property on a much larger scale than heretofore.——It is reported on good authority that the Mason Valley Mines Co. has taken a lease and bond on the Mayflower, in New York cañon. This mine is in condition for large production, and it is purposed to extract ore as soon as the smelter at Thompson starts, which will be at an early date.——Fermina's property, known as Copper Queen, it is said will be operated soon under the direction of J. H. Miller, administrator for the estate.——There is much better feeling in camp than there has been since the War broke out, and much activity is expected in the near future.

TORONTO, ONTARIO

Molybdenite and Tungsten.—New Silver District.—Nickel Again.

The Imperial Institute of London has been making inquiries of the Ontario Department of Mines as to the possibility of obtaining a supply of molybdenite from this province. This mineral is much in demand for steel-hardening purposes for armament manufacture at present. Although molybdenite deposits occur in eastern and northern Ontario, so far they have not been worked to any extent. The Institute states that there is also a demand for tungsten for the same purpose. The Department of Mines is making an investigation.

Reports concerning the discovery of a new silver district near Fond du Lac, at the northeast corner of Lake Athabasca in Saskatchewan, about 800 miles northeast of Edmonton, have aroused considerable interest in mining circles here. Glowing accounts of the richness of the area, the conditions of which are stated to resemble those of Cobalt, have been brought in by prospectors. Many people have gone there from Edmonton and Calgary. J. A. Reid, mining engineer of Toronto, has gone to make investigations in the interest of a syndicate of Toronto and Cobalt capitalists.

The nickel question came up again in the Canadian Parliament on April 3, when inquiries were made of Sir George E. Foster, minister of trade and commerce, as to what action the Government proposed to take with reference to the refining of nickel in Canada. Sir George's reply gave little encouragement to any expectations the promoters of the scheme might have formed of assistance from the Government. He said that the Government had arrived at no conclusion, either to prohibit the export of matte or to starting nickel refining. Also that many questions would have to be considered. Capital and equipment would be necessary. The matter may now be regarded as shelved indefinitely so far as the Canadian government is concerned. The Ontario administration appears in no hurry to appoint the promised commission of investigation.

LORDSBURG, NEW MEXICO

Railroad Affairs.—Notes from Various Districts.—Oil Development.—Mogollon Bullion, Roads, and Tailing.

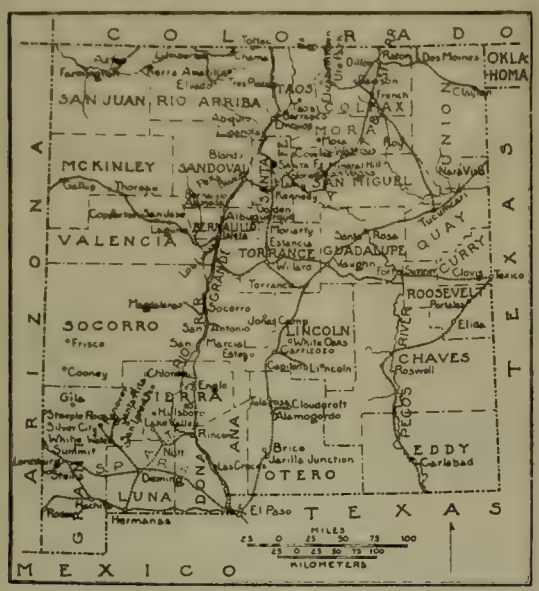
The St. Louis & Rocky Mountain railway has been sold to the Atchison, Topeka & Santa Fe system. This transaction is of importance to the mining regions of northern New Mexico, as the line will doubtless be extended later on by the Santa Fe and afford transportation for some of the now practically isolated mining camps of merit. The road runs from Des Moines to Cimarron, a branch connecting Raton from a point where it crosses the Red river and the Santa Fe. The Arizona and New Mexico railroad and the Southern Pacific system have held a hearing in Santa Fe, before the State Land Commissioner, in connection with the right-of-way dispute between the two roads for the construction of a spur to the 85 mine from Lordsburg.

In the Lordsburg district work continues up to full capacity. Several new companies may start operations.——The Last Chance mine and the Sutton Consolidated Mining Co., at Pyramid, have been absorbed by the El Centro Mining Co., of Los Angeles, California, and probably will soon resume operations.——Several companies are considering the purchase of the Atwood mine. This was recently examined by John M. Sully, manager of the Chino Copper Co., and others. Its favorable location in the Virginia district is bringing the Atwood into prominence.——Shipments at Steins are being made periodically by the November Mining Co.——Several other prospects in the district are showing good ore.

Drilling for oil in the Puertecito field, 28 miles north of Magdalena, will begin soon. A 3000-ft. capacity well-drilling

outfit has been shipped from El Paso, Texas. The Pearson interests are said to be interested in the new concern known as the Magdalena Exploration Co. Over 2000 acres of oil-lands have been leased by the company. J. R. Stancliff, at Lake Arthur, in the Pecos Valley oilfield, has purchased casing and an outfit for drilling west of that place.

The Mobile Mining & Milling Co., of Bayard, New Mexico, is a new corporation which was granted a charter by the State Corporation Commission recently. Mobile, Alabama, people are interested in the company, which is capitalized at $3000. They are developing a good property and are erecting a mill near Bayard. Gold and silver bullion worth $70,000 was shipped in one lot from Mogollon on March 27. There were 48 bars, weighing 3500 lb., in the consignment. It was one of the largest shipments ever made from the district. The post-office at Cooney, in the Mogollons, has been discontinued, and mail for that point will go to Mogollon. The road-building fund being subscribed by the companies of Mogollon and the merchants of Silver City is increasing.



NEW MEXICO.

With the bill passed at the last session of the State Legislature making the road a state highway, it appears that the gold and silver district will yet have a good road for the transport of supplies, bullion, and concentrate. The Silver City fund is practically all subscribed, so that work may be commenced in a short time. The Mogollon milling companies have been warned by the attorney-general of Arizona that tailing must not be discharged into the Frisco river, thereby damaging the lands and streams of irrigation in the Gila valley. The nuisance must be abated or Arizona will take action toward stopping it.——The suit of Paul Davis *v.* the heirs of G. E. Wood, and B. L. Farrar, Martin Fishback, and E. C. Rice for the title of the Excelsior mine in the Organ district of Dona Ana county resulted in a verdict for the defendants. Davis jumped the Excelsior mine, claiming the annual assessment had not been done according to legal requirements. The property is one of the most valuable in the district. With the end of the litigation it is stated that new equipment will be installed at the mine, and operations resumed.——The Yellow Jacket mine at White Oaks, Lincoln county, is again shipping ore to the Pueblo, Colorado, smelter. An adit is being driven. The stamp-mill at the American mine is undergoing overhaul.——The report of the Chino Copper Co. for 1914 has been issued.

BOSTON

Costs and Future of Utah Copper, Chino, Ray, Alaska Gastineau, and Butte & Superior Mines.

In an interview in Boston, D. C. Jackling gave some interesting information about the companies that are under his management. He said:

"The most gratifying achievement at the properties during the past year was the fact that we were able to cut operations to 50% of normal without any perceptible increase in costs per unit of output.

"At Utah Copper the cost during the second quarter of the year, working full time, was 7½c. per pound of copper. In the fourth quarter, working half time, the cost was 7.7c. At Chino the cost for the second quarter was 7.7c. For the fourth quarter, under some adverse conditions, it had increased only to 8c. At Ray Consolidated during the fourth quarter it was 9.1c., the lowest the mine has ever made. The secret of it all is unit operation. Work is so divided into units of reasonable size as to produce maximum flexibility. The idea at all the properties has been to secure the best talent available. We are willing to pay well for it. This also was a factor. We are making important metallurgical improvements at the Utah mills. This will enable us on the same tonnage of ore to extract from 15 to 20% more copper. The additional recovery will be obtained at a nominal cost.

"At the Alaska Gastineau we have done enough to make it clear that we shall be able to mine and mill ore at a cost 20% lower than originally estimated. Tailing losses are under 25c. per ton. The ore, when obtained from normally distributive points, has been averaging from $1.80 to $2 per ton. Recoveries therefore have been over $1.50. The whole operation, however, is so vast that the figures to date are merely indicative and confirmatory rather than final. The property has worked out remarkably well. Every anticipation is being more than realized.

"At Butte & Superior it was originally estimated that zinc would be produced for 4c. per pound. Last year the cost was 0.5c. less than this. As to the life of the property, there is nothing to indicate that we will not be mining ore at the present rate for many years to come."

HOUGHTON, MICHIGAN

Men Employed.—Drilling for Iron.—Iron Ore Shipments.

Nearly 15,000 men are employed at the mines in this district. This is about 1000 more than before the strike of 1913. More will be engaged shortly. Practically all properties are working full time.

A report comes from Ishpeming that the Cleveland-Cliffs Iron Co. is preparing to start diamond-drilling in North lake, about four miles west of Ishpeming. Piles are now being driven through the ice, which is about 20 in. thick, and everything will be in readiness to start work as soon as the ice disappears. The drill will operate near the centre of the lake in about 15 ft. of water. North lake probably will be drained before many years, as it is known that there is ore underneath.

The Miller mine, at Aurora on the Mesabi range, shipped 20 cars of iron ore to the docks at Two Harbors this week. This was the first shipment of the year. For a number of years the Miller has been the first property on the eastern Mesabi to ship in the spring, and the last to stop in the fall. Other mines are preparing to send out ore. It is thought that there will be considerable ore at the head of the lakes by the end of April.

The Oliver Iron Mining Co. is preparing to employ several hundred men in its mines at Ishpeming and Negaunee. A number have already been taken on, but the majority of them cannot be given work until more stockpile room has been provided at the shafts.

THE MINING SUMMARY

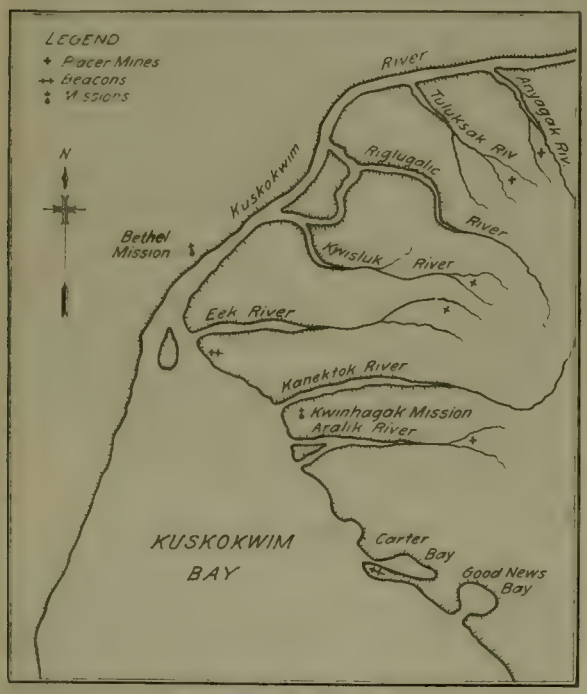
The news of the week as told by our special correspondents and reflected by the local press.

ALASKA

BETHEL

(Special Correspondence.)—People on the Kuskokwim river are greatly indebted to the Seattle Chamber of Commerce for assistance in having the Kuskokwim bay and river surveyed. This will facilitate navigation and connect the states with this unknown region, and will decrease the heavy expenses which exist at the present time.

William McGrogen, an operator from Kwisluk river, is in Bethel making preparation for the next summer's work.—— The reindeer herders are hauling provisions for the new set-



BETHEL DISTRICT, ALASKA.

tlement on Canyon and Fall creek. They will be busy until the river breaks in the spring. Three tons of material has been set up. Men are cutting lumber there. Buildings will be erected to accommodate 35 men or more, as Mr. McGrogen intends to work three shifts.

G. L. Geane is also here from Kwisluk, but is undecided as to his plans for this summer. His ground is deeper and requires machinery. Last summer the ground worked produced a good average and paid well. The gravel was from 5 to 8 ft. deep, and at times 50-cent pans were found 5 ft. from bedrock. Most of the time the 'pay' was on bedrock, which is a porphyry.——There are a number of other prospectors on Kwisluk, Tuluksak, Yagak, and Aralik rivers, busy getting things in shape for next summer's work.——Mr. Gabrielson, on Aralik river, put in a Headley scraper, run by a 12-hp. gasoline motor, last summer, with a capacity of one-third cubic yard. The gravel is 8 ft. deep and yields 25c. per sq. ft. on bedrock. The scraper was operated 15 days and yielded $100 per day. On account of not having sufficient cables, the scraper could not work to full capacity. Mr. Gabrielson has the scraper in first-class order now, and expects to start work in May, when the river breaks. He stated that there is hardly any frost in the ground this year on account of the mild winter.

Bethel, February 6.

FAIRBANKS

On March 29 the Yukon river was open in several places between Tanana and Birches. This year's break-up is earlier than previously.——The Tolovana district has been well prospected, and many people are optimistic. According to P. Lynch, the 'pay' on Olive creek is 200 to 250 ft. wide. Estimates average the gravel at $2.50 per foot. Bedrock is at 24 ft., 10 ft. being 'muck.' Jay Livengood, who discovered gold at Tolovana, has sold his claims to D. Cascaden for about $40,000.

NOME

Rich gravel is reported by telegraph as being found on Dexter divide, four miles from Nome. 'Pay' is estimated as 12 ft. deep, 60 ft. wide, and a good length.

ARIZONA

GILA COUNTY

Copper production from the Inspiration Consolidated Copper Co.'s mine will commence in June of this year, according to the general manager, C. E. Mills, in his report for 1914. It was again decided to increase the size of the mill. It will finally consist of 18 units, each having a capacity of 800 tons per day. By September, 7000 tons per day will be treated and at the end of the year the quantity will be 14,000 tons.

Mine development, in charge of Mr. McDonald, was confined to the Inspiration. No work was done in the Live Oak. Total work accomplished was 102,066 ft., or 19.33 miles. To date the length is 42.9 miles; also 29.33 miles of churn-drilling. At the end of 1914 there was 192,842 tons of 1.65% ore stored on the surface. The New Keystone property was acquired during the year for $795,940. Ore reserves in the company's properties are estimated as follows: sulphide, 46,252,000 tons of 2.01%; low-grade sulphide, 28,698,000 tons of 1.26%; oxide material, 17,460,300 tons of 1.31%; and 4,732,700 tons of 1.31%; making a total of 97,143,000 tons averaging 1.63 per cent.

The balance-sheet at December 31, 1914, showed accounts receivable, $225,219; bond subscription unpaid, $722,865; and cash, $1,691,792. Current liabilities amounted to $288,703.

YAVAPAI COUNTY

The Arizona Power Co., which is the only concern selling power in this county to mines and for domestic purposes, is to spend about $250,000 in enlarging its plant on Fossil creek. The new equipment will include a 2000-hp. generator, nearly four miles of steel flume, 3000 ft. of pipe, a diversion dam, and an intake tunnel 440 ft. long. The United Verde smelter will use more power. A transmission line is being constructed to the De Soto mine. R. S. Mason, the chief engineer of the company, is at Prescott. Preliminary work has been started.

The Buffalo-Arizona Consolidated company's mill, 11 miles from Hot Springs, was destroyed by fire last week. The damage is estimated at $20,000.——The Montezuma company's adit near Crown King is to be extended to about 3000 ft. from the portal. Drilling equipment has been ordered. A fair quantity of ore has been opened. J. P. Waldron is manager.——The Lynx Creek dredge has been moved.

CALIFORNIA

Amador County

The Mountain King and Queen properties at Pine Grove are under option to Russell Robinson for $100,000. He is developing them under a new agreement with the owner, W. B. Pitts.

Butte County

Re-dredging dredge tailing has frequently been discussed in California. According to Charles Helman, manager of the El Oro Dredging Co. at Oroville, tests have shown that a modified boat will save enough gold to make re-dredging profitable.

Calaveras County

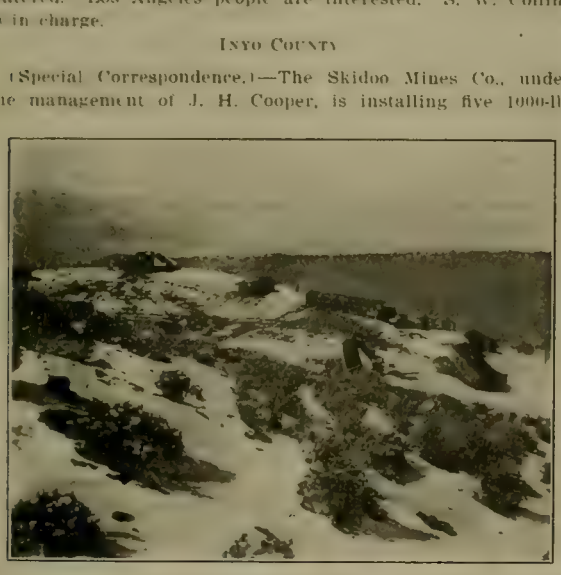
A better feeling prevails at San Andreas regarding the mining situation.——The Ford mine is being unwatered. J. C. Benson controls the property.——The Felloweraft is also to be unwatered.——Preparations are under way to re-open the Pioneer Chief.

Eldorado County

Records with the county recorder at Placerville show that the Golden Rod, Empress, and Minerva, and the property of the Union Gold Mining Co. have changed hands.——The Alpine mine, three miles south of Georgetown, is being unwatered. Los Angeles people are interested. S. W. Collins is in charge.

Inyo County

(Special Correspondence.)—The Skidoo Mines Co., under the management of J. H. Cooper, is installing five 1000-lb.



SKIDOO MINES.

stamps. There are ten working now. Two Deister concentrators are also being installed. The additional plant is expected to be in operation by May 15.——At Harrisburg, the five-stamp mill is working one shift daily, as only a small amount of ore is on hand. Murphy and Trent are installing a cyanide plant to treat the accumulated tailing. Seven men are employed.——The antimony mine at Wild Rose is shipping 12½ tons of oxide ore to the Merchants' Finance Co.'s smelter, near Los Angeles. The sulphide ore is being treated in a six-ton reverberatory furnace, two miles from the mine. The sulphide ore analyzes 40% antimony.

Skidoo, April 15.

Kern County

Three feet of rich gold ore has been opened for 40 ft. on the 170-ft. level of the old Long Tom mine. The company is to sink a shaft to 500 ft. to cut the Lady Langtry vein, which was a good producer. I. M. Hirsfield is in charge of 30 men.

Mariposa County

The report of the Mountain King Mining Co. for the year ended March 31 includes the reports of the president, W. S. Miller; superintendent, A. Hamilton; engineer, R. Van Norden, and secretary, H. T. Harper. The property is in a transition stage. A new mill and power-plant are being constructed. The former was started on February 13. It contains a 350-kva. generator driven by a 450-hp. Francis turbine. Work at the mill is well ahead. Mine development amounted to 1209 ft. Other necessary work was done. After a considerable amount of prospecting, a new vein was cut. It has been opened west for 251 ft., averaging 9 ft. in width. In the centre of the vein is a 12 to 18-in. streak. It contains free gold and sulphides. Two stopes were started, showing the following: length, 189 ft.; average width, 8.7 ft.; and value, $8.80 per ton. There was 1200 tons of ore, worth $4.64 per ton, crushed from the low-grade shoot. In March 900 tons yielded bullion worth $3550 and concentrate valued at $756. Reserves are estimated at 60,000 tons worth $6 per ton. From ore-shoot No. 1, on which stoping was completed early in December, 3374 tons milled averaged $9.60 per ton. The total from this body is 4266 tons for $42,373.

Revenue during the year amounted to $108,197, made up as follows: bullion and concentrate, $47,682; cash at April 1, 1914, $15,281; and loans, etc., $45,234. Expenses were: operating, $47,698; plant, $48,977; engineer's fees, etc., $5688. Cash on April 13, 1915, amounted to $5832.

Nevada County

The North Star Mines Co. has paid its regular quarterly dividend of 20c. per share, equal to $50,000.——At the Empire mine ore is being opened at 4600 ft. It is reported that the apex rights dispute between the Empire and North Star has been settled.——At the Union Hill 10 stamps are crushing ore. The 800-ft. level is being extended to cut the Union Hill vein.——Four miles below Grass Valley is Deadman's Flat. Considerable activity is apparent there at present.——At a depth of 360 ft., a drift on the Forlorn Hope vein of the Black Bear mine, in the Rough and Ready district, is showing 3 ft. of rich ore. The 10-stamp mill is to start soon. Fifteen men are employed in charge of William Buchholz.

Placer County

It is reported that the old Whisky Diggings mine, northeast of Lincoln, will be re-opened by Wallace Gibson. The ore contains gold and copper.——The Herman company, at Westville, may install an electric plant this spring. Four veins are to be developed.——Work has been resumed at the Rip Van Winkle and Green Immigrant mines.

Shasta County

The boat of the Shasta Dredging Co. is to be moved from Horsetown to another area 12 miles distant. The dredge will be dismantled for removal. A. G. Frost, of Redding, has the contract for $6000.——On April 20, W. Hooper, shift boss at the Gladstone mine, was killed. A barrel fell down the shaft 700 ft., broke the bonnet of the cage, and then hit him.——The Noble Electric Steel Co. is resuming production of ferro-manganese and ferro-chrome. The Northern California Power Co. will supply the electricity, amounting to about 2400 horse-power.——The Midas mill and cyanide plant yielded $6000 in the past two weeks.——Eastern people have bonded 1277 acres of dredging ground on Churn creek.

Tuolumne County

At 2700 ft. in from the portal, good ore is showing in the adit of the Experimental mine at Columbia.——The Springfield Tunnel & Development Co. has cut the old Buchanan channel by a 225-ft. rise from the 2400-ft. adit.

COLORADO

Clear Creek County

The remodeled mill at Idaho Springs is receiving a good supply of ore. Concentrate shipments have been started.——

The shoot recently opened in the Waldorf mine in east Argentine is producing rich ore. The last shipment of 22 tons averaged 1.53 oz. gold, 67.1 oz. silver, 8.05% lead, and 12.85% copper. The average value was $91.94 per ton.——Lessees and others in the district continue to be busy.

LAKE COUNTY (LEADVILLE)

Six furnaces are in blast at the Arkansas Valley smelter. The yards are full of ore.——Pumps at the Penrose shaft are ready to start. Great interest is now centred on this drainage scheme.——Three shifts at the zinc-oxide plant are treating 48 tons of zinc carbonate ore per day.——The spelter market has affected some of the zinc-ore producers. No settlements have been made for ore shipped a month ago.——Lessees at the London mine are extracting high-grade gold ore. Shipments have been delayed on account of the railroad being blocked with snow. Haulage is expensive from this property.——A shoot of rich lead ore is being mined at the Hope shaft. The daily output of the mine is about 25 tons. A large body of ore containing 12% silica, 26.3% iron, and 26.5% manganese was opened some time ago. Arrangements are being made with the Illinois Steel Works of Chicago to supply some of this ore.——The Garbutt mine is producing 50 tons of $16 to $20 ore per day.——A mill to cost about $50,000 is contemplated for the Gordon-Tiger. G. W. Boyce is manager.

LA PLATA COUNTY

A rich vein, 2½ in. wide, has been opened in the Incas mine near Durango.

OURAY COUNTY

Ore being treated at the Atlas mill contains gold, silver, lead, and copper. Water concentration formerly saved only about 65%, but the Minerals Separation flotation process has increased this to 90%. The manager, Mr. Carroll, expects to extract 95% before long.——Two miners were killed in the Wanakah mine last week. Their machine drilled into a missed hole.

TELLER COUNTY (CRIPPLE CREEK)

The Vindicator Consolidated Gold Mining Co. attracted considerable attention recently when it acquired control of the Golden Cycle properties in Cripple Creek. The reports of the president, Adolph J. Zang; vice-president and general manager, Irving T. Snyder; superintendent, H. P. Nagel, Jr.; mine engineer, Fred W. Crosley; and secretary and treasurer, G. S. Wood, contain the following information for the year 1914: Development totaled 6105 ft., making 198,208 ft. to date. No. 1 shaft was sunk from 1626 ft. to 1943 ft. Stations were cut on No. 22 and 23 levels, 183 and 308 ft. below No. 20, or 1600-ft. level. During December a large flow of water was cut on the 1800-ft. level. Pumps were installed to lift it to 1600 ft., from where it will flow into the Golden Cycle mine. Operations underground were curtailed on account of improvements being made. Reserves of broken ore were heavily drawn on. Development on company account was mostly done on the lower levels. The orebodies at 1600 ft. show a large tonnage. From No. 1 shaft the company produced 76,295 tons of ore. This yielded 26,343 tons of $27.04 ore for shipment. Lessees produced 3897 tons of $33.58 and 9741 tons of $19.79 ore from No. 1 and other shafts respectively. The lower levels of the mine were wired for electric lighting. A 25-drill Sullivan motor-driven compressor of 1900 cu. ft. capacity has been installed. The gross revenue from all ore shipped was $802,280. Operating expenses totaled $335,708, and $165,712 was paid to lessees. This left an operating profit of $300,860. Adding sundry income, and deducting other expenses, the final profit was $251,157. Cash on hand at the beginning of the year was $227,112. Dividends amounted to $270,000. On January 1, 1915, the cash balance was $208,270. The new concentrating mill started on October 15. Its purpose is to treat ore-house waste and material that has been put on waste-dumps.

IDAHO

SHOSHONE COUNTY (COEUR D'ALENE)

The orebody that was faulted in the Caledonia mine several weeks ago has been found. The general manager, Charles McKinnis, states that the occurrence is similar to that in other parts of the property.——In the lower adit of the Silver Cable, east of Mullan, a rise has entered ore assaying up to 60% zinc, with some gold and silver. This is under the great shoot in No. 2 adit.——Construction has been started on the 100-ton mill at the H. E. & M. mine. R. Hunter is in charge.

MISSOURI-KANSAS-OKLAHOMA

In the first 16 weeks of 1915 this region has produced the following: blende, 74,898 tons; calamine, 5973 tons; and lead, 12,067 tons. The total value is $4,202,098. According to the *Joplin News Herald*, the following are the chief features of the district: New mill construction is a feature of much importance at this time. Work will start within a week on a 1000-ton concentrating plant for the Granby Mining & Smelting Co., 1½ miles south of Granby, Missouri. O. W. Sparks, operator of several large mines, announces that within 20 days he will commence building two 300-ton mills. Both of these will be situated in the west Joplin sheet-ground district. The rejuvenation of several large properties, likewise, is attracting attention. In the Lincolnville, Oklahoma, district, where no mining of importance has been conducted for three years, the Underwriters Land Co. is draining the drifts of the Mission and the Omaha-Petersburg mines. Both these properties are equipped with large mills. North of Miami, Oklahoma, the Picher Lead Co. has four shafts down to a depth of 95 ft. A fifth is down 20 ft. This work is in a virgin district, several miles removed from the nearest mines. Extensive drill prospecting has shown an enrichment of importance at this point. The Picher company plans to construct two 1000-ton mills on this property.

MONTANA

BROADWATER COUNTY

The Townsend district is fairly active at present.——The Broadwater County Mining Co. has decided to have its property reported on and developed.——Lessees and miners at the Black Friday, East Pacific, and other mines are busy.

JEFFERSON COUNTY

Twenty-one miles east of Butte is the Pipestone district. It is showing increased activity. Good copper ore was recently opened in the Smuggler claim. At 75 ft. in the Gold Bug there is 3 ft. of 5½% ore. At 110 ft. in the Welcome Stranger is 3 to 4 ft. of fair ore.

SILVERBOW COUNTY

The U. S. Bureau of Mines rescue-car No. 5 has gone to the Washoe smelter at Anaconda. From February 16 to April 17 it was at the Butte mines, in charge of J. L. Boardman. A large number of men received instruction in first-aid. The Anaconda company facilitated the work in many ways. The car remained at Anaconda until May 1. It then went to the coal mines of the state. A first-aid contest will probably be held in Butte before long.

At the Butte & Great Falls mine, northeast of Butte, the shaft is down 350 ft. It will be sunk another 150 ft. The country is granite.——It is probable that the Butte & London will be re-opened.——The Anaconda company is preparing to resume work at the Lexington mine in the Walkerville district. The shaft is 1450 ft. deep. About 400,000 tons of zinc ore has been blocked out.——Rich ore has been opened at 2800 ft. in the West Stewart mine of the Anaconda.——The annual report of the Butte & Superior states that 327,210 tons of ore was treated last year. The net profit was $1,417,128. Ore reserves are estimated at 1,030,000 tons, averaging 20% zinc and 7 oz. silver per ton. On the 1500-ft. level east of the Black Rock claim the Mammoth zinc lode was cut last week. It is 60 ft.

wide at that point. In the west 1300-ft. level a good deal of copper is contained in the zinc ore.

In 1914 the mine of the East Butte Copper Mining Co. only worked 229 days, being idle from August 8 to December 31. While in operation, the yield was greater than the rate in the previous year. Development in the Pittsmont totaled 4814 ft. The main shaft was sunk from 1585 to 1770 ft. Development in the upper levels opened a large tonnage of new ore. Other parts of the property showed good results. Improvements at the mine and smelter were completed and started. Operations were as follows:

	1914.	1913.
Ore treated, tons	110,992	186,815
Copper yield, pounds	9,175,579	14,401,108
Silver, ounces	242,347	506,897
Gold, ounces	2,219	8,803
Value of metals sold	$1,291,676	$2,471,551
Other income	163,779	174,017
Expenses	1,048,856	1,881,112
Surplus after paying other items	222,252	531,772

NEVADA

Churchill County

On May 21 the Nevada Wonder company will pay a dividend of 5c. per share. This amounts to $70,415. Total is $563,120.

Clark County

In the Los Angeles Chamber of Mines and Oil monthly organ, *Oil and Mining Bulletin*, J. Nelson Nevius contributes a paper entitled 'Reconnaissances of the Goodsprings Mining District.' It is accompanied by illustrations and a map; while all of the important properties are described, including the Boss mine, in which platinum-bearing ore was found in 1914. Mr. Nevius concludes his paper as follows: "This region gives every promise of becoming an important and steady producer of lead and zinc ores of high grade. Virgin outcrops can be seen in the 'ore lime' horizon throughout the district, and as practically none of the zinc mines has opened orebodies too small to be profitable intelligent development should open many new mines of importance. Several of the present properties would bear exhaustive examination with a view to developing them on a large scale. The pronounced financial success of the Yellow Pine indicates the possibilities of these mines when financed and capably managed, and the investment of new money in this mine was small. The discovery of rare metals in the Boss mine is new to mining, and only proves that there are lots of things which we do not know yet. It is an important discovery and a valuable property, but how big or how important, or how the ore will be treated, or how much it will cost, is not yet known by anyone. It has been proved that platinum is not confined to this mine alone, and other discoveries may be expected, especially after the geology of the Boss is better understood. There is no occasion for excitement, or the paying of fancy prices for the privilege of developing the other fellow's prospect; but the district offers an excellent opportunity for intelligent investment of mining capital after thorough examination of all conditions."

Esmeralda County

If certain arrangements are made, and it can double its business, the Goldfield Consolidated Water Co., will reduce its rates by 50%, according to C. G. Patrick, manager of the company.——Litigation is discussed editorially in this issue of the *Press*.——The rise from 1750 ft., and winze from 1400 ft. in the Atlanta have connected. Better ventilation has resulted. Ore extraction will be increased.——The Goldfield Consolidated Mines Co.'s final report for March contains the following: ore treated, 32,049 tons; net profit, $170,965; total cost, $5.43 per ton; development, 3526 ft.; cost per foot, $5.97; lessees production, 1215 tons valued at $40,678.

Officials of the Jumbo Extension and Merger companies failed to agree as to terms in the apex suit on April 28. They have left San Francisco for Nevada.

Nye County (Tonopah)

The Tonopah district produced 10,109 tons of ore valued at $207,922 in the week ended April 24.——Extension profits were $55,838 in March.——The Belmont shipped 118,242 oz. of silver last week.——The West End forwarded 16,978 ounces.

According to the general manager, J. L. Josephs, the property of the MacNamara Mining & Milling Co. was operated for eight months in 1914. The shut-down was due to lack of development, shortage of money, and the low price of silver. The mine and plant are in good condition. The general superintendent, J. W. Sherwin, reported that development down to 800 ft. amounted to 2018 ft. The mill treated 15,776 tons of ore averaging $11.08 per ton, with 93.3% recovery. Custom ore totaled 5232 tons, and the company's output of 10,544 tons assayed $7.04 per ton. The average price received for silver was 55.6c. per ounce. Costs for seven months amounted to $10.344 per ton.

Including assessments, $43,477, the revenue totaled $219,396. The cash balance was $1277 at the end of 1914.

OREGON

Baker County

The Powder River Dredging Co. is constructing a 9-cu. ft. boat near Sumpter. The one already at work is of 7-ft. capacity.——At Gold Center, J. B. Wetherell and partners have ordered a dredge from the Union Iron Works at San Francisco.

Josephine County

(Special Correspondence.)—The copper claims of the United Copper & Gold Mining Co. were sold last week to Charles O. Wheeler & Co. of Scranton, Pennsylvania, for $250,000, on terms. They are situated 33 miles from Grant's Pass.——Extensive development is to be started by the new owners. It is almost certain that the railroad from Grant's Pass to Crescent City, California, will be completed. Twohy Bros. have taken over the partly constructed line, and state that they will finish it. Engineers are now investigating the work done, and to be constructed.——The old Concord coach and horse-teams for freight have been taken off certain roads in the western part of the county. Automobiles and trucks are carrying everything.——Kerby, Waldo, Holland, and other western mining towns and districts are waking up, and more mining is being done in that area than for many years.

Grants Pass, April 15.

TEXAS

(Special Correspondence.)—According to William B. Phillips, director of the bureau of economic geology and technology at the University of Texas, drilling at 875 to 1700 ft. in Potter and Randall counties has disclosed a larger quantity of potash than has been found in any wells in the United States. The two wells are 35 miles apart, 23 miles northwest and 16 miles southwest from Amarillo, respectively.

Austin, April 10.

UTAH

Juab County

It is stated at Eureka that Utah smelters are negotiating for the silicious ore and tailing dumps at the Eureka Hill mine.

Salt Lake County

The report of Frederick Cowans, manager of the Utah Consolidated Mining Co., for 1914 shows the following: ore reserves are estimated at 256,321 tons of copper ore averaging 1.90% copper, 0.54 oz. gold, and 0.697 oz. silver; and 50,365 tons of lead ore averaging 16.48% lead, 0.48 oz. gold, 2.68 oz. silver, and 0.60% copper. There was mined 153,345 tons of copper ore and 48,482 tons of lead ore, which yielded 7,584,391 lb. copper, 14,588,276 lb. lead, 284,196 oz. silver, and 15,528 oz. gold. The profit was $565,666, against $636,470 in 1913. Div-

idends totaled $600,000, compared with $450,000. The year started with a surplus of $772,096, and ended with $632,175. Copper on hand is valued at $749,319.

According to Lee Glockner, who recently visited the south fork of Big Cottonwood cañon, where are the Kennebeck, Carbonate, Tar Baby, Rexall, Reed's Peak, Big Cottonwood Consolidated, Cardiff, and others, the last named has about 90,000 tons of silver-lead ore opened. This will average $25 per ton. When the roads are better, shipments will be resumed to the smelters.

SUMMIT COUNTY

Ore shipments from Park City during the first quarter of 915 totaled 26,375 tons. This is an increase of 7430 tons over the quantity in that period of 1914.——At the 2300 ft. the Daly-West company has started to drive to the Daly Judge mine. This will open new ground in the latter.——Further trouble has arisen with the Silver King Consolidated. W. D. Foster alleges that Solon Spiro, the president, planned to rob the company of $303,746.09. The plaintiff wants an accounting of this money.

WASHINGTON

FERRY COUNTY

(Special Correspondence.)—Back pay, amounting to 30% of what was owed them, has been paid to the men who were employed by the Western Union Mines Co.——At the Knob Hill 15 men are employed. The weekly output is 100 tons. Most of this comes from 300-ft. depth, north of a trachyte dike.

Republic, April 24.

After being held by a receiver for two years, the property of the North Washington Power & Reduction Co., of Republic, consisting of concentrating mill, power-plant, and other equipment, has passed into the hands of Spokane men. It will be re-started. The property has been purchased from W. W. Tolman, receiver, by F. R. Clark, a Spokane mining engineer, for $25,000. Adjoining holdings also have been secured by Mr. Clark, and the entire property organized under the name of the American Reduction Co., having authorized capital of $250,000. The incorporators of this new company are F. R. Clark, P. N. Clark, and G. W. Sommer.

STEVENS COUNTY

The northern part of this county, around Colville, promises to be more active this season than before. The Bonanza and Dominion mines are working, while the Clugston, Meyers Falls, and others are about to resume.——Increased interest is being taken in the Tuck district.

The Scotia mine, on the east side of Kettle river between Marcus and Orient, will be worked this spring. A 2500-ft. tramway is to be erected connecting the mine with the Great Northern line. The Scotia ore, with high copper content, will be handled by the Granby smelter.——An appropriation of $25,000 has been made for re-opening and timbering the Old Dominion mine on Dominion mountain near Colville. The mine contains a rich silver-lead orebody, and more than $1,000,000 has been extracted in the last 30 years, of which $650,000 has been spent in development. The mine has 17,000 ft. of workings. W. H. Linney, of Spokane, is president of the new organization to handle the project, the Dominion Silver-Lead Mining Co. The other officers, all Spokane men, are R. C. Lammers and A. E. Gallagher.

WYOMING

BIGHORN COUNTY

Near Byron, the Ohio Oil Co. has brought-in a well producing 25,000,000 cu. ft. of gas per day. There are five wells in the district yielding a total of 50,000,000 ft. Two of them belong to the Utah-Wyoming Consolidated Oil Co. This company has a well down 1350 ft., and oil is expected within 400 ft. The Montana & Wyoming Co. is sending oil to the refinery at Cowley. Five wells are being drilled in the district.

CANADA

BRITISH COLUMBIA

Owing to the depression in the metal-markets, the British Columbia Copper Co.'s revenue in 1914 decreased from $1,904,695 to $911,355. Operating expenses were $788,685. Payments for custom ore amounted to $162,435. Development has continued. Normal production will be attained soon.——On March 31 the Hedley Gold Mining Co. paid 5c. per share, equal to $60,000. The total to date is $1,583,520. The annual report of this company includes the following information: All ore treated was extracted from the Nickel Plate mine. Development generally was satisfactory. The Dickson incline shaft was sunk to 750 ft. Stations were cut, and equipment installed. The new water-power plant of 2100-hp. turbines, driving a 1250-kva. generator, was started on January 2, 1915. It cost $192,009, $7991 below the estimate. A motor-driven compressor was also installed. Mine buildings were rearranged. A new jaw-crusher and tube-mill were erected in the mill. Ore production was 78,494 tons averaging $10.80 per ton. Cyaniding and concentration recovered 94.09%, a total of $797,341. The profit was $388,289. Dividends amounted to $300,000. Surplus at the beginning of 1915 was $360,325. G. P. Jones is superintendent of the property.

Ore shipments from Rossland mines in the week ended April 7 were as follows: Centre Star, 3250; Le Roi, 3400; and Josie, 318 tons.

ONTARIO

Rich ore is still being mined at this mining centre. Narrow veins of 2000-oz. ore are not uncommon. In an open-cut of the Townsite City mine of the Mining Corporation of Can-

ada, the specimen shown in the accompanying photograph was found recently. It was only a few feet below the surface. The slab is approximately 10 in. thick and 48 in. square, assaying over 4000 oz. per ton. It weighs 2600 pounds.

Pumping out Kerr lake has been resumed.——Construction of the 100-ton mill at the Schumacher mine has been started. It will consist of a revolving grizzly, Buchanan crusher, Jeffrey belt-conveyor, ore-bin, belt-feeder, Hardinge ball-mill, Dorr classifier, tube-mill, Dorr agitators and thickeners, clarifier, and Merrill filter-press.——The report of La Rose Consolidated Mines Co. for 1914 shows that the output of 1,368,247 oz. silver was a decrease of 1,268,449 oz. The profit was $217,979. Dividends amounted to $749,313. The year started with a surplus of $1,602,005, and ended with $1,040,380. Ore reserves are estimated at 47,464 tons, containing 859,919 oz., a large decrease.——A new paper, *The Northern Miner*, has made its appearance in this province. It is a weekly, published by Ben Hughes at New Liskeard. It contains a résumé of the latest of interest to mining men.

YUKON

On April 9 the Canadian Klondyke company had 400 men preparing its dredges and other plant for the coming season. A new pumping station was being erected above the mouth of Hunker. The manager, Charles Boyle, expected to start three boats soon after. No. 2, which capsized in October, will not be ready for a time.

KOREA

Profit of the Oriental Consolidated in February was $81,488. This was made up as follows: Operating profit, $51,532, less improvements, $26,043, leaving net, $25,489, plus insurance collected on Maibong mill and power-plant, $56,000, making $81,488.

MEXICO

SAN LUIS POTOSI

Resumption of mining operations in San Luis Potosi depends on political and transportation conditions. Mining men are anxious to resume, and have been watching conditions closely, according to U. S. consul Wilbert L. Bonney, at San Luis Potosi, on March 29. The re-opening of mines depends also on the re-starting of operations by the smelters. Difficulties of the smelters are numerous and complicated. The coke supply must come through Tampico. Last fall when conditions for a time were somewhat promising, a moderate supply of coke was received by the smelters. It is still on hand. At the same time a limited amount of cyanide was imported. At that time, September 1914, the representative of a large smelter in the San Luis Potosi district informed his consulate that 20 tons of coke per day could be used if transportation could be furnished for getting it from Tampico. At the same time a leading importer informed the consulate that he would buy 50 tons of cyanide if it could be obtained. Shortly afterward communications with Tampico and with Saltillo were interrupted. Hope of resuming mining was abandoned for the time. The smelters are further embarrassed by the necessity of obtaining a variety of ores from distant regions in order to make a proper mixture for economical treatment. Cyaniding will be resumed earlier than lead smelting, probably soon after transportation becomes regular. A mining and milling company at Guanajuato has continued operations under difficulties. At Cedral, silver and quicksilver have been extracted from tailing. No product has been shipped for months. At Charcas a small amount of ore has been taken out. It cannot be shipped to smelters. Copper mines at Charcas and Matehuala belonging to an American company have been shut down. No date is set for opening. The sulphur mines of an American company near Cerritos have long been closed. An agent of the company who is now in San Luis Potosi gives little hope of early resumption. The mines at San Pedro are merely keeping their work in proper condition for re-starting when the situation becomes favorable. In general, mining men are awaiting the opening of the Tampico route, the return of settled political conditions, the determination of taxes, and better labor conditions. Before they can plan resumption they must be assured that they can export their product safely and profitably, and that they can secure supplies promptly. Mine-owners are most anxious to resume. They have kept in contact with their employees to hold their organizations together. None of those now in San Luis Potosi is willing to set any date for resuming.

The INSTITUTE OF METALS held its annual meeting in London on March 12 and 13. Papers covered copper-aluminum alloys, effect of rapid cooling on the constitution of binary alloys, copper-tin alloys, etching reagents, nickel-aluminum alloys, copper-nickel-aluminum alloys, appliances for metallographic research, micro-chemistry of corrosion, and the effect of heat and work on the mechanical properties of metals.

PERSONAL

ALBERT BURCH is a Goldfield.

H. C. BAYLISS has gone to Siberia.

W. H. ALDRIDGE is in Northern Mexico.

LEWIS A. WRIGHT, of New York, is here.

JAMES W. NEILL is here from Pasadena.

C. M. ROLKER is in New York from London.

W. J. CHALMERS is at the St. Francis Hotel.

GEORGE C. SCHROTER is here from New York.

T. A. RICKARD is visiting Goldfield and Tonopah.

RENSSELAER H. TOLL, of Denver, is at Angels Camp.

F. CHARLES MERRY is spending a holiday in New York.

SCOTT TURNER sails from New York for London on May 1.

C. H. MUNRO is returning from Colombia to New York.

W. J. LORING is at Sonora, in Tuolumne county, California.

J. A. BURGESS, superintendent of the Nevada Wonder mine, is at Berkeley.

FREDERICK B. IRVINE is now with the Morgan Engineering Co., at Dayton, Ohio.

M. S. BRANDT is engineer to the Seneca Consolidated Gold Mines in Plumas county.

C. L. BRUNS, engineer for the Cuba Copper Co., has been spending a holiday in New York.

R. VAN A. NORRIS has been elected president of the Columbia School of Mines Alumni Association.

GELASIO CAETANI has received a commission in the engineering department of the Italian Flying Corps.

R. T. HIRSH has returned to New York from the examination of placer deposits along the Rio Tocatina, in Brazil.

MASAO IKEDA, professor in the Royal Mining Academy of Akita, Japan, has been visiting our Western smelters.

WILLIAM F. JAHN, metallurgical engineer, from San Juancito, Honduras, is sojourning in San Francisco on his way to New York.

F. BURNETT, superintendent of one of the properties of the Oriental Consolidated Mining Co., is in the United States for a holiday.

Information is desired as to the whereabouts of THOMAS C. HOWELL. Please notify L. S. HOWELL, 1720 Pacific avenue, San Francisco, California.

FREDERIC R. WEEKES, for the past five years connected with the New York office of A. CHESTER BEATTY, will continue his engineering practice at 71 Broadway, New York.

Schools and Societies

The INTERNATIONAL ENGINEERING CONGRESS, to be held in San Francisco in September, announces that Vol. III of its transactions will comprise about 20 papers on the general subject of municipal engineering.

The COLORADO SCHOOL OF MINES senior-class tour this year started on April 26. Between that date and May 24 it will include Colorado Springs, Victor, Concrete, Florence, Canon City, Leadville, Breckenridge, Shoshone, Carbondale, Marble, Redstone, Castle Gate, Salt Lake City, Bingham, Magna, Tooele, Garfield, Park City, and Denver.

The STATE SCHOOL OF MINES at Salt Lake City announces that applications will be received up to May 15 for five research fellowships in metallurgy. Each has an annual value of $720. Applicants should send copies of their training to the director, Joseph F. Merrill. Although there has been quite a little bit of trouble between the University and some of the members of the faculty, the Department of Metallurgical Research is not affected as it is entirely under the direction of the Bureau of Mines in co-operation with the State School of Mines.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, April 29.

Antimony	.25	—25¾
Electrolytic copper	.19	—19¼
Pig lead	4.45—	5.45
Quicksilver (flask)		$70.00
Spelter	.15	—15¼
Tin	.45	—46½
Zinc-dust, 100-kg. zinc-lined cases		16

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, April 29.—Copper is strong and advancing; lead is dull, spelter is excited with a runaway market.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Apr. 22	17.63	Mch. 17	14.59
" 23	17.63	" 24	14.90
" 24	17.75	" 31	15.37
" 25 Sunday		Apr. 7	15.75
" 26	17.75	" 14	16.03
" 27	18.25	" 21	16.85
" 28	18.57	" 28	17.93

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	....
Feb	14.16	14.38	Aug.	12.34	....
Mch	14.11	14.80	Sept.	12.02	....
Apr.	14.19	....	Oct.	11.10	....
May	13.97	....	Nov.	11.75	....
June	13.60	....	Dec.	12.75	....

The present price of copper is due to the great exports used in munitions of war, nothing else. Best grades of Lake copper have been sold up to 21½c. The U. S. Geological Survey has issued a report on copper in 1914. The 'Press' of next week will have this in full. Stocks on January 1, 1915, were estimated at 173,640,501 pounds.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending	
Apr. 22	50.50	Mch. 17	51.18
" 23	50.62	" 24	50.33
" 24	50.62	" 31	50.14
" 25 Sunday		Apr. 7	50.04
" 26	50.75	" 14	50.06
" 27	50.50	" 21	50.18
" 28	50.62	" 28	50.60

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	....
Feb	57.53	48.45	Aug.	54.35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	....	Oct.	51.12	....
May	58.21	....	Nov.	49.12	....
June	56.43	....	Dec.	49.27	....

Silver is firm, with a tendency to steady advance. On April 24 about 900,000 oz left San Francisco for the Orient. Exports from England to Asia up to April 15 were approximately 5,000,000 oz. less than in this period of 1915. Stocks in London are about £1,600,000 (16,000,000 oz.). India has been a disappointing factor in the market lately. Full power supply is available at Cobalt. This will increase the output. The Nipissing continues to ship to New York. On February 28 the Tonopah Mining Co. had metal stored worth $609,162, say 1,200,000 oz. Samuel Montagu & Co., of London, publishes the following regarding imports of silver from the United States on the first quarter of 1915 and 1914, in ounces:

	1915.	1914.
January	8,056,225	6,679,661
February	7,936,593	4,694,175
March	5,266,737	5,311,613
Total	21,259,555	16,685,449

As the syndicate which took over the India Specie Bank was selling its stock of silver early in 1914, this probably deterred the United States from selling freely in that quarter. Mexican supplies, considerably reduced, are included in the above totals. Exports from Canada in the first quarters of the two years were 4,133,619 and 4,449,947 oz. respectively. In spite of the increased total imports the price has been on an ascending scale, even though a great shrinkage in trade demand has taken place as a consequence of the War. The fact suggests that the market as a whole stands on a sound footing.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date		Average week ending	
Apr. 22	4.23	Mch. 17	4.01
" 23	4.23	" 24	4.15
" 24	4.23	" 31	4.15
" 25 Sunday		Apr. 7	4.23
" 26	4.23	" 14	4.20
" 27	4.23	" 21	4.20
" 28	4.23	" 28	4.23

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.75	July	3.80	....
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	....	Oct.	3.60	....
May	3.90	....	Nov.	3.68	....
June	3.90	....	Dec.	3.80	....

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan	37.85	34.40	July	31 60	....
Feb.	39.76	37.23	Aug.	50.20	....
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	....	Oct.	30.10	....
May	33.29	....	Nov.	33.51	....
June	30.72	....	Dec.	33.60	....

Tin is steady at 40 to 42c. April movements are discussed on the next page of this issue. In London the price is £163 10s. per ton.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Mch. 31	80.00	Apr. 14	80.00
Apr. 7	80.00	" 21	80.00
		" 28	70.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60.00	Aug.	80.00	....
Mch.	39.00	78.00	Sept.	76.25	....
Apr	38.90	77.50	Oct.	53.00	....
May	39.00	....	Nov.	55.00	....
June	38.60	....	Dec.	53.10	....

According to a consular report from Trieste, dated February 27, in 1913 there were seven mercury mines in Austria. Only the Idria was worked. From 130,608 metric tons of ore 24,108 flasks were obtained.

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date		Average week ending	
Apr. 22	10.25	Mch. 17	7.92
" 23	10.75	" 24	8.59
" 24	10.75	" 31	8.50
" 25 Sunday		Apr. 7	8.75
" 26	11.00	" 14	9.12
" 27	11.50	" 21	9.37
" 28	12.00	" 28	11.04

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	5.22	9.05	Aug.	4.45	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	....	Oct.	4.75	....
May	4.91	....	Nov.	5.01	....
June	4.84	....	Dec.	5.40	....

It is reported that sales were made in London on April 28 at £67 per ton, equal to 16.75c. per lb. The excited market in the United States is solely due to exports for war purposes. Ore at Joplin advanced to $65 per ton, choice lots to $68. Stocks of ore have been reduced to 9000 from 13,000 tons.

New York Metal Review

The war demand for copper and spelter is growing. Both metals seem to be sharing this relatively equally. Most of the business does not involve export of raw metals, but of munitions of war in which they are used. Of the $83,000,000 order for shrapnel that was placed with the Canadian Car & Foundry Co. recently, many millions in sub-contracts will be divided among 40 concerns in the United States. Copper, spelter, lead, and antimony are all required in these death-dealing devices. The domestic demand for copper continues below normal. Lead, for some reason, has weakened in London, with a corresponding effect in this country. Spelter is strong and quotations are near 12c. again. Dealers in tin are nonplussed by England's strict control of the supply. English brands of antimony continue scarce and nominal.

Business in general shows many indications of improvement. One is the announced intention of the Pennsylvania Railroad Co. to spend $20,000,000 in rolling stock. The Lehigh Valley company will spend $1,000,000. Several railroads have issued lists of machine-tools and other shop equipment. Some of the lines have agreed to publish their requirements, rather than let them leak out through mill and selling representatives. Exports of finished and semi-finished steel are increasing in volume. Many machine-tool manufacturers cannot promise delivery on new orders before August. Pig-iron furnace stocks, taken as a whole, have decreased since the beginning of the year. The entire situation is one to inspire optimism. Exports in March from New York to all foreign countries amounted to $126,904,534, against $71,136,061 in March 1914, an increase of over $55,000,000. The imports at New York in March totaled $90,473,231, against $102,200,786 in March 1914, a decrease of $12,000,000.

COPPER

The war demand for copper in April was enormous. This might be expected, in view of the large contracts placed here for ammunition, shrapnel, lyddite shells, and other munitions of war. On every shrapnel case is shrunk a band of copper. A great deal of the metal will go into the drawn shells that contain the charge which throws the shrapnel shell from the gun. Exports for the month promised to be small, as up to April 23 they totaled 11,341 tons. As indicated, however, a large quantity of copper will soon be going abroad under some other name. Both Lake and electrolytic shared the demand. Their quotations moved upward steadily. On April 1 prime Lake was quoted at 17c., and April 6 17.25c. cash, New York. A heavy business was done. On the 13th Lake touched 17.75c. cash, New York. From that day on there were daily advances until, on the 20th the quotation was around 20.50c. for prime metal. Of course, the less favored brands were sold one or two cents lower. Choice brands easily commanded 21c. The month opened with electrolytic at 15.87½c. cash, New York; but on the 7th there were good sales on the basis of 16c., delivered in the Naugatuck valley, 30 days. On the 12th there were further large sales at 16.25c. cash, New York, and from that day on the entire program was one of advance. On April 20 the quotation was 17.37½c. cash, New York. There was some business April 22 at 17.62½c. cash, New York, but activity quieted down as a result of the rapid rise in prices. The trend of the market is illustrated by the advances in the base price of hot-rolled sheet-copper, as announced by the Ansonia Brass & Copper branch of the American Brass Co., as follows: April 8, base price, 21c.; 13th, 21¼c.; 14th, 21½c.; 17th, 22c.; 19th, 22½c.; and 22nd, 23c. Exports in March reached the total of 30,148 tons, compared with 15,583 tons in February and 26,193 tons in January. Exports in March 1914 were 46,504 tons.

LEAD

For about the first 10 days of April lead was strong under foreign influences. The situation caused the leading interest to advance its New York price on April 1 to 4.20c. At St. Louis, independents quoted 4.12½c. Large export inquiries were reported. It was generally accepted that a premium of at least $2 per ton was asked on export sales. On the 12th, however, London showed marked weakness, and on this side the market became heavy. Up to the 21st, the New York price was unchanged at 4.20c. St. Louis had weakened to 4.10c. The decline in London brought the quotation there down to £20 7s. 6d. on the 16th. The domestic demand has not revived to any noteworthy extent; in fact, it is disappointing. Consumers seem inclined to await events. This has brought about more pressure to sell from the middle of the month on. Exports, up to April 23, totaled 3613 tons.

SPELTER

There was another spurt in spelter prices in April. The metal from the first of the month had been steadily gathering strength, until about the 21st, the market showed excitement again, and spot prime Western was quoted at 11.87½ to 12c., New York. Choice brands were nominal at quotations up to 20c. It was commented that never before had spelter been quoted higher than copper. At all times exact quotations were difficult to obtain, but those of April 1 averaged about 9.50c., New York, and 9.25c., St. Louis. Domestic consumers were known to be short of the metal. Producers were in a sold-up condition. Would-be buyers were more in evidence than sellers. Future deliveries partook of the strength of spot. At St. Louis, May was quoted at 11c., and June at 10½c. on April 23. The month's exports up to April 23 totaled 3324 tons.

TIN

Dealers in tin were in a quandary in April. They are not yet out of their troubles. The extreme restrictions placed on shipments by Great Britain aroused the ire of many importers here. Not only has it been stipulated that the English shipper must be licensed, but also that dealers here must fill in a formal blank indicating the ultimate destination of the metal. From the consumer they must get another formal declaration stating that he will use the metal for his own manufacturing purposes, and not export the tin directly involved, or any other tin, except to Great Britain or her possessions. The first effect of this procedure would be to restrict business among dealers. It also would interfere with the supplying of retailers. The latter distribute about 20% of the tin which comes to the United States. It was further stipulated that tin arriving unsold or on consignment should go into the safekeeping of the banking firm of J. P. Morgan & Co., who are to collect ¼ of 1% of the value of the importations for their services, pending a delivery of the metal satisfactory to the British government. The entire situation is brought about by the fact that through neutral countries, Germany has been supplied with tin. About the middle of the month a committee of the New York Metal Exchange called on Sir Richard Crawford, special agent of the British government at Washington, and appealed for relief from the drastic regulations. Practically the only satisfaction they obtained was that some way would be found to place small quantities in the hands of retailers. It was pointed out that the operations of a large plant might be held up by the lack of a comparatively small amount of the metal. Sir Richard made it clear that Great Britain will not allow any accumulation of spot tin in this country. Through the month business was almost entirely confined to small lots of spot. Up to April 23, 1930 tons had arrived, but there were prospects of relief when arrivals from the Far East became available. Three vessels arrived April 20, but all put in at Boston, where they were delayed a few days. War prices were reached again. The quotation on April 9 was 58c. After that there came daily declines until 46.50c. was reached April 20 and 41.50c. on April 22. The downward trend was due to the easier feeling that followed the reporting of the vessels referred to. Deliveries for three months of 1915 were 8875 tons, or 2475 tons less than in the same period of 1914.

Current Prices for Oils and Candles

(Corrected monthly by Standard Oil Co., California.)

All prices are f.o.b. San Francisco except where otherwise specified, and are subject to change without notice.

Granite Mining Candles.	Per set. cents.	Granite Mining Candles.	Per set. cents.
6s-12 oz.-40s	8¾	6s-14 oz -20s	9½
6s-12 oz.-20s	9	6s-16 oz.-40s	10
6s-14 oz -40s	9¼	6s-16 oz.-20s	10¼

Extra hard 1c. per set higher than the above.

The following prices are for oils (Calol) in wood barrels; cases (2-5 gal.) 3c. per gallon higher.

	Per gal., cents.		Per gal., cents.
Compressor oil	40	Light gas engine oil	28
Amber gas engine oil	40	Red compressor oil	26
Castor machine oil	20	Red engine oil	17
Dynamo and motor oil	24	Turbine oil	30
Engine oil	24	Turbine oil, heavy	30
Gas engine oil	26	Diesel engine oil	40
Heavy gas engine oil	45	Cylinder oil	37
Heavy red engine oil	19	High-pressure cylinder oil.	50
Heavy red journal oil	21	Low-pressure cylinder oil.	37
Ice machine oil	28	Valve oil	44

The following prices are for oils in iron barrels, cases (2-5 gal.) 7c. per gallon higher, except on Eocene, which is 8c. per gallon higher.

	Per gal., cents.		Per gal., cents.
Pearl oil	9	Engine distillate	7
Headlight oil	10	Aroturps	18
Eocene oil	11	V. M. and P. Naphtha	10½
Red Crown gasoline	11½		

	Per bbl.
Calol fuel oil, f.o.b. Richmond Refinery	$0.85

	Per ton.
Petrolastic cement X	$13.00
Petrolastic cement XX	12.00
Asphaltum	$5.50 to 12.50

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted, except as noted, f.o.b. San Francisco. Buying prices marked *.

	Min.	Max.
Antimony ore, 45 to 55%, per ton	$45.00	$55.00
Arsenic, white, refined, per lb	0.04	0.05
Arsenic, red, refined, per lb	0.12	0.15
Asbestos, chrysotile	100.00	350.00
Asbestos, amphibole	5.00	7.50
Asphaltum, refined, per ton	11.50	20.00
Barium chloride, commercial, per ton	50.00	60.00
Barium sulphate (barytes), prepared, per ton	20.00	30.00
Bismuth ore, 15%, per ton	*250.00	upward
China clay, English, levigated, per ton	15.00	20.00
Chrome ore, according to quality, per ton	7.50	10.00
Cobalt metal, refined, f.o.b. London, per lb	1.90	....
Coke, foundry, per 2240 lb	12.00	15.00
Diamonds (according to size and quality):		
Borts, per carat	2.00	15.00
Carbons, per carat	55.00	80.00
Feldspar, per ton	5.00	25.00
Firebrick:		
Silica, per M	50.00	55.00
Snowball, per M	40.00	45.00
Flint pebbles for tube-mills, Danish, per 2240 lb	21.00	24.00
Fluorspar, per ton	10.00	15.00
Fuller's earth, according to quality, per ton	20.00	30.00
Gilsonite, per ton	35.00	40.00
Graphite:		
Amorphous, per lb	0.01	0.02½
Crystalline, per lb	0.04	0.13
Gypsum, per ton	5.00	7.50
Infusorial earth, per ton	10.00	15.00
Iridium	55.00	....
Magnesite, crude, per ton	5.00	7.50
Magnesite, dead calcined, per ton	20.00	25.00
Manganese ore, oxide, crude, per ton	10.00	15.00
Manganese, prepared, according to quality, per ton	50.00	75.00
Mica, according to size and quality, per lb	$0.05	$1.00
Molybdenite, 95% MoS_2, per ton	1000.00	1500.00
Monazite sand (5% thoria), per ton	150.00	200.00
Nickel metal, refined, per lb	0.45	0.60
Ochre, extra strength, levigated, per 100 lb	2.00	3.00
Osmiridium, per oz	30.00	40.00
Platinum, native, crude, per oz	30.00	45.00
Silex lining for tube-mills, per 2240 lb	35.00	45.00
Sulphur, crude, per ton	25.00	30.00
Talc, prepared, according to quality, per ton	20.00	50.00
Tin ore, 60%, per ton	425.00	450.00
Tungsten ore, 65%	400.00	425.00
Uranium ore, 10% min.	25.00 per unit	
Vanadium ore, 15% V_2O_5, per ton	150.00	180.00
Wolframite (see tungsten ore).		
Zinc ore, 50% up, per ton	*15.00	20.00

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Heimann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are f.o.b. San Francisco and subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66°, drums, per 100 lb.	$ 0.80	$ 1.10
Acid, sulphuric, com'l, 66°, carboy, per 100 lb.	1.25	2.00
Acid, sulphuric, C. P., 9-lb. bottle, bbl., per lb.	0.13	0.18
Acid, sulphuric, C. P., bulk, carboy, per lb.	0.09½	0.12
Acid, muriatic, com'l, carboy, per 100 lb.	1.60	3.00
Acid, muriatic, C. P., 6-lb. bottle, bbl., per lb.	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, per lb.	0.10½	0.15
Acid, nitric, com'l, carboy, per 100 lb.	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., per lb.	0.16	0.22
Acid, nitric, C. P., bulk, carboy, per lb*	0.12½	0.15
Argols, ground, bbl., per lb	0.10	0.20
Borax, cryst. and conc., bags, per 100 lb.	4.25	5.15
Borax, powdered, bbl., per 100 lb.	4.75	5.60
Borax glass, gd. 30 mesh, cases, tin lined, per 100 lb.	11.50	14.50
Bone ash, 60 to 80 mesh, bbl., per 100 lb.	0.50	6.50
Bromine, 1-lb. bottle, per lb.	0.55	0.65
Clay, domestic fire, sack, per 100 lb.	1.50	2.00
Cyanide, 98 to 100%, 100-lb. case, per lb.	No quotes	
Cyanide, 98 to 100%, 200-lb. case, per lb.	"	"
Cyanide, 129%, 100-lb. case, per lb.	"	"
Cyanide, 129%, 200-lb. case, per lb.	"	"
Lead acetate, brown broken, casks, per 100 lb.	9.00	10.50
Lead acetate, white broken, casks, per 100 lb.	10.50	10.75
Lead acetate, brown broken, casks, per 100 lb.	9.00	10.50
Lead acetate, white, crystals, per 100 lb.	12.50	13.25
Lead, C. P., test., gran., per 100 lb.	13.00	15.00
Lead, C. P., sheet, per 100 lb.	15.00	18.00
Litharge, C. P., silver free, per 100 lb.	11.50	13.50
Litharge, com'l, per 100 lb.	8.00	9.50
Manganese ox., blk., dom. in bags, per ton.	20.00	25.00
Manganese ox., blk., Caucasian, in casks, per ton (85% MnO_2—¾% Fe)	130.00	140.00
Nitre, double ref'd., small cryst., bbl., per 100 lb.	13.50	14.00
Nitre, double ref'd., granular, bbl., per 100 lb.	13.50	14.00
Nitre, double ref'd., powdered, bbl., per 100 lb.	13.50	14.00
Potassium bicarbonate, cryst., per 100 lb.	14.00	16.00
Potassium carbonate, calcined, per 100 lb.	25.00	35.00
Potassium permanganate, drum, per lb.	0.55	0.65
Silica, powdered, bags, per lb.	0.03	0.05
Soda, carbonate (ash), bbl., per 100 lb.	1.45	1.75
Soda, bicarbonate, bbl., per 100 lb.	2.00	2.50
Soda, caustic, ground, 98%, bbl., per 100 lb.	2.75	3.25
Soda, caustic, solid, 98%, drums, per 100 lb.	2.50	2.75
Zinc shavings, 850 fine, bbl., per 100 lb.	17.50	....
Zinc sheet, No. 9—18 by 84, drum, per 100 lb.	No quotes	

*Extra charge for packing nitric acid for shipment to conform to regulations.

Roessler & Hasslacher quoted as follows April 13:

Ammonia, anhydrous, in 50-lb. cylinders, per lb	$0.27
Arsenic, white powdered, in 500-lb. bbl., per lb	0.05
Cobalt oxide, black, in 10-lb. tins, per lb	1.05
Cyanide, potassium, 38.4% cyanogen, per lb	0.27
Cyanide, mixtures, potassium cyanide equivalent 39.5% cyanogen, per lb	0.20
Sodium, metallic, in 1-lb. tins, per lb	0.40
Zinc dust, in bbl. 1600 lb	0.12

Since the last report general conditions in chemicals have not changed. Certain stocks are low, and prices of a number of chemicals have increased.

MINING DECISIONS

Oil Lease—Forfeiture Denied

Equity will refuse to enforce a forfeiture, at the suit of a lessor, based on locations of oil-wells by the lessee at points different from those prescribed in the lease, where, with knowledge thereof, the lessor has accepted his share of the production therefrom and the lessee has spent considerable sums in a *bona fide* attempt to develop the property.

Horse Creek Coal Land Co. *v.* Trees (West Virginia), 84 Southeastern, 376. February 2, 1915.

Notice of Patent Application—Posting

Section 2325, Revised Statutes, contemplates that notice of an application for patent for a mining claim shall be posted within the exterior limits of the area applied for; and the posting of such a notice outside of a claim and 800 ft. distant therefrom, is not such a substantial compliance with the requirements of the law as will warrant submission of the entry to the Board of Equitable Adjudication.

Equity Mining and Investment Co. (Land Department), 43 Land Decisions, 396. September 19, 1914.

Oil Lease—Condition Construed

Where a six months' lease of land for sinking oil-wells was conditioned that a well must be sunk which would produce a given quantity per day and for a given time, before it was to be considered a paying well so as to give the lessee a permanent lease, the lessor had the right to cancel the lease on a failure of any of the driven wells to produce the contract quantity in the time limited, though they did produce a paying quantity.

McLean *v.* Kishi (Texas), 173 Southwestern, 502. January 8, 1915.

Coal Lease—Held Merely an Option

A coal-mining agreement to lease seven parcels of land, with different time limits, conditioned on payment of royalty for coal mined, providing that it was not compulsory on the lessee to exercise any rights on the lease, that the lessee was to incur no damages for non-performance, that if he elected to work under the lease he should mine the coal under certain land first, was held to be an option requiring notice of election in order to be binding on the lessee.

Ray Coal Mining Co. *v.* Ross (Iowa), 151 Northwestern, 63. February 20, 1915.

Mining Corporations—Income Tax

A mining corporation which had leased all of its ground for mining purposes long prior to 1909, when the Federal income tax law took effect, and after that date only continued to receive royalties from such leases and to distribute the same among its shareholders, is not receiving an income subject to the Federal tax, but merely that which was in effect the purchase price of lands sold long prior to the date on which the tax act became effective. In other words, the return of a part of its capital investment, it appearing that the lands were of no value except for the ores in them. The word 'income' in the Act is not synonymous with the word 'receipts', and does not include receipts from the conversion without gain or profit of any part of the property of the corporation into money, or other form.

Von Baumbach *v.* Sargent Land Co. (Minnesota), 219 Federal, 31. December 9, 1914.

RECENT PUBLICATIONS

Biennial Report of the State Geologist of North Carolina. Joseph Hyde Pratt. 1913-1914. P. 176. Illustrated. Raleigh, 1915.

Anales de Ingeniería. Organo de la Sociedad Colombiana de Ingenieros. Numeros 263 y 264, 1915. P. 64. Bogota, Colombia, 1915.

Mineral Resources of the Philippine Islands in 1913. Issued by the Division of Mines, Bureau of Science. P. 71. Map. Illustrated. Manila, 1914.

Tertiary Echinoids from the San Pablo Group of Middle California. By William S. W. Kew. P. 12. Illustrated. University of California, Berkeley, 1915.

Report on the Non-Metallic Minerals Used in the Canadian Manufacturing Industries. By Howell Frechette. P. 199. Charts, index. Department of Mines, Ottawa, Canada, 1914.

Recent Progress in Colorado Paleontology and Stratigraphy. By Junius Henderson. P. 22. Paper read at meeting of the Colorado Scientific Society, October 3, 1914. Denver, November 1914.

Revision of the Tertiary Mollusca of New Zealand. Based on type material. Part I. *Paleontological Bulletin* No. 2. By Henry Suter. P. 64, and 16 plates. New Zealand Geological Survey. Wellington, 1914.

Höganas Iron Sponge. Its use in the manufacture of steel and iron. P. 11. Illustrated. Höganäs-Billesholms Aktiebolag. Höganäs, Sweden. This is a comparatively new product, and is exhibited in the Sweden building at the Exposition.

Some Deep Borings in Illinois. By J. A. Udden. *Bulletin* No. 24. P. 141. Plans, index. State Geological Survey of Illinois, Urbana, 1914. The well records show interesting strata passed through, and the drilling has been of great value in geological investigations.

Peat, Lignite, and Coal. Their value as fuels for the production of gas and power in the by-product recovery producer. By B. F. Haanel. P. 261. Ill., plans, maps, index. Department of Mines, Ottawa, Canada, 1914. One of the problems in Canada is the rendering available of the various supplies of low-grade fuels, and this study describes what is being done in Germany, and what is suitable for Canada.

British Columbia Bureau of Mines bulletins, Victoria, 1915:

Mineral Resources of the Atlin Mining Division. By W. M. Brewer. No. 2. P. 24. Illustrated.

Mineral Resources of the Skeena Mining Division. Also portions of the Onimeca and Queen Charlotte divisions. By W. M. Brewer. No. 3. P. 56. Illustrated. Recent issues of the *Press* have contained notes on these districts.

Water Supply, Sewerage, and Drainage in Western Australia. Second annual report, 1913-14, of the Government department controlling these public utilities. P. 104, with numerous illustrations, maps, and plans. Perth, 1914. The Government in this state operates the principal water supplies of the towns, including that of Perth, and the great goldfields system with a main 353 miles in length. The engineers' reports are of great interest, and abstracts will be made for other issues of the *Press*.

New Machines and Devices

Information based on letters and catalogues from manufacturers.

Engineering Specialties at the Panama-California Exposition

As will be seen from the accompanying picture, the Lunkenheimer Co., of Cincinnati, Ohio, has a neat and attractive exhibit at the Exposition being held at San Diego, California. 'Quality' is the watchword of this concern, this being apparent after an inspection of its products.

In great variety are displayed bronze, iron, 'puddled' semi-steel and cast-steel globe, angle, cross, check, gate, non-return boiler stop and throttle valves; also bronze and iron pop-safety, relief, and blow-off valves; water columns and gauges; whistles; ground keywork; injectors and ejectors; bronze fittings and unions; cylinder lubricators, oiling devices, oil and grease cups; automobile and motor-boat specialties, and other specialties.

LUNKENHEIMER SPECIALTIES AT THE EXPOSITION AT SAN DIEGO.

Commercial Paragraphs

A price list of oil and gas well 'lines' or steel ropes has been published by the HAZARD MANUFACTURING Co., of Wilkes-Barre, Pennsylvania.

The BURD HIGH COMPRESSOR RING Co., of Rochester, Illinois, announces that it has moved its general and executive offices to 307-309 South Main street.

L. F. HAMILTON, in charge of the advertising and specialty department of the NATIONAL TUBE Co., has returned from an extended business trip to the Pacific coast in connection with the company's exhibit at the Panama-Pacific Exposition. The display is part of the United States Steel Corporation's exhibit. This is in the Palace of Mines and Metallurgy. It occupies 44,000 sq. ft., the largest single exhibit at the Exposition.

A new electrically-driven combination swing and rip-saw has recently been perfected and will be manufactured by the RENO-KAETKER ELECTRIC Co., of Cincinnati, Ohio. Both units are independent of one another, it being possible to use them either in combination or at different parts of any work. Both of these outfits are especially suited for mines, for cutting timbers and lumber used extensively in mine-shaft construction.

The Interstate-Callahan Mining Co. has let a contract to the AMERICAN STEEL AND WIRE Co. for the construction of a 10,500 ft. aerial tramway from its mill to Sunset station, Idaho, on the Nine-Mile branch of the Northern Pacific Railway, in the Coeur d'Alene. Work will begin about April 20, and it is expected that the line will be ready to operate not later than May 15. An engineer for the construction company will be in charge, and between 75 and 85 men will be employed. The Interstate-Callahan tram will be the longest in the Coeur d'Alene, and the second longest in the West, the only longer one being a 13-mile system at Saline, California.

The HOLT MANUFACTURING Co., of Stockton, California, states that some of its Caterpillar tractors are being used in the following work: saving $100 per ton in hauling dredge machinery, 65 miles out of Nome, Alaska, the cost being only $20 per ton; hauling ore at Lordsburg, New Mexico; hauling rock for the California state highway, and hauling wool over rough roads near Golconda, Nevada.

The SULLIVAN MACHINERY Co. of Chicago has sent us two new bulletins, No. 65-C and 71-A. The former deals with their diamond core-drills, giving estimates, equipment required, and prices. The cost of these installations varies from $555 for the 'M' hand-power rig to $12,869 for the 'PK' steam or air-drive for deep prospecting. This standard machine is well and favorably known. Air-lift pumping is the subject of the other bulletin, and among the advantages of this system the following are claimed: quantity and quality of water increased, temperature reduced, durability and simplicity, and sustained efficiency.

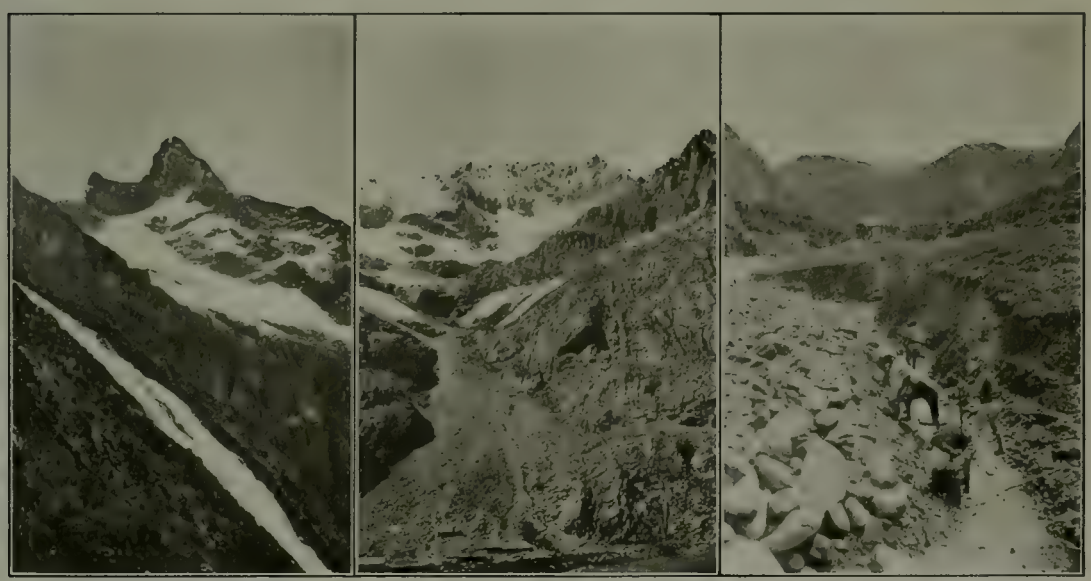
The POWER & MINING MACHINERY Co., 115 Broadway, New York, reports that it has built a 60 by 84-in. receiving opening jaw-crusher for the Bethlehem Chile Iron Mines Co. It is sectionalized to a 30,000-lb. limit to facilitate handling at its destination. The total weight is 525,500 lb. The service in this instance is particularly severe, as the compressive strength of Tofo iron ore is nearly 44,000 lb. per sq. in., compared with hard trap-rock of the United States estimated at between 35,000 and 40,000 lb. Following this crusher and taking the 10-in. product from same, there will be installed three No. 9 McCully all-steel gyratory-breakers. A 66 by 84-in. machine was recently completed. Five years ago the Birdsboro Stone Co., Birdsboro, Pennsylvania, installed one of these crushers. About 2,000,000 tons of trap rock has been reduced. The only expense for repairs was the renewal of the lower row of crushing plates.

Mining and Scientific Press

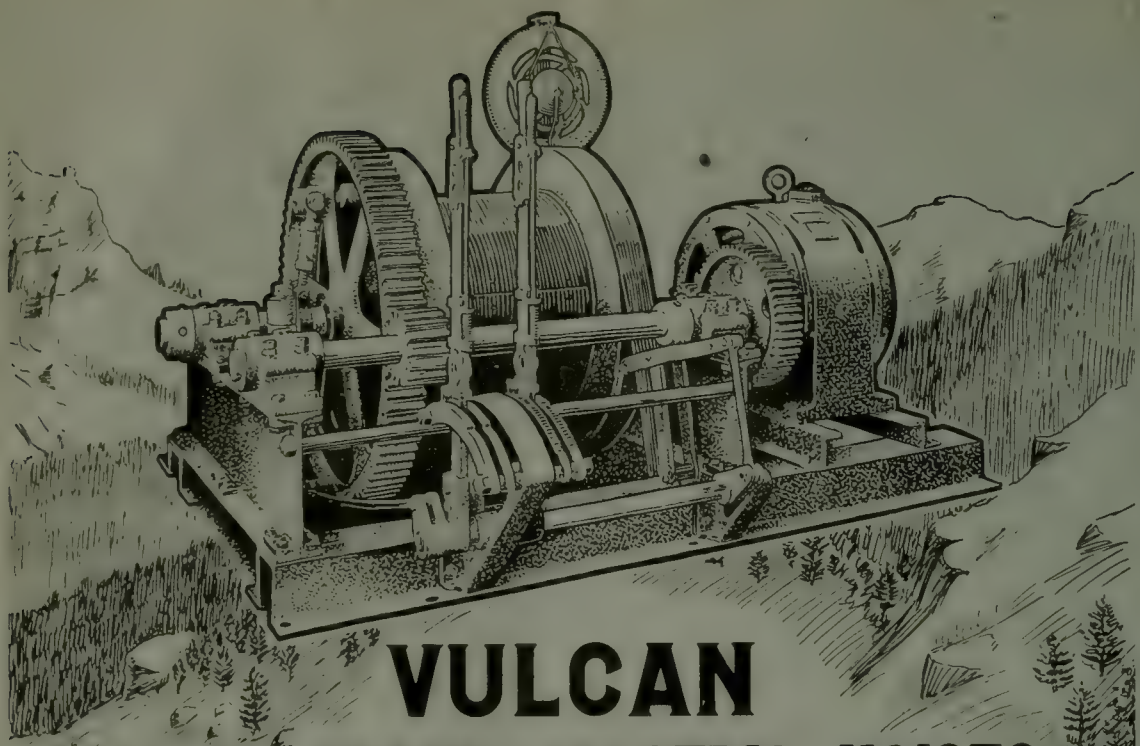
Edited by T. A. RICKARD

Volume 110 SAN FRANCISCO, MAY 8, 1915 Number 19

TIN is much in demand. The price has risen from 31 cents per pound in July to 57 cents per pound in April. The United States consumes 50,000 tons per annum and produces only 50 tons, chiefly from Alaska. Even the Bolivian ore goes to Europe to be smelted, the



tin being returned to this side for the manufacture of tin-plate, bronze, and tin-foil. A good tin mine would be a sweet business today. The prospector should keep his weather eye open for that useful metal. Meanwhile we publish a description of Quimsa Cruz, one of the Bolivian districts, to indicate the conditions favorable to tin deposits.



VULCAN
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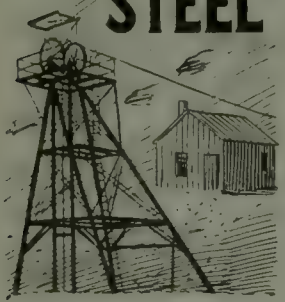

The frame is stronger and stiffer, the weight is one-third less, easily knocked down, convenient to assemble. Just the thing for mule-back transportation. It can be taken underground to any level and assembled easily. Freight charges are less.

STEEL FRAME HOIST CATALOG ON REQUEST

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Buyers Directory—Page 28
Advertisers Index—Last Page

TABLE OF CONTENTS

EDITORIAL. Page.

NOTES 711

COST AND EFFICIENCY 711
A review of the factors of true cost.

ADMINISTRATIVE CONTINUITY 712
An excellent policy in mining.

JAPAN AND CHINA 713
Observations on the Far Eastern situation.

PETROLEUM CONSERVATION IN CALIFORNIA 714
Wise legislation is about to be enacted.

DISCUSSION

PLUMBING A SHAFT.
By James A. Walker and R. T. Crawford 715
A correspondent inquires as to the effect of the moon's pull on a plummet, and the assistant astronomer at the University of California gives the facts of the case.

RESEARCH FOR ENGINEERS.
By E. Gybbon Spilsbury 715
The Library of the United Engineering Societies has arranged to investigate any desired subject at a small cost.

RISE OR RAISE?
By L. S. Ropes and A. L. Horner 715
More discussion as to the right use of words.

THE CRACKING OF OILS.
By E. I. Dyer 717
The chief engineer of the Union Oil Co. explains the limitations of the process.

ARTICLES

COST AND EFFICIENCY.
By Heath Steele 718
Mere figures as to cost are not sufficient for comparative study, since the unit cost may differ and a property which uses fewer units may show a greater total because the unit cost is higher. Suggestions are made as to the collecting of data that will make exact comparison possible.

QUIMSA CRUZ TIN DISTRICT, BOLIVIA.
By Francis Church Lincoln 721
The tin deposits of Bolivia extend for 400 miles along the main range of the Andes. In a recent issue the Milluni district was described, the Quimsa Cruz district adjoins that on the south. The deposits are described and details of working cost are given.

QUANTITATIVE BLOWPIPE ANALYSIS IN THE FIELD.
By George Delius 725
The transporting of samples of gold and silver ores for long distances to have them assayed can be avoided if the prospector is sufficiently skilled in the use of the blowpipe. A surprising degree of accuracy can be attained, and the advantage of securing quick returns is evident. A skilled operator describes the equipment and the methods to be followed.

LABOR-SAVING DEVICES.
By S. A. Worcester 727
Minor automatic devices can be made to save the labor of one or more men about a mill. Regulators for mill pressure, air-lifts, and zinc-dust feed, a pump-control, indicators for storage bins and pump discharge, and a tell-tale for belt-conveyors are all described.

METAL PRODUCTION IN JAPAN IN 1914 729
Gold production for the past year was $4,476,500; silver, 4,647,767 oz.; copper, 139,676,531 lb.; coal, 21,695,071 tons; sulphur, 150,548,300 lb.; and petroleum, 2,936,240 barrels.

NEW SYSTEM OF MINING COAL AT DAWSON, NEW MEXICO ... 730
Hereafter entries will be driven to the boundaries before turning rooms, recovering all the coal in one operation and securing the advantages of long-wall working. To prevent dust, tight cars are to be used, and moisture radiators are installed at the entrances.

MINING COSTS AT GOLDFIELD CONSOLIDATED 730
Details of all the items making up the total mining and milling cost are given.

CYANIDE PLANT OF THE CHIKSAN MINES, KOREA.
By Charles W. De Witt 731
The ore is crushed to 30-mesh by stamps, run over amalgamating-plates, and concentrated on Standard tables. The table tailing is leached in vats that are filled and emptied by coolies. The solution is precipitated on zinc shaving. During the past year the recovery was 80c. per ton of tailing, at an operating cost of 33½c. per ton.

NEVADA MINERALS AT THE EXPOSITION 735
The exhibit of Nevada minerals is well arranged and instructive.

MINERALS OF NEW ZEALAND AT THE EXPOSITION 735
Agriculture is more important than mining in New Zealand; nevertheless a good mineral display has been made.

DEPARTMENTS

CONCENTRATES 733

REVIEW OF MINING 736
Special correspondence from Toronto, Ontario; Joplin, Missouri; Cripple Creek, Colorado; Salt Lake City, Utah; Goldfield, Nevada.

THE MINING SUMMARY 739

PERSONAL 743

SCHOOLS AND SOCIETIES 743

THE MARKET PLACE:
Lead Production in 1914 743
Copper Production in 1914 744
Copper Selling Prices in 1914 744
Eastern Metal Market 745
Metal Prices 746

NEW MACHINES AND DEVICES:
A New Cupel 747
Power Transmission at the Exposition 747
Metal Hose at the Exposition 747
Manufacture of Spiral-Riveted Pipe 747
Commercial Paragraphs 748

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For Texas, Oklahoma and Arizona business refer to Southwest General Electric Co., (formerly Hobson Electric Co.) — Dallas, El Paso, Houston and Oklahoma City. For Canadian business refer to Canadian General Electric Company, Ltd., Toronto, Ont.

Motor Agencies in all Large Cities and Towns.

5475

EDITORIAL

T. A. RICKARD - - - - Editor THOMAS T. READ - Associate Editor

COPPER MINING in the Southwest is now within 10% of its pre-War activity.

UNEMPLOYMENT in the mining centres is disappearing like the winter snow.

EXTRA taxation of the mining companies of the Rand is a logical consequence of the War, especially the operations of the Union Government in German Southwest Africa.

ANGLO-AMERICAN enterprise in Siberia is making good progress, despite the War. Labor supplies are improving, so that exploratory work is increasing. The embargo on vodka has improved efficiency remarkably.

ACCORDING to *The Mining Magazine*, the terms on which the Broken Hill Proprietary and the Sulphide Corporation have sold zinc concentrate to the American smelters are not so encouraging as to presage a large business in that product.

GUANAJUATO has been made to feel the heavy hand of revolution. During the last three or four weeks it has become the arena of conflict between the Carranza and Villa insurgents. The railway service has been so disrupted as to compel cessation of mining operations.

AMONG those rescued from the *Falaba*, which was sunk by a German submarine on March 29, were four engineers, namely, Messrs. Allan A. Davidson, A. Goldwater, H. I. Johnson, and F. P. Barker. Among those lost was Leon C. Thrasher, as we recorded in our issue of April 3.

MEXICAN PETROLEUM shares have had a big rise in consequence of the contract between that company and the British Government. This seems to involve a sanguine disregard of sundry unpleasant possibilities. If and when a stable government is restored in Mexico it will become necessary to raise revenue for the rehabilitation of the country; and when that happens, it is to the prosperous oil industry that the tax-gatherer will turn. An export-duty on oil is a possible eventuality. As a counter for a gamble, Mexican Petroleum has obvious attractions, but as an investment it appears unduly risky at the present time.

FRANCISCO VILLA, otherwise Pancho Villa, alias Doroteo Arango, alias Doroteo Castañeda, is being pushed to the wall by the Constitutionalist or Carranza faction in Mexico. His defeat at Irapuato, the repulse of his associate General Filipe Angeles at Celaya, followed by the retreat of General Maytorena, Villa's governor of Sonora, from Navajoa, indicate that the so-called Convention party is losing its hold on the northern region.

COPPER continues to rise. It may go to 25 cents. The war orders placed in this country during the last 10 days are enormous. Contracts running into millions of dollars have been placed with the Canadian Car & Foundry Company, the American Locomotive Company, the Crucible Steel Company of America, the Westinghouse Air-Brake Company, the New York Air-Brake Company, and other gigantic orders are pending. Besides there are thirty or forty concerns working on sub-contracts. All this will mean an increased and sustained demand for copper and spelter. The makers of the machines required to turn out shrapnel, lyddite shells, and projectiles are sold up to next August and September.

Cost and Efficiency

In this issue we publish a thoughtful article by Mr. Heath Steele on the factors determining the cost of mining operations. An analysis of this kind is a great help toward forming a clear idea of the realities underlying the making of money by the extraction of metal from the ground. Even in an industrial centre like Johannesburg, and despite the co-operative activity of a community of engineers, it required several years of misdirected effort to bring home the truth that economic success is measured not in the cost per ton but the profit per ton. It remains yet for many engineers and operators to appreciate the fact that ultimate profit may be

sacrificed to the profit per ton. The purpose of mining is to make a maximum ultimate profit in the form of dividends or liquid assets. In order to further the technical value of cost records, it is imperative, as Mr. Steele indicates, to use an intelligible basis of comparison. The cost of living, for example, at any time or place, is based upon the price of the primary staples, these being accepted as an index to all the secondary expenses of mankind. To compare the cost of living in terms of house-rent, for example, would be misleading, for rentals are not levied on any common basis in various countries or even localities. Similarly, the cost of clothes would furnish no reliable criterion, nor even the average wages. The unit of measure must be one applicable under varying conditions. So in mining, the dollar does not suffice for purposes of comparison; we must have the cost expressed in something nearer the base of the industrial problem, namely, the energy and material consumed in the operations. Mr. Steele gives a list of items required to make an intimate comparison between mines. Not all of these details may be available, but without some of them it is impossible to make any intelligent comparison. Thus it is not the average wage, but the average tonnage of ore broken per day per man that gives the relative efficiency of the labor employed. It is not the cost of development per foot, but the cost of development per ton of ore developed that indicates the expenditure required to maintain the vitality of a given mine.

As regards the making of intelligible statements of cost, it may be taken that the first requisite is the desire to give information. If there is one way of stating facts clearly, there are a hundred ways of obscuring them in figures and in words. The reports of mining companies afford constant illustration of the adage that "Speech was given to man to conceal his thoughts." The same is true of figures, for did not Disraeli say that there were three kinds of lies: "Lies, damned lies, and statistics." The copper statistics issued on both sides of the Atlantic during the contraband controversy last November may be instanced. One could prove anything from them according as the periods and the countries involved were selected or combined. Some mining companies issue no detailed report, others give a cloud of figures from which no real information can be precipitated. The cost, especially among British companies, is often a nebulous figure representing an intermediate stage of book-keeping. This brings us to the assertion, once more, that the real cost of mining is the value of the product less the money distributable to the owners of a mine. Dividends may not be the whole measure of the profit, for part of the surplus may be re-invested, but in the end it is only the money that is placed to the shareholder's credit at his own bank that is profit to him; the rest may be deferred or anticipated, but it is not truly his until he places his own hands upon it. That is why the term 'operating' or 'working' cost must be used carefully. It should mean the total cost at the mine, the whole expenditure coming under the immediate cognizance of the resident manager, but it should never be allowed to masquerade as a final accounting. Taxes, general expenses, directors' fees, insurance, and the like are as much a part of the expense of mining as is the cost of dynamite and drills. In most American mining enterprises the 'working cost' is within 5% of the total cost, but in some Rhodesian mines, for example, it is 30% short of the reality. Obviously, the 'working cost' should be used, like the daily assay-sheet, as a guide for the management and not as a figure to express the final economics. Figures of cost, whether the total or in detail, should serve as a spur to efficiency, which is the right application of power, mental and mechanical, for the achievement of the purpose in hand. In mining, the purpose is to make a maximum ultimate profit by extracting metal from underground.

Administrative Continuity

Fortunately or unfortunately, depending upon the point of view, most men outlive most mines. A manager may hope, or may regret to expect, to direct the operation of several mines successively in the course of his career. Again, good managers are at least as scarce as good mines. Manifestly, it is economic not only to select an efficient manager, but to keep him continuously employed. What is true of him as an individual is even more true of the management or administration as a whole, for a number of technical men working as a unit under their chief constitute an asset not to be liquidated in a hurry. Such are the ideas suggested by the policy to be inferred from the corporate acts of several of the best known mining companies in Nevada. The Goldfield Consolidated recognizing, we presume, the proximate exhaustion of its group of mines at Goldfield, has acquired the control of the Aurora Consolidated and is about to begin the systematic exploitation of that old property. The Tonopah Mining Company has recently acquired the Reliance and other dredging properties at Breckenridge, Colorado, besides exercising its option on the Eden mine, in Nicaragua. The Tonopah Belmont Development Company has just announced the acquisition of an option on the Potosi mine, in Nicaragua, near the Eden mine of the Tonopah Mining Company. In addition, the Tonopah Belmont has under option a mine at Surf Inlet, in British Columbia, and the Oro Belle mine at Hart, in California. The Montana-Tonopah Mining Company is largely identified with the control of the old Commonwealth mine in Cochise county, Arizona, and the Black Oak in Tuolumne county, California. These examples suffice to indicate a trend of policy. The operators or capitalists controlling these companies see the wisdom of retaining the services of a competent and experienced staff; they recognize the fact that the original property, for the working of which their company was formed, is destined to be exhausted, sooner or later; so they preserve the asset that wastes less slowly, namely, the technical skill of a well-organized administration. Most of them have scouts on the

look out for likely new mines, to supplement the properties already under option and in process of being tested. We commend this policy. It is wise. It conserves a valuable asset: the *esprit de corps* of a staff. It renews the vitality of a corporate enterprise. It prolongs the fruitfulness of capital. It prevents that worst of all waste, the waste of experience.

Japan and China

Out of the deplorable War now raging has arisen much confusion of ideas as well as disruption of international commerce. Official statements, papers white, blue, and gray, have been published, setting forth the conditions leading up to the War, and writers of every nationality, degree of prejudice, absence of balance, and lack of insight have given us the benefit of their opinions as to its causes and effects. Amid this babel of conflicting tongues the United States as a nation has remained officially neutral, while our people have also remained as neutral as men with red blood in their veins can be when they see their fellows revert to the habits of the jungle. In this country there are millions of estimable citizens of German descent, or affiliation, many of whom have felt aggrieved that there appears to exist here so little sympathy with the German cause. It is not, however, a matter of sympathy; it is a matter of unimpassioned belief as to which side is in the right. Stripped of all its confusing adjuncts the central fact of the German cause is a biological philosophy of life, a philosophy that projects the theory of a struggle for existence and the survival of the fittest into all human relations. This includes the idea that the strong and efficient will necessarily overcome or displace the weak and inefficient; therefore weakness and inefficiency should be swept away. Against this is set the ethical philosophy of life, which maintains that while man is indeed a biologic organism he differs from all other forms of animal life in being also a psychic organism, and that the latter is the higher factor. Animals know neither right nor wrong, they act in response to the stimuli of their environment. The fox catches and eats the rabbit in response to the stimulus of hunger; the powerful landowner is restrained from appropriating the poor man's fertile garden by ethical considerations that, in the abstract, at least, the whole world approves. Civilization recognizes the right of the weak to exist. Human slavery was based on the biologic view of life, which accords to the strong man dominion over the weak; the struggle for freedom that has characterized human history for the past thousand years is based upon the assertion that such a view of life is fundamentally false. Linked with this is our refusal to accept the biologic criterion of what constitutes weakness and inefficiency. From the gladiatorial viewpoint the life of a Christ who lived without home or property, who taught consideration of others, and who died on a cross, was a pitiful failure, but the majority of men acclaim it as a splendid triumph. It is for this reason that the American public as a whole, without depreciating the German contribution to science or the German gift to art, or the splendid record of German efficiency in the organization of business, is convinced that the German philosophy of human relations cannot be accepted. When the War ends, as we hope it may soon, there will be one great compensation for its destruction of life and property if it shall have established that the modern world will not accept the biologic concept of human relations.

Preoccupation with what is happening in Europe has been so great that our public is largely unaware that a nation adhering to the biologic philosophy of life is becoming the dominant factor in Asia also. The marvellous increase in the power, wealth, and influence of the German nation, which in little more than a century has arisen out of a group of warring kingdoms, is surpassed by the astonishing rapidity with which Japan has emerged from a collection of petty feudal dukedoms into a modern nation of wonderful efficiency, energy, and power. The method pursued in both cases is the same. Centralization of government in an autocratic emperor, representative institutions without democracy, the subordination of the citizen to the State, and the directing of national life along lines planned by the Government have combined to produce the astonishing result. Japan, even more than Germany, adheres to the gladiatorial theory. With a small area of country, limited resources, and a growing population it sees the assurance of its future only in the extension of dominion over weaker and less efficient peoples. Formosa, Korea, and southern Manchuria have been absorbed; now the little brown hand reaches out to the whole of China. In all that has happened in the past six months a definite purpose and plan is evident, as a brief review of events will show. On August 15 the Japanese government sent to Germany a demand for the delivery to her "without condition or compensation, of the entire leased territory of Kiaochou, with a view to the eventual restoration of the same to China." Some doubt having been felt in America as to the exact meaning of this phrase, Count Okuma sent for publication in this country the following statement: "As Premier of Japan, I have stated and now again state to the people of America and of the world that Japan has no ulterior motive, no desire to secure more territory, no thought of depriving China or other peoples of anything they now possess." Meanwhile Kiaochou had been blockaded and preparations were in progress for a land attack. A start was made to place troops within the leased territory, but the plan was suddenly revised, and the forces were sent to Lung-kou, a small port on the inner side of the peninsula of Shantung, involving the marching of Japanese forces through 150 miles of Chinese territory. China at first protested, then 'saved her face' by declaring this territory a warzone in which belligerent operations might proceed. As a gross violation of neutrality the action of Japan was on all fours with the invasion of Belgium, the only difference is that in the latter case a brave and warlike people stubbornly resisted the violation of their rights, confident in the hope of aid from other nations that do

not subscribe to the biologic theory. China saw no hope of aid, and weakly yielded, in the hope of saving something from the wreck. In due time Tsingtao, the city of the territory of Kiaochou, fell. The Japanese seized not only the area, but the custom-house, which was Chinese, not German, and the railway from Tsingtao to Tsinan-fu, which was the property of a corporation. The purpose of Japan then became evident. A set of demands were made upon China that in tone and import are those of a conqueror to a conquered people. These have been widely published in full; they provide for extending the rights already acquired by Japan in China, the granting of fresh zones of influence, the placing of the police and other functions of government in sundry areas in Japanese hands, and the virtual surrender of Chinese autonomy. If these concessions had been made, China would have become a vassal of Japan. Many of the less important demands have been granted, in the hope of resisting the others. Meanwhile Japanese troops were moved into China, even into Peking itself, while the second squadron of the Japanese navy was sent to patrol the entrance to the Yellow Sea. The end is not yet, and it remains to be seen whether China will be obliged to surrender her national entity. The situation has been much confused by talk of trade and international influence, whereas it is simply one of right and wrong. Shall the rights of the Chinese people be respected, or shall they be grossly disregarded to allow free rein for progress and efficiency? Rivers of blood and millions of treasure are being poured out in Europe to establish the right of the weak to exist. In America we suffer patiently the murder of American citizens and the destruction of American property rather than interfere with the right of the Mexican people to misgovern their country as they will. In Asia the Chinese people, who have successfully established a republican government, put the revenues of the country on a sound footing, and are modernizing their institutions as rapidly as is practicable in an ancient democratic civilization, are falling under the iron hand of autocracy. This is not a matter that concerns only China and Japan, it concerns the whole world, it is a turning back of the hands of progress a thousand years. No nation is in a position to interfere except the United States, and this people that made no protest at the assassination of Belgium cannot be expected to make any move to uphold the hands of an alien people. But two points must be remembered. The Chinese have a racial entity paralleled only by the Hebrews. Throughout forty centuries Mongol, Tartar, and Manchu have swept down upon China, achieved political domination for a time, only to be slowly and silently forced back by the resistless tide of Chinese racial entity. Japan can hope to obtain no permanent hold over China. More imminent is the probable result of a national policy contrary to the spirit of the 20th century. This has been well expressed by Mr. Liang Chi Chao, who has recently said: "Japan succeeded because China could not retaliate. Indeed, the people of the world can do nothing to Japan now. But is it really worth while to purchase political ambition at the expense of leaving behind it a heritage of hate? Let the far-sighted statesmen of Japan bethink themselves long and earnestly." To this we may reply in the words of Carlyle that nothing based on wrong can hope to endure. The policy of the Japanese government, like that of the German government, is on the way that leads to destruction. It must be understood clearly that we are here criticizing governments, not peoples. Governments, like corporations, have no souls. Only the sense of honor of a people can curb the soulless diplomacy of a government. For those that disregard international law there waits a Nemesis. Political crimes eventually avenge themselves.

Petroleum Conservation in California

At various times in the past we have referred to the danger to which the petroleum industry of this state is subjected through allowing the underground waters encountered in drilling to find their way into the oil-bearing sand. One unguarded well may wreak havoc to many others adjacent, and it is only through concerted action that safety can be assured. The State Mining Bureau most properly has taken the lead in the efforts to bring about co-operation. During the past three years many conferences have been held and several bills drafted. None of these has yet been enacted into law, but by the discussion of them a better grasp of the factors involved has been attained, so that the present bill, now before the legislature at Sacramento, is a satisfactory measure. The funds necessary for administration are to be furnished by levying an equally distributed special tax on the properties producing oil. General supervision is to be in the hands of a commissioner of gas and oil wells, under the State Mining Bureau. He is to have control of the water problems in the oil-fields throughout the state, and is empowered to appoint deputies for the various fields. Appeals from the commissioner's decisions are to be heard by a board of three arbitrators, whose decision shall be final. The operators are more nearly united in favorable opinion of the bill than they have ever been on any of their other problems, and the enactment of the bill seems assured, since it has already been passed by both the Senate and the House, and will at once go before the Governor for signature. As Governor Johnson is understood to be favorable to the bill, he will undoubtedly sign it, and the law will go into effect 90 days thereafter. The bill provides for a sufficient salary for the commissioner to make it possible to secure a good man for that post, and it should be the duty of the petroleum operators to see to it that the office is not allowed to become one of the spoils of political patronage. Providing as it does for a just combination of local control and central supervision, the proposed law should prove both satisfactory and equitable in its working. It is to be hoped that this spirit of co-operation will continue to characterize the activities of the operators' associations.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

Plumbing a Shaft

The Editor:

Sir—Having subscribed to your paper since 1893, I take the liberty of seeking your knowledge on the subject of deep-shaft surveying. Take the case of transferring a base line from the surface to the bottom of a vertical east and west shaft, 1000 ft. deep, by means of heavy plummets on the finest permissible wire. Would the varying declinations of the moon tend to draw the plummets from the vertical in an erratic manner according to the angle of the gravitational pull? Then again, should the shaft's longest axis be north and south, would the changing angle of pull of the sun's influence affect the alignment below, and to what approximate extent?

JAMES A. WALKER.

Brock's Creek, Australia, January 25.

The Editor:

Sir—The answer to both of Mr. Walker's questions is No. The reason for this is shown by the following considerations. The influence of the moon on the problem is greater than that of the sun, so we need to show only that the moon's influence is negligible. The expression for the deviation of a plumb-line due to the horizontal component of the moon's pull on a plummet is

$$3/2\ M/E\ \sin^2 p \sin 2z\ 206265''$$ (in seconds of arc)

where M and E are the masses of the moon and earth respectively, p is the moon's horizontal parallax, and z is the zenith distance of the moon. $M/E \sin^2 p = 1/17{,}800{,}000$, so that the angular deviation of the plumb-line due to the action of the moon is very approximately 1/60 of a second of arc times sin $2z$. The maximum displacement, therefore, that a plumb-bob at the end of a 1000-ft. cord could have would be 1000 tan 1/60″ (in feet), which is less than 1/1000 of an inch. This maximum would be for a zenith distance of the moon equal to 45°.

R. T. CRAWFORD.

Berkeley, California, May 1.

Research for Engineers

The Editor:

Sir—Your editorial in the issue of April 17, 1915, 'Mining Ventures in China,' appeals to me very much, owing to the fact that I am at the present time interested in the organization of a Library Search Bureau in connection with the combined libraries now known as the Library of the United Engineering Society. I have for a long time past felt that one of the chief aims of the library board ought to be in extending to the fullest possible degree the utilities of the library to the members and the public generally who have not the advantage of living in close proximity to it. This Library Service Bureau is now being organized so as to furnish to members, who desire to be kept posted on current literature, reference cards on any subject in which they may be especially interested.

Our library receives currently over 1000 periodicals, and has now 80,000 volumes on technical subjects. The Service Bureau has engaged the services of thoroughly competent searchers and translators, each one of whom is equipped with a thorough professional knowledge of the branch of engineering put in his care. An engineer who has registered a given subject on which he wants current information receives every two weeks reference cards giving the title, author, and exact citation of all articles appearing in the current literature on that subject, these cards being sent out at the nominal charge of 5c. each. The charges made for abstracting, translating, and photostat copies are moderate and should appeal to everybody desirous of learning what has been published on any given technical subject.

The Library of the United Engineering Society is not allowed to go into this business for the sake of making a profit; it can only do so as an accommodation to the membership of the United Societies, and the only charges made are to cover the actual expense of the service rendered. As this department has only just been formed, I have thought it might interest your readers to learn what we are doing.

E. GYBBON SPILSBURY.

New York, April 29.

Rise or Raise?

The Editor:

Sir—Noting Mr. F. Sommer Schmidt's exception to the change in his manuscript, from the word "raise" to "rise," permit me to add my protest to some of the changes from well established mining expressions and terms that are becoming more and more numerous.

For some months past, for several years I may say, changes have been suggested and in many instances made, relative to certain words, names, and expressions which have become well established by usage in the mining world, and which, as Mr. Schmidt suggests, give the impression that the writer is putting on airs. The

English language is made up of words and expressions which become correct by usage. Usage is the builder of the dictionary of any language. The lexicographer views some words through their orthographic derivation and in this narrow range of vision attempts the restriction of usage to his view-point, while in the case of other words, he unwillingly admits a correctness due to usage. How then are we to be confined to lexicographical correctness in the handling of such a word as 'raise'?

From childhood I have been accustomed to the word 'raise' as meaning an opening in a mine from a drift or tunnel upward. In mining parlance, it is as definite a term as is the word 'winze'; it is understood the world over, where English is spoken, as a distinct type of mine-opening and is as thoroughly established by usage as any other word in the language. Why then attempt, at this late date, a reversion to the orthography of the word?

Personally, there is affectation in the changing of many of the other words, so well established in mining, smelting, and metallurgy, as 'tailings,' 'smelter' (referring to the plant), and others which have been under discussion during the past two or three years. Such words have become general in their usage and familiar to all the world, as of definite meaning; they are firmly established by usage; they have, as in the use of the word 'tailings,' been applied to a definite product of a plant or to a type of plant, just as 'block' has been applied to a building in the business section of a city, or 'tree' to a type of vegetable growth. These words have not been applied from their orthographic relation, but merely suggested thereby and the 'rise' has been named a 'raise'; therefore, as it was christened a 'raise' some generations ago, let it be called a raise; let a lessee who is 'scramming' in a mine, be called a 'leaser,' as he has been by usage for years past; let the metallurgical plant, used for smelting our ores, remain a 'smelter' as it has been for some generations, and let the 'tailings' run as 'they' have since we of this generation were born.

L. S. Ropes.

Helena, Montana, April 21.

[We welcome discussion and criticism, if for no other reason but that it helps us all to understand one another. In the comments of Mr. Ropes and other worthy friends, we find great play made with the word 'usage.' Yes, we respect usage, but whose usage? Only too often the loose speech of the mining camp is quoted in support of the employment of sundry terms of an entirely local character. In many cases the vulgarisms and colloquialisms of the careless educated or reckless illiterate are called "established," while as a matter of fact they represent new variations foisted on older literary usage. What is "the mining world" to which Mr. Ropes refers? All those that are engaged in legitimate industry are worthy of honor, especially the shift-boss, but does he suggest that the trammer and timber-man are to pass on technical terminology? The 'lexicographer' or dictionary man defines words according to the usage of authoritative writers, that is, those that have a loving care for the niceties of speech and endeavor to give it maximum efficiency as a medium of thought from man to man. Is the 'lexicographer' to ask the single-handed stoper how to spell technical terms? As to 'raise' and 'rise,' we are not dogmatic. We believe the latter form preferable, and so we use it in the *Mining and Scientific Press*. It is no infliction on our readers, for even in the guise of 'rise' it will not be confused with anything but 'raise.'

We suspect Mr. Ropes of getting a 'rise' out of us, when he tilts against the up-to-date use of the singular in such terms as 'tailing' and 'slime.' This usage—that is, the recognition of a valuable inflection as distinguishing singular from plural—has been adopted widely, notably by the leading technical society in South Africa, in London also, and by many technical authorities in this country. However, we must not boast. Perhaps somebody will come to our rescue, for our sword-arm is not free in replying to this thrust of Mr. Ropes. Yes, 'block' and 'tree' are standard, but has 'tailing' any less definite meaning than 'tailings'; nay, is not 'tailing' the more definite? How would Mr. Ropes write or speak concerning the one tailing that mingled with the several other tailings? Would he speak of the 'ores' of a mine, as is often done when the mine produces only one kind of ore; if he did, how would he distinguish this case from that of a mine producing several ores, a lead ore, a zinc ore, and a gold-bearing quartz ore. If we are to say of 'tailings' that 'they' run, what is *it* that runs? Indeed, the reckless and unthinking squandering of the plural inflection is the mark of wooly thinking. In poetry we talk about the "sands' on the seashore because we are thinking of the multitudinous grains of sand; but do you mix 'sands' or 'sand' with lime to make mortar? If tailing is to be used only in the plural, why use the singular of other words and terms? We have heard miners talk of "them quarts," and we know that the immigrants to Australia expected to find gold in quarts or double pints. Are we to adopt that usage? If not, why not?

Yes, if we are to adopt localisms generally, we must employ 'leaser' instead of 'lessee,' although 'leaser' is a corruption of 'lessor,' who is on the opposite side of the fence from the 'lessee.' Certainly, we shall then use 'scramming,' 'mucking,' 'dirt,' and all the other meaningless terms adopted by men too tired to trouble about precision of speech; but if we do that, then we must allow the Australian to talk about pug, paddock, and poppet-heads; we must allow the American in Siberia to speak of starateli, hishniki, and sajenes; we must permit the Englishman in South America to write about his oficina, caliche, and barilla, and so forth *ad absurdum*.—Editor.]

The Editor:

Sir—I was much interested in the 'kick' made by Mr. F. Sommer Schmidt, published in your issue of April 17, relative to the proper term for a "shaft upside down," and it does seem too bad that many of the old names that we have been accustomed to should be

changed; and yet your evidence appears to be indisputable.

Frequently a trivial expression will lead to naming some old custom with a new appellation, and to this end I beg to state that we have for some time past been 'raising' in a 'rise,' and during that period I received a telegram from one of our interested parties asking what progress we were making in the "up-lift." Why not call it 'up-lift'; there could be no dispute as to the orthography and it would have a more soulful accent.

A. L. HORNER.

Columbia, California, April 19.

['Uplift' is good. We remember a manager in Western Australia who wrote to his board of directors in London to tell them that a winze was needed on the 4th level. They telegraphed to him to buy one right away.—EDITOR.]

The Editor:

Sir—I am 'right with' Mr. F. Sommer Schmidt in all he says in his letter of March 16, 1915. When will the editors of the Century and the Standard dictionaries learn that the function of a dictionary is to record the usage and pronunciation of words and not to force down our throats the ideas of some pedantic college professor?

If we accept the Standard as our guide to salvation, we learn that there is no such mineral as chalco'pyrite, no such place as an as'say office, and no such city as Spokane (pronounced Spo'can). Instead we have a mineral called chalcop'yrite, a place called an assay' office, and a city called Spo-cane. When will the dictionaries learn that we make as'says in an as'say office? How long! How long!

AN INNOCENT BYSTANDER.

Clarkdale, Arizona, April 20.

[Our correspondent must have misread his Standard dictionary, as that authority (1913 edition), quite correctly, gives the pronunciations chalcopy'rite and Spokane'. It is true that the pronunciation of 'assay' preferred by our correspondent is the one commonly heard; nevertheless the dictionary rendering is the time-honored and correct one, as the word is derived from the old French *assay'er*, and the old pronunciation is invariably retained for the participle assay'ing. If the word were of Anglo-Saxon origin, it would be pronounced as'say. Current usage tends to ignore the origin of the word and in a few more years may become strong enough to prevail; meanwhile those who are careful of their speech adhere to the older pronunciation. The common form, indeed, has in it a hint of the stable that is scarcely complimentary to the ass'ayer. There are many words that are commonly mispronounced, but that does not suffice to establish the faulty pronunciation as good usage. Both our correspondent and Mr. Schmidt fall into error in supposing the common form to be the older one, and the dictionary usage a new-fangled invention, whereas the reverse is the case, the old usage having been modified by accident or intention.—EDITOR.]

The Cracking of Oils

The Editor:

Sir—I note with interest the item concerning cracking of oils in 'Concentrates.' The cracking process, wherever it is in use, is intended to produce a larger yield of light distillates than can be obtained by normal distillation methods. It consists essentially in distilling oil at a temperature higher than the normal boiling-points of the constituents which it is desired to decompose and convert into products of lower boiling-point. The method is a very old one and its practical application was first carried out by having the upper part of the stills uncovered, and allowing the vapors to condense on this portion of the still and fall back into the hot still-contents. Later similar effects were brought about by distilling at high temperatures and under pressures considerably above that of the atmosphere. I suppose, first and last, anywhere from five hundred to ten thousand people have done this very thing with oils, and the result is always the same, namely, to produce a larger quantity of lighter distillate than could be obtained by distilling in the ordinary way at atmospheric pressure and without heating beyond the normal boiling-point. The various patents for methods of this character have to do with apparatus and details of operation. Everybody has the right to distill under pressure, but there are restrictions imposed upon the general public by individual patents that cover methods more or less commercially feasible. The actual decomposition is simple. For example, a hydrocarbon like $C_{23}H_{48}$, which belongs to the paraffin or marsh gas series and which is one of the constituents of ordinary solid commercial paraffin, might be broken down and a liquid obtained that would contain C_6H_{14} and $C_{17}H_{34}$. The former is a light volatile liquid of the paraffin series known as hexane and is a considerable constituent of gasoline; the latter belongs to the olefine series and would doubtless possess a bad odor and could not be used for anything except fuel. You will see that almost any kind of permutation and combination can be worked. During decomposition a fixed gas is usually evolved and carbon is left behind, as the decomposition cannot be controlled exactly. The commercial objection to these processes is that the distillate evolved usually contains olefines and similar complicated members of the aromatic and other series, which impart an undesirable color and odor to the product, so that excessive treatment is necessary to get a merchantable material. Such treatment also usually results in almost total loss of everything except the paraffin series, so that this matter of increasing the gasoline content by cracking has many sides to it, and it is usually better to adhere to the ordinary distillation methods. There are exceptions to this, as there are to all generalities.

San Francisco, May 2. E. I. DYER.

[It is a pleasant experience to have a brief item evoke so much additional information from a specialist who speaks with authority, and we wish it might become a common one.—EDITOR.]

Cost and Efficiency

By HEATH STEELE

At the beginning of this discussion on costs I want to state that at best I hope to set forth only a few of the many governing factors. The object of this article is to make a plea for a concerted effort on the part of the mining fraternity to change the almost universal method of recording costs only in dollars and cents. Such ideas as I shall present were suggested from time to time by the obvious failure of statements of cost in dollars to furnish comprehensible data for estimates. It is certain that many others have noticed the anomaly. In fact, I know that several have the same complaint to make, namely, that in using such data there is no accurate way of determining the amount of material or energy represented; hence a just comparison cannot be made. A few operators figure their costs in detail on the basis of units of energy and material, but the prevailing custom is to make a sort of financial statement of cost-data for publication, the intended usefulness of which is to promote efficiency. For several years I have had occasion to investigate mining costs and have collected a mass of figures, more or less complete, on the expense of operating the principal mines of the world. Yet I do not feel that I am acknowledging any extraordinary lack of insight when I confess that these figures are abstruse.

One object in compiling records is to furnish data for comparison with past performances at the property, as well as a record of what is being done, but the engineer or manager who stops at this point fails to take full advantage of the information before him. If he does not go farther than this he will surely fall short of attaining the highest efficiency from his labor and material. He must not only know how his present work measures up to his past achievements, but how it compares with what the other fellow is doing. And the other fellow must not be limited to his neighbors in the same district, but must include, so far as it is possible for him to learn, every form of mining throughout the world. If he does this he will set the right standard of work at his property. There should be but one standard for doing any particular kind of work, whether it is in America or Asia; depending, of course, upon the facilities at hand. Yet where is the man engaged in mining who has not known of a day's work in one mine meaning a greater or less amount of effort in another mine of the same district? For example, a driller at one is expected to drill 25 ft. per shift, while 35 ft. per shift is demanded at the other mine. Such conditions result commonly from the acceptance of a standard of work below par and are undoubtedly due to the failure properly to compare the achievements of other mining enterprises with the records there being made.

Suppose the working conditions at two mines in the same district are identical and that both are using the same system of mining and milling. We would naturally expect their costs to be the same, but suppose that the cost at one amounts to $6 per ton and $4 at the other. Now, with full knowledge of working conditions and a detailed cost-statement in dollars before us, how are we going to say which is too high? It may be that at the mine where it costs $6 the ore is more carefully selected, waste being discarded that the other is treating as ore. If this be so, the true cost at the mine reporting $4 may be $6 and the selection of ore accounts for the difference in the reported cost. But if the trouble is not in ore selection, then it must be caused by inefficient labor, loss of mechanical energy, or waste of material. We are able to discover in a comparative table of detailed costs where the difference arises, but we are not able to make a clear analysis with measurements in dollars and cents. The item of labor may be too high. How are we to know it is not caused by inefficient drilling-machines or some other such cause instead of poor workmanship? Further, if we run the trouble down to drilling-machines, again the question arises, is the trouble with the machine itself or with the drill-steel. It is certain that such questions cannot be answered off-hand from any statement of costs of the usual kind. Some information must be furnished showing the rate of drilling by the machines during actual drilling-time and the average footage per drill sharpened. If the cost of supplies is high a mere statement that it is $2 per ton will not suffice. Neither will the statement that the cost of dynamite is 25% higher at one mine than at another indicate that the difference is caused altogether by a greater consumption of explosives; one may buy its supplies more advantageously than the other. However, if the statement is before us that one mine uses 0.5 lb. of 40% dynamite per ton and the other 0.625 lb. of the same dynamite there is no question of the fact. These simple illustrations are given to emphasize the difficulty of drawing correct conclusions from general cost data, such as usually fill the engineer's note-book and the technical press, when such details are necessary before passing final judgment on records at first hand. In milling and smelter practice the custom of stating costs in units is more common, and anyone with experience knows how readily a fair comparison may be made with such statements.

Of what real use is it to know that it costs a mine in Colorado $1.50 per ton for labor and a Montana mine $3 per ton, working under the same conditions, unless supplemented with more information? On the other hand, if we know that one secures 5 tons per 8 man-hours, while the other gets only 2½ tons, the difference is explained. It is at once evident that something is wrong with the class of labor employed or with the management. The

failure to analyze records from the standpoint of the amount of human energy, mechanical power, and materials required to accomplish the different steps in mining operations has undoubtedly led to the prevailing opinion that cheap labor is always an advantage in securing a low cost, that a mine employing labor at 45c. per day has a distinct advantage over one paying $3.50 per day. As a matter of fact at many places where such low wages prevail, as in India, the tonnage per man is so low that there is a difference of about 20% in favor of the American miner at the higher wage. One fact to be borne in mind is that the amount of effective energy secured from labor varies with the intelligence of the laborer as markedly as the effective power of an engine varies according to its state of repair.

Given the rate of work to be expected from labor, the amount of power required to perform the various mechanical operations, and the consumption of supplies an engineer may apply local prices for labor and supplies and come very near making an accurate estimate of the cost of operating a new enterprise. It is hardly necessary to remark that the first factors to investigate when studying costs are the geology of the district and the nature of the country in which the deposit is situated. With the geology of the deposit must be considered the character of the orebody and methods of mining and treatment. In connection with the character of the country such factors as the climate, distance from markets, methods of transport, supply of labor, and natural resources that may be utilized for operations, must be considered. All these general factors can be ascertained in regard to the principal mining districts. Such information might be put to better use if data could readily be obtained showing the average tonnage per man, items of principal supplies expressed in quantities per ton of ore, and the horse-power required in mining and treatment per ton. With all these data and the cost-statements now obtainable, a standard of work could be computed for each group of mines working under similar conditions. It should be possible to go farther than this, to secure such details as tonnage broken per man in stopes, rate of drilling per hours of running-time, average hours of running-time for machines per shift, powder consumption, rate of timbering, rate of shoveling, and other like detailed data as easily as itemized costs expressed in dollars can now be obtained. This would certainly improve the efficiency of mining operations, for it would permit any manager to search carefully into his records to find where he falls below the other fellow. He might find differences in his cost attributed to a higher wage-scale to be partly due to inefficiency in some part of his organization.

In construction work and some branches of engineering the cost is figured by units of material, energy, etc., but mining engineers have been slow to reduce their cost-factors to this basis. One result of this is that those desiring such data are handicapped because few mines keep any complete records in these units. The accompanying form is only an outline of a summary sheet, the principles of which might be adopted by any concern. Such a summary may be compiled from more detailed information kept by each department and will show the general result at a glance. The greatest value of such a record would come through its adoption by mining companies in general and the publishing of the information in the technical press. It would require too much space to give forms that might be kept for separate operations, or to try to cover all items, but it might be well to mention a few of the subjects that should be covered. While the general departments such as offices, mechanical, electrical, etc., are finally absorbed in the cost of running the main operations, some information should be at hand to compare their efficiency with those of other companies. Careful consideration should be given to the number of men necessary to run these departments for a mine of given size. The consumption of supplies for their maintenance and machinery efficiency are equally important. A record should be kept of the total shop-hours operated, details of labor employed by occupation, average man-hours per shop-hour, average cost of supplies for maintenance per shop-hour and man-hour. Some of the following facts are important to ascertain about mining operations:

Tons per day per man employed on surface.

Tons per day per man employed underground.

Tons per day per man for all men employed at the mine.

Tons broken per day per man employed in stopes.

Tons produced per day per man employed in development.

Tons produced per day per man employed in general underground work.

Feet of development work per day per man on development.

Foot-tons trammed per day per man from development headings.

Foot-tons trammed per day per man from stopes.

Feet drilled per machine-shift in stopes.

Feet drilled per machine-shift in development.

Drills sharpened per foot drilled by machines.

Actual drilling-time in stopes.

Actual drilling-time in development.

Tons broken per machine-shift in stopes.

Feet advanced per machine-shift in development.

Total air-consumption for drilling per ton of ore produced.

Tons secured from stopes per cubic foot of free air in drilling.

Feet advanced in development per cubic foot of free air in drilling.

Tons broken in stopes per foot of hole drilled.

Feet advanced in development per foot of hole drilled.

Average consumption of drill-steel per ton of ore produced.

Average amount of drill-steel sharpened per man-hour.

Pounds of powder consumed per ton of rock broken in stopes.

Pounds of powder consumed per cubic foot of development.

Timber consumption in stopes per ton of ore.

Timber consumption per foot of development.

Total timber consumption per ton of ore produced by mine.

Average amount of track, spikes, rails, etc., consumed per ton of ore produced.

Average pipe-consumption per ton of ore produced.

Lubricating oils and greases consumed per ton of ore produced.

Average hoisting depth or total foot-tons hoisted.

Average power consumed per ton or foot-ton hoisted.

Details of power-consumption in operation, such as pumping, etc.

Total power-consumption at mine per ton of ore produced in horse-power-hours.

Milling data should be collected to show the power, labor, and supplies required for the various steps in the course of treatment as expressed in units. For example, the amount of power required to crush a ton of ore from one size to another and downward through concentration to the final product. Data published on the efficiency of machines are usually compiled in units of power, but if the practice of giving out this information was more widespread it would be better. It is necessary to face the fact that while a dollar is a known quantity in the monetary system, it is by no means a definite expression when used to denote quantities of labor and material, and that so long as operators continue to use it to measure labor, supplies, and power in mining they will fail to raise mining operations to the highest standard of efficiency.

By these remarks I have not intended to convey the impression that I advocate the introduction of such data into the general accounting or cost-record system of mining companies, or that all these facts should be published in their annual reports. But I do advocate that operating departments should keep some such records and that the heads of these departments should make a careful study of their costs on this basis. To further the cause of efficiency they should, if possible, publish such information in the mining journals, so that general comparisons may be made between mines.

GENERAL SUMMARY OF COST & EFFICIENCY DATA FOR ALL OPERATIONS

		Departments	Mines	Trans-portation	Milling	Smelting	Selling	Construct-ion	Total
	Tons Handled								
LABOR	Total Labor Cost								
	Total Man Shifts								
	Av'g Wage per Man Shift								
	Tons Handled per Man-Shift								
	Cost Labor per Ton Handled								
SUP-PLIES	Total Cost Supplies								
	Av'g Cost per Man-Shift								
	Cost Supplies per Ton Handled								
MISCL. CHGS.	Total Cost Miscellanies								
	Av'g. Cost per Man-Shift								
	Cost per Ton Handled								
POWER	Total Cost of Power								
	Total H.P.-Hours								
	Av'g. Cost per H.P.-Hr.								
	Tons Handled per H.P.-Hr.								
	Cost Power per Ton Handled								
	Total								
	Distribution of Department Charges								
	Total Cost of Operations								
	Total Cost per ton Handled								
	Net Metal Production.								
	Total Cost Per Unit of Metal								
	Per Balance Sheet	No.	No.	No.	No.	No.	No.	No.	No.

Average cost of keeping mine-tracks in repair per mile of track, labor in man-hours.

Ton-miles hauled by underground locomotives.

Details of power-consumption for underground haulage in horse-power-hours, per ton-mile.

Ratio of supply-cost to labor-cost.

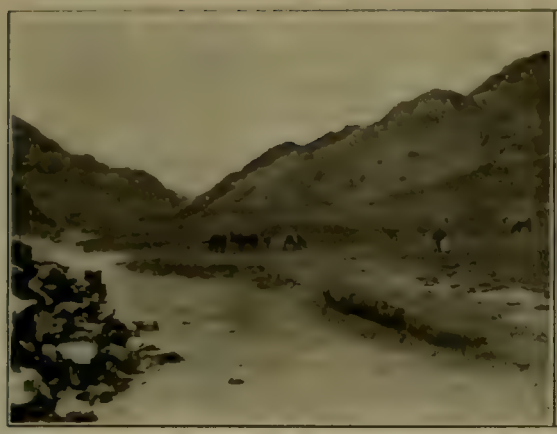
Ratio of cost of separate operations to total cost.

Many of these and other facts may be obtained from the regular system of reports now in use. When publishing such information it is important to know the hours represented by a shift, the amount of ore and waste actually broken, the amount of ore and waste hoisted, proportions of rock hoisted as ore that is later discarded as waste in sorting, ratio of development work to ore produced, average grade of underground tracks, etc. It is also interesting to collect these details to show the relative merits of the different systems of mining employed, and to show development data for driving, shaft-sinking, rising, and sinking winzes, in fact, any segregation of costs that will throw any light on the performance of work under different conditions about the mine.

GOLD AND SILVER MOVEMENTS in New York up to March 27 were as follows:

	Exports.	Imports.	Same period of 1914.	
Gold	$2,493,700	$6,255,809	$18,335,854	$3,008,936
Silver	9,347,185	1,401,203	9,769,732	2,793,657

Added to the imports of the current year is the sum of $30,500,000 received from the Bank of England's auxiliary reserve at Ottawa, Canada, to which over $100,000,000 was sent from New York last year. Nearly 50% of the gold exported between August 1 and December 31, 1914, has been returned to this country.



1. THE PASS.

2. CALUYO STAGE-STATION.

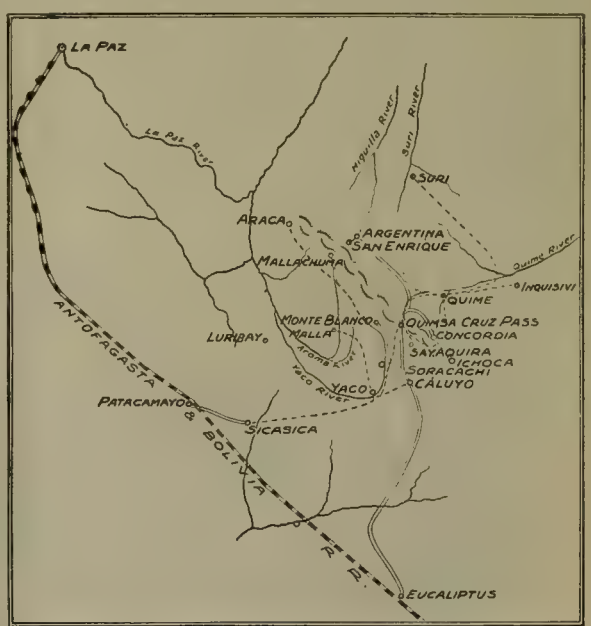
Quimsa Cruz Tin District, Bolivia

By FRANCIS CHURCH LINCOLN

The tin deposits of Bolivia extend from Carabuco, on Lake Titicaca, near the Peruvian border, southeast for some 400 miles along the main range of the Andes to Portugalete, near the Argentine boundary. The northernmost producing district is that of Milluni, in the department of La Paz, north of the city of that name, which has been described in a previous article.* The next in order is that of Quimsa Cruz, in the same department, but southeast of the city of La Paz, about midway between it and Oruro, as may be seen by reference to the sketch-map.

The Quimsa Cruz district stretches from the town of Araca, and for about 35 miles to the town of Ichoca. Quimsa Cruz means 'Three Crosses' in Aymará Indian, the name having first been applied to the principal pass, and later to the district as a whole. The pass has an altitude of 15,570 ft. above the sea and derived its name from three piles of stones, locally termed 'crosses,' which mark the trails to Caluyo, Yaco, and Quime, respectively. The Indians believe that the high passes of the Andes are inhabited by genies, who can be placated by the throwing of a stone upon a pile by the roadside. This will bring good luck. The designation of the piles as crosses indicates an attempt on the part of the missionaries to Christianize a heathen superstition.

This district lies northeast of the Antofagasta-Bolivia railway, which runs from La Paz to Oruro, and thence to the Chilean coast at Antofagasta. Most of the tin ore and concentrate produced in the district is packed on llamas, burros, or mules to the railway at Eucaliptus or Patacamayo, while a little is transported as far as La Paz and Oruro. A regular weekly stage-coach runs from Eucaliptus to Caluyo, 42 miles from the railroad, beyond which the road branches to the Monte Blanco, Huanchaca, and Concordia mines. The Caluyo stage-station is shown in the accompanying photograph. Mail for the district comes from La Paz weekly by rail to Patacamayo and thence by carrier *via* Sicasica. There



MAP OF THE REGION.

are Government-telegraph stations at Caluyo, the towns of Yaco and Quime, and the mines of Monte Blanco, Concordia, and Pacuni.

The country-rocks of the tin lodes are slate and quartzite intruded by a granitic batholith and acidic dikes.

Mining and Scientific Press, March 27, 1915.

At the Concordia mine, and probably elsewhere in the district, the sedimentary rocks are of Devonian age. Outside the lode-area, as at Yaco, where tin placers are worked, the slate and quartzite are overlain unconformably by red desert sandstones of Triassic age. The granitic intrusion appears to be quartz-monzonite, while the dikes are quartz-porphyries. The quartz-monzonite makes its most southern appearance at the Argentina mine, 15 miles north of Quimsa Cruz pass, the outcrop being said to extend north for 10 miles to Araca. Several quartz-porphyry dikes were observed south of Quimsa Cruz pass. The tin lodes appear to be genetically related to these igneous rocks. The topography of the district is glacial, and small glaciers still exist on the higher peaks.

The lode deposits are all veins, but so greatly do their characteristics vary that no general description will suffice. The valuable mineral is cassiterite, which is usually purer and richer closest to the surface and at the highest altitude. This condition may be explained, in part at least, by secondary sulphide enrichment, which is apt to proceed deeper in higher altitudes because the ground-water level is lower. The leaching of the upper parts of the lodes increases the purity of the ore and renders it richer per ton if not per cubic foot, while the precipitation of sulphides in the lower parts of the lode has exactly the reverse effect.

The Argentina and San Enrique mines adjoin one another in the quartz-monzonite area. Sugar-Loaf peak, at the Argentina mine, is shown in the accompanying photograph; also the San Enrique mine. The igneous rock at these mines is sheeted almost perpendicularly, as may be seen by examining the photographs, the direction of this sheeting varying from N.75°E. at the Argentina to N.17°W. at the San Enrique. The veins are numerous and strike in all directions, frequently branching and occasionally crossing one another. They appear to have been formed contemporaneously. At the Argentina they are somewhat narrower and richer than at the San Enrique. The typical ore consists almost entirely of a gangue-mineral believed to be tourmaline, and the ore-mineral cassiterite. The tourmaline occurs in radiating groups of dark-green acicular crystals, ⅛ to ½ inch in diameter, the interspaces being filled with brown cassiterite.

Across the range, just outside the quartz-monzonite area, is the Mallachuma mine. The workings at this mine extend beneath a glacier. The veins are in quartzite, but the glacier brings down boulders of quartz-monzonite, showing that the outcrop of the igneous rock is not far distant. The veins are nearly parallel, but they branch and unite, forming a linked system with a strike ranging from N.10°E. to N.80°E., and nearly perpendicular dips. This linked-vein system cuts across the quartzite, which is thickly bedded and dips from 29° to 35° in a direction varying from S. to S.15°E. As at the Argentina and San Enrique mines, the veins at Mallachuma all seem to have been formed at the same time. The filling consists of quartzite, quartz, pyrrhotite, arsenopyrite, pyrite, cassiterite, and a little hematite, chalcopyrite, and tourmaline. Traces of lead, antimony, zinc, and silver are also shown by assay. The proportion of the various vein-minerals varies widely, not only in different veins but also in different parts of the same vein.

There is one American mine in the Quimsa Cruz district, the Concordia mine of the Andes Tin Company. This vein is also in quartzite, but, unlike the Mallachuma veins, it has a brecciated filling and has in places been intruded by a dike of quartz-porphyry. The strike of the Concordia vein is N.10°E. and its dip nearly perpendicular. It has been faulted in numerous places, the northern segments always having moved toward the east. The filling consists of brecciated pieces of quartzite, tongues of quartz-porphyry, quartz, tourmaline, feldspar, muscovite, sphalerite, pyrite, and cassiterite. The geology of the Concordia lode has been described in detail by William R. Rumbold,† who has also described briefly the geology of the Coya, Monte Blanco, Barrosa Cota, and San Roque mines in the Quimsa Cruz district. Besides the American mine, there is also an American prospect in the Quimsa Cruz district, namely, the Scranton of B. Sandall & Co.

Stream-tin derived from the Quimsa Cruz lodes is found in the Yaco and Aroma rivers. It occurs on and near bedrock in both the river and bench-gravels. The river-gravel is 5 to 12 ft. thick and consists of equal amounts of sand and small boulders; while the bench-gravel is 5 to 30 ft. thick and contains a larger proportion of sand, together with soil and clay, not present in the river-gravel. The stream-tin varies in size from powder to boulders a foot in diameter. Its metallic content is low; shipments of first-class ore ranging from 52.67 to 58.45% metallic tin, but it is much less complex than the lode-ore, the principal impurity being quartz. Besides the first-class ore, which makes up about 85% of the product, there is 15% of second-class ore of lower tin content and containing pyrite. Gold has also been found in the Yaco river, nuggets weighing several ounces being not uncommon and one weighing 51 oz. having been discovered, but it is very irregularly distributed and of little commercial importance. On the Yaco river, the quantity of stream-tin per square yard of bedrock increases toward the lode mines, but suddenly decreases before they are reached. This suggests that a glacier was active in bringing the stream-tin down to the point where the sudden increase begins, the small amount of stream-tin above this having been brought down during or after the retreat of the glacier.

Tin was discovered in the Yaco river in 1903 and about 4 long tons of first-class ore has been produced from the Yaco and Aroma rivers since then. Most of this has been mined by tributers. These miners dig small pits in the river-gravel to bedrock, work out as much ground as they can reach from the bottom before the pit caves, and then start a new one. The tributer must dispose of his product to the owner of the placer.

†*Economic Geology*, Vol. IV, p. 321 (1909).

who pays him a certain pre-arranged rate per 100 lb. (quintal), which varies with the price of tin. In 1914 this ranged from $6.40 to $8 (16 to 20 bolivianos). J. A. Sedlmayr, manager for the Nuevo Jerusalem placer, employed miners by the day to dig trenches as shown in the photograph. These men were paid 40c. per day and given a bonus of $\frac{1}{10}$c. per pound on all the stream-tin they extracted.

The wages paid at Yaco are the lowest in the district, because labor is plentiful, the cost of living low, and the climate good. At the lode mines it is wet and cold, living is dear, and labor comparatively scarce. Labor is frequently supplied by contract, the contractor being paid 40c. for each Indian. Sometimes a bonus of 20c. is paid for such Indians as stay a second month, and an additional bonus of 10c. for those who stay a third. The wages paid are about as follows:

Outside men	$0.80
Shovelers	1.20
Trammers	1.40
Miners	1.60
Blacksmiths	2.00

About three-quarters of the wages earned is usually spent in the company stores, where profits ranging from one-sixth to one-eighth are realized, thus reducing the actual cost of labor by one-eighth to one-quarter.

Mining supplies cost about as follows:

Dynamite	$0.40 per lb.
Caps	0.88 per 100
Fuse	0.10 per 20 ft.
Charcoal	1.40 per 100 lb.
Blacksmith coal	4.80 per 100 lb.
Wood	0.60 per 100 lb.
Drill steel	0.16 per lb.
Hammers	0.20 per lb.

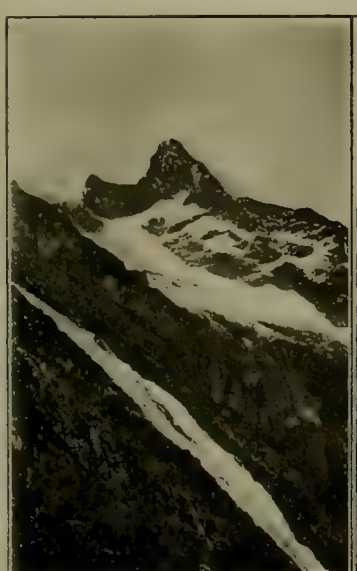
Figures as to the cost of mining are difficult to obtain, as detailed accounts are seldom kept. The following detailed costs of mining 811 tons from a narrow vein with 9 men stoping will therefore be of interest:

Labor:	Per ton.
Miners	$1.980
Blacksmith and helper	0.096
Nipper	0.060
Trammers	0.232
Sledging in stopes	0.092
Loading and firing shots	0.056
Sampling	0.008
	$2.524
Supplies	0.804
Supervision	0.500
Overhead charges	1.544
Total	$5.372

Mining the same type of vein on a large scale would greatly reduce the cost of supervision and the overhead charges, bringing the total down to about $4.50; while in wider veins this would be further reduced to about $3. The cost of development work on the same property, exclusive of superintendence and overhead charges, was about $10 per foot for 5 by 7-ft. adits, cross-cuts, rises, and winzes; and $8 per foot for intermediate drifts averaging 3½ by 4½ ft. The list on the next page shows the producing mines in the Quimsa Cruz district in the spring of 1914.

The methods of milling employed in the district range from the crudest to the most refined. Primitive methods are in use at the small mines. At the Argentina mine, crushing is performed by rocking great stones, known as *quimbaletes,* back and forth over the ore. The crushed ore thus obtained is screened by hand and concentrated on convex buddles.

The mill at the San Enrique mine is a complex form of the primitive type. Instead of using *quimbaletes,* a Chilean mill having a single granite roller, chipped by hand out of the solid rock, is employed. Power for this



3. PAN DE AZUCAR.

4. SAN ENRIQUE MINE.

5. TRENCHING FOR TIN.

PRODUCING MINES OF THE QUIMSA CRUZ DISTRICT

Mine.	Canton.	Owner.	Nationality.	Number of employees.	Tons of tin concentrate per month.
Viloco	Araca	Harrison & Boettiger	English and German	300	125
Mocoya	"	Hugo Zalles	Bolivian	40	5
Tarujumana	"	Louis Pando	"	40	10
Mallachuma	Yaco	Benedicto Goytia	"	20	2
Monte Blanco	"	Cia. Minera Monte Blanco	Chilean	200	18
Antioma	"	Deppe y Cia.	Bolivian	5	½
Nuevo Jerusalem	"	Cia. Minera Tres Cruces (Leased to J. A. Sedlmayr)	Bolivian and German (German)	35	3
Soracachi	"	Seferino Selaez	Bolivian	5	1
Aroma	"	Albert Hufenast	Swiss	5	½
Santiago	Quime	Frederick Blatch	English	18	5
San Enrique	"	Juan Lazzeri	Swiss	15	10
Bajadería	"	Bebin Frères	French	30	5
Concordia	Ichoca	Andes Tin Co. (Leased to Inslee & Ahern)	American (American)	17	12
Scranton	"	B. Sandall & Co. (Leased to Natalio Ramos)	American (Bolivian)	1	1/8
Favorita	"	Natalio Ramos	Bolivian	1	1/8
Coya	"	Penny & Duncan (Leased to Pietro del Favero)	Scotch (Italian)	10	1
Mariana	"	Kock y Cia. (Leased to Apolinar Lopez)	German (Bolivian)	15	10
Boliviana	"	M. B. Gonzales and estate of V. Matteo	Spanish and Italian	10	1
San Roque	"	John B. Minchin	German	15	1½
Capatilla	"	Manuel Ulloa G.	Bolivian	7	1
Caprichosa	"	McBride & Helguero	Scotch and Bolivian	15	1/8

mill is supplied by a small impulse water-wheel. Concentration is effected by hand-screens, hand-jigs, circular convex buddles, oblong moss-bottomed buddles, and barrels fitted with paddles. These machines are used and re-used, according to a complicated system that produces concentrate ranging from 58 to 62.3% metallic tin. The loss by this system is high, probably exceeding 30%.

Modern mills have been erected at the Viloco, Monte Blanco, Huanchaca, and Concordia mines. The cost of milling at these plants is about $1 per ton. The loss is said to range from 5 to 25%, and probably usually exceeds 10%.

I took 29 samples from four properties in the Quimsa Cruz district. The assays ranged from 0.41 to 10.81% metallic tin, and averaged 4.83%. With a milling loss slightly in excess of 10%, such ore would concentrate 15 into 1, yielding 65% tin concentrate. With a cost of $4 per long ton for mining and milling, the cost of producing one long ton of 65% concentrate would be $60. Transport to the railroad would cost about $30; while exporting, shipment to Europe, and smelting would cost about $200; thus bringing the total cost up to $290. The value of the tin in 65% concentrate, when the price of Straits tin in London is £185, would be $585. Deducting $290 from this would leave $295 as the profit per long ton of concentrate, equivalent to nearly $20 per ton of original ore.

WITH THE PAYMENT of its posted dividend of 65c. per share on March 25 the total dividend disbursements by the Homestake Mining Co., of South Dakota, will reach a total unsurpassed by any gold mine in the western hemisphere, namely, nearly $37,000,000.

MINERAL PRODUCTION of Rhodesia in 1914 was as follows:

	1914.	1913.
Gold	£3,580,209	£2,903,268
Silver	14,275	15,105
Lead	2,487	5,234
Chrome iron	107,612	141,481
Tungsten ore	.....	427
Asbestos	8,612	5,224
Coal	115,099	78,421
Copper	50,559	.....
Arsenic	161	.....
Diamonds	3,985	7,781
Total	£3,882,999	£3,156,941

The increased gold production of £676,941 is principally due to new producers, namely, the Bell, which entered the producing list in March (£60,410), Falcon in August (£50,416, apart from copper), Cam & Motor in January (£171,602), Eileen Alannah in the same month (£46,864), Shamva in February (£272,871), and Golden Kopje in September (£28,274), while the Kimberley, which came into the list late in 1913, increased its output from £30,000 to £75,000, and the Antelope similarly from £4600 to £94,300. The decreases that may be expected in the future will doubtless be more than counterbalanced by the yields of the new producers. Nor must the part, large and important in the aggregate, played by the small producers be overlooked.—*South African Mining Journal.*

GOLD YIELD of the Lena property, Siberia, from September 30, 1914, to January 10, 1915, amounted to 61,130 oz. from washing 121,895 cu. yd. Gravel mined totaled 255,122 cubic yards.

Quantitative Blowpipe Analysis in the Field

By GEORGE DELIUS

For the benefit of those interested in making blowpipe assays during field-work I shall give a few hints by which the work may be much simplified. During a period of over 20 years of experience with this method, I have found that blowpipe analysis gives accurate quantitative results, as proved by check assays. Accurate results are certain, in a fraction of the time required by the usual fire-assay, providing the operation is conducted in the proper manner. The apparatus can be purchased from any reliable dealer in assayer's supplies; but I have found some of the usually advertised parts to be not quite suitable for practical work, especially for the field. The whole apparatus should be of the simplest, yet at the same time of the most practical, construction possible. A stout satchel which opens at the top, with strong straps and handles convenient to transport on pack-animals if necessary, is used for carrying the outfit. Bottles with acids should be separately packed, to guard against injury in case of breakage. A small folding table is desirable, but not essential. Any place sheltered from the wind will do to set up the apparatus to perform efficient work. As fuel for the blowpipe lamp, I have found common kerosene to be the most satisfactory. An efficient blowpipe lamp is readily constructed by fitting a common large-necked bottle, about 6 inches high and having a metal screw-cap, with a large-sized lamp-burner with a flat wick. By removing the superstructure of the burner, soldering it to the screw-cap, and filing the upper flat part to an angle of about 35°, a most efficient blowpipe lamp is produced. A flame over 5 inches long can be obtained by using this lamp and kerosene. It is easily regulated and the flame answers for both reduction and oxidizing purposes. If turned down until smokeless, the lamp can be used for gentle heating for such purposes as parting.

I will briefly describe in detail the different parts of the outfit, and their proper uses. A small bell-shaped mortar, about 5 in. across the bell, is most satisfactory for the fine crushing of ore samples. I generally crush to about 20 mesh, after having quartered down in the usual manner. The 20-mesh pulp is quartered to about 1 oz. This quantity can be quickly reduced to 150 mesh or finer in the mortar. It is, of course, of prime importance to sample correctly, and nothing coarser than 150 mesh should be used to obtain the final sample. The fine pulp is now ready to be mixed on a sheet of black glazed sampling-paper. It should be spread evenly in a thin sheet. From this sheet of fine pulp, with the aid of a small and thin spatula, small quantities are taken from as many equally spaced places as convenient, and one or more blowpipe assay-tons (100 mg. in weight each) weighed out accurately. The weight of one blowpipe assay-ton being 100 mg., a button of silver obtained by the assay weighing 1 mg. represents exactly 1% in weight of the one assay-ton of pulp taken for assay.

I have found the common pulp-scale unhandy under some field conditions, and furthermore not quite delicate enough, but have managed to devise a more accurate pulp-balance for this purpose. It is constructed on the balanced single-lever principle, shows quick-weighing qualities, easily weighs down to 0.1 mg., and when dismantled occupies a very small space. The small scale-pan can be lifted off the balance, after weighing the pulp, and is of the proper shape to pour its contents directly into the small mixing scoop, in which the pulp is thoroughly mixed with proper fluxes, such as borax glass, sodium bicarbonate, silica, and test lead. The weights used for this pulp-balance are in the form of small riders made of aluminum, different sizes representing blowpipe assay-tons or fractions thereof. By using standardized regular assay-balance weights as counterweights, these riders are constructed without difficulty. A set of regular assay-weights from 1 gram to 0.1 mg. should be carried, to construct new weights at any time or check up old ones.

Suppose now sampling has been attended to, the exact assay-ton (100 mg.) weighed out, the fluxes in proper proportion mixed with the pulp in the mixing scoop, the charge is next transferred to a small soda-paper cornet and folded up into a little ball about ⅜-in. diameter. These cornets are made from a good grade of filter paper, previously saturated with sodium bicarbonate, and dried. The paper capsules are very simply made by cutting the impregnated filter-paper into rectangular pieces 1½ by ¾ in. and by rolling the little paper squares around a smooth wooden mandrel (made from a lead-pencil), making a paper tube about ⅜ by ⅝ in. long. They are each tightly folded over on the end of the mandrel, and slipped off ready for use. The charge is readily poured into the tube by the aid of a fine camel's-hair brush without any loss. The open end is then folded over tightly and it is ready for the furnace. The furnace in this case is a stick of charcoal with a crucible-shaped hole bored in either end. The quality of charcoal for this work is of prime importance. I have found that common pine or fir charcoal, if properly burned, answers the purpose admirably, and I recommend its use in preference to willow charcoal. The stick should be about 5 or 6 in. long, and the holes bored, with a proper charcoal-borer, to a depth of ½ in. by approximately ½-in. diameter at the open end and smaller at the bottom. The holes must be bored at the grain ends of the charcoal in every case.

A gentle oxidizing flame is now directed upon the

folded paper surface of the charge in order to burn off the surplus paper. After the contents of the crucible are in a fluid state, the reducing flame reduces all the test lead, which, if properly done, collects the metal contents of the assay into one button, attached and partly surrounded by the fluid slag. The heat is now increased, using the reducing flame only. When finished the charge is ready to be poured. I use for this purpose a small, smooth, cup-shaped piece of Acheson graphite, as neither the slag nor lead button will adhere to this. While the pour is still red-hot in the graphite cup a drop of water will, if properly handled, form a balloon-shaped bubble of cold slag. This gives a valuable clue to the content of the gangue rock by the color imparted to the slag.

The lead button should be bright and soft; if otherwise, it shows the presence of sulphur, arsenic, or antimony. If bright but very hard, it indicates a high silver or gold content. The operation having proceeded so far, the lead button is now ready for cupellation. If the button is not perfect, it can be readily purified by replacing in the same crucible and scorifying it until pure. If this is not done the impure lead button will present difficulties in the subsequent cupellation for fine metal. The cupels for blowpipe use must be made of not less than 60-mesh bone-ash, of the best quality. They must present a smooth inner surface, and in spite of fine grain must show no tendency to form cracks, for the minute spherical silver or gold buttons resulting from low-grade ores might be lost into the cracks. Besides, if the button comes to final rest directly over a crack, its perfect spherical form, which any blowpipe button should assume on solidification, would be destroyed.

The cupellation of the lead button, which now contains all the silver or gold originally in the pulp taken for assay, is next. The lead button is cleaned from any adherent slag and placed on the smooth cupel, after heating the cupel to a low red heat by the blowpipe. The cupel itself is readily made by using the metal cap of a No. 10 paper shot-gun cartridge for a receptacle for the fine bone-ash, which must be dry and powdery. The little brass cap is filled tightly with bone-ash, and the surface made perfectly smooth by the aid of a smooth pestle, shaped according to the curved surface to be desired. I have found nothing better for this purpose than a common glass or agate marble about 1½-in. diameter. This gives just about the right curvature to the cupel surface, and also the smoothness necessary. The lead button is placed near the rim of the hot cupel and a small oxidizing blowpipe flame is directed on the lead button. A gentle heat will cause the lead to 'open' and commence to scorify. The oxidizing red-hot lead should be surrounded by a partly melted bath of litharge. When the lead button becomes about the size of a large mustard-seed, it is allowed to roll upon the clean, hot cupel surface; it is kept rolling about until the sudden brightening of the resulting silver or gold-silver bead shows that the operation is finished, the lead having been completely removed.

The silver, or silver-gold, button thus produced is now ready for weighing. The small button is a perfect sphere, with a minute flat spot where it came to rest on the smooth cupel, and is, for blowpipe work, not generally weighed on an assayer's balance, but measured on a Plattner ivory scale. The principle of the scale is based on the fact that the diameter of a sphere of any given metal is exactly proportional to its weight. The ivory scale is constructed of a thin polished strip of pure white ivory, about 7 in. long by ⅛ in. wide. On this smooth surface two converging hair lines are drawn with a diamond point. These two fine lines come together at one end, and diverge at the other end a distance of less than one millimetre. The whole length of these converging hair lines is divided exactly by 50 cross-lines, with subdivisions representing, for silver, weights from 0.00002% at the lower end to 3.48% at the upper end for each 100 mg. in weight taken for the assay.

The accuracy of the ivory scale is proved by taking a series of five or six silver buttons of different weights, ranging from 3 mg. to ½ mg., weighed with extreme accuracy on a good assayer's button-balance. Re-treat each button, after ascertaining its exact weight, on a fine blowpipe cupel with a minimum of pure test lead. Then measure the buttons on the Plattner ivory scale. If the scale is properly constructed, each little button will correspond to the weights previously determined by the button-balance. If variation exists, the ivory scale is imperfect, not having been properly calibrated.

When cold the bead is lifted off the cupel and is ready for weighing. It is removed from the cupel with a fine pair of jeweler's tweezers and transferred carefully to the Plattner ivory scale. With a good magnifying glass its exact position between the two hair lines can be determined quickly. The true place being found, the corresponding number on the scale at once shows its exact weight. Suppose the little spherical bead fits exactly between the hair lines on the ivory scale at the place numbered 33; its weight, if pure silver, is exactly 1% of the charge of 100 mg. taken. This corresponds to 291.66 oz. per ton of 2000 lb. If the silver button contains gold, it is parted with a drop of parting acid, washed, and the gold taken up with a tiny piece of pure leadfoil, held by the tweezers. This is replaced on the cupel, re-cupelled, and the weight of the pure gold deducted from that of the silver.

A little practice will soon make the operator sure of all operations in handling small quantities of pulp. For convenience, and in order to save time, I have calculated the results in weights corresponding to the numbers on the Plattner ivory scale and plotted them in the form of a simple table which is a great convenience, especially in the field. The operations of quantitative blowpipe analysis are simple, although requiring patience and practice in order to become sure of results. I hope this synopsis will contribute to a better understanding of it.

Labor-Saving Devices

By S. A. WORCESTER

The adoption of minor conveniences that operate automatically is often the means of saving the labor of one or more men, in milling plants. It is an established fact that for the majority of simple mechanical operations, machines are more reliable than manual labor, so that a mill designed to be automatic is less liable to interrupted operation than one having few automatic features and requiring careful attendance at many points.

The devices shown, while not claimed as original, are much needed, as I know from extended observation, in a large number of mills, where they would prevent many sloppy overflows and kindred troubles, saving labor in some cases and power in others.

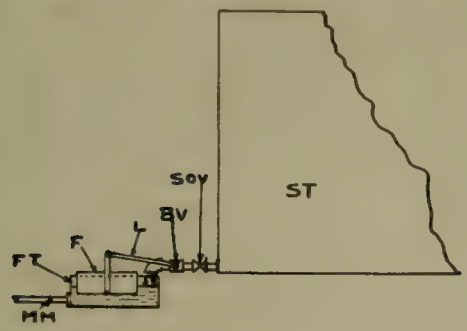


FIG. 1.

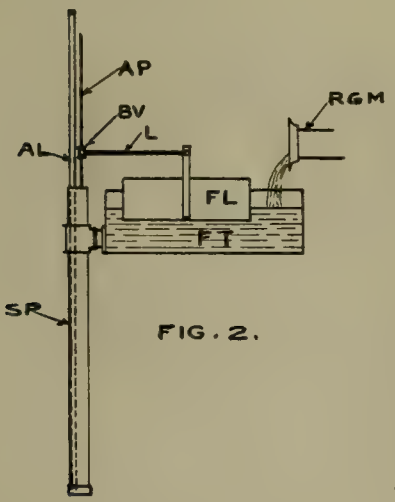


FIG. 2.

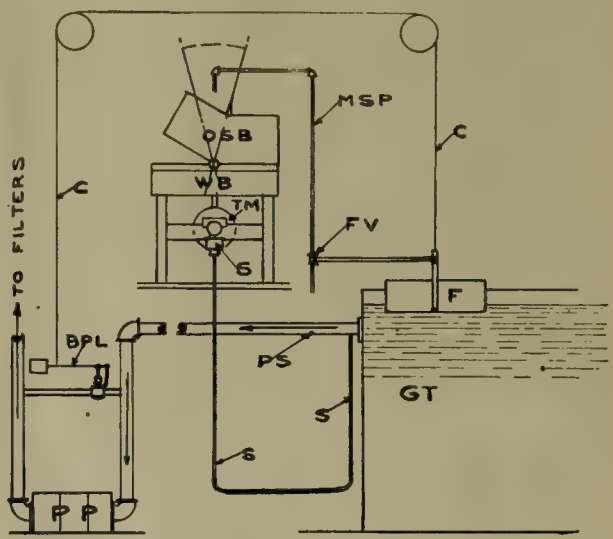


FIG. 3.

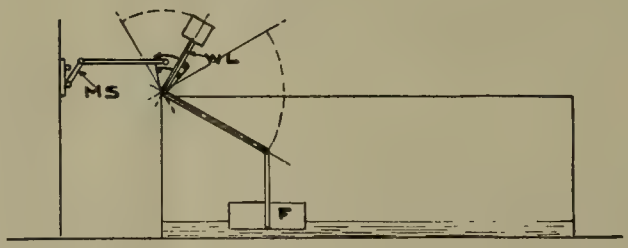


FIG. 4.

Mill-Pressure Regulator

Where a uniform head is needed for supplying water or solution to classifiers or concentrators, the float arrangement shown in Fig. 1 is satisfactory. Receiving water or solution either from a storage-tank, as shown, in which the level of the fluid varies from near the top to near the bottom, or in other cases receiving from a main in which the pressure fluctuates, the float-tank *FT* has its liquid-level maintained within a narrow limit of variation and allows the pressure in the mill-main *MM* to fluctuate but slightly, not more than a few ounces, whatever the mill-demand or the supply-variation may be. The float *F*, connected by the lever *L* to the butterfly-valve *BV*, governs the supply to the float-tank. A lever-gate or almost any form of lever-valve may be used, but I prefer the butterfly-valve as the easiest to operate. It is desirable in most cases to have a shut-off valve *SOV*, in addition to the regulating valve, for use in case of shut-downs, because a lever-valve, particularly the butterfly, seldom closes tight. The float shown is a light steel pan or bucket, but a cheap float can be made of wooden blocks nailed together, or a single large block.

The lever-valve should be large enough to give an opening equal to the full pipe without opening wide. It will then regulate the flow with slight movement of the float.

Air-Lift Regulator

Air-lifts for raising pulp from the discharge ends of tube-mills and other re-grinding machines are usually run with considerable waste of air. This regulator, Fig. 2, effects a considerable saving. The float *FL*, connected by the lever *L* to the butterfly-valve *BV*, governs the quantity of compressed air admitted through the air-pipe *AP* to the lift *AL* in the submergence pipe *SP*. Any increase in pulp-supply from the re-grinding machine *RGM* raises the float and admits more air to the lift, while a decrease in pulp reduces the air supplied. The float-tank is made small, so that the pulp will keep in motion and not accumulate enough to impede the movement of the float.

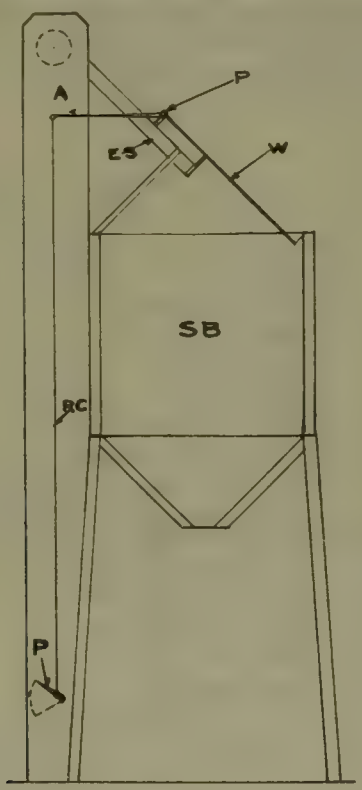


FIG. 5.

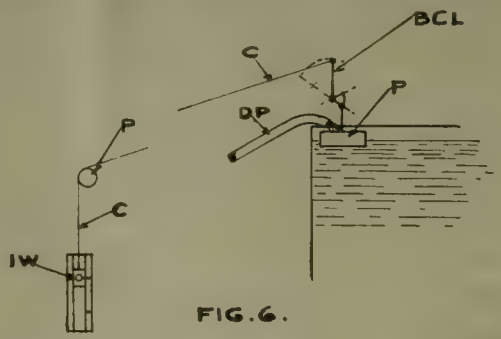


FIG. 6.

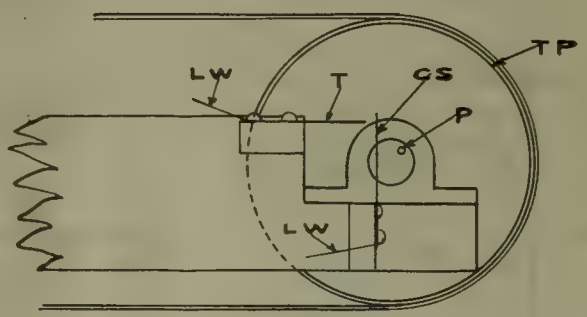


FIG. 7.

Zinc-Dust Feed-Regulator

This arrangement, Fig. 3, governs the quantity of solution delivered by the precipitation-pump *PP* to the filter-presses, and at the same time proportions the amount of zinc-dust fed to the pump-suction *PS*, to the volume of pregnant solution drawn from the gold-vat *GT*. The gold-solution level is thus kept within a narrow range while the influx may vary widely. The float *F* is connected by the cord *C* to the by-pass valve-lever *BPL*. The pump has constant speed and delivery, but when it reduces the level of the gold solution sensibly the float is lowered, opening the by-pass and reducing the volume pumped to the filters. Increased inflow to the gold-vat raises the float, closing the by-pass and increasing the quantity pumped to the filters. Zinc-dust is supplied to the pump-suction by a feeder operated by the oscillating solution box *OSB*, the frequency of oscillations and proportionate feed depending on the quantity of mill-solution supplied to the oscillator through the float-valve *FV* and pipe *MSP*. The float thus governs both pump and feeder. The oscillating box rotates, by means of a ratchet, a small screw-conveyor in the bottom of the zinc-dust hopper, feeding the dust out into the water-box *WB*, from which the solution discharged from the oscillator washes it out into the tube-mill *TM*. Here it is thoroughly emulsified and discharged into the open end of the siphon *S*, through which it enters the suction *PS*. It is obvious that by using a long or short lever for the float, the range of the solution level may

be varied from a few inches to several feet, as may be required under the conditions prevailing in the plant.

Automatic Pump-Control

Fig. 4 shows a simple device for such applications as, for instance, returning barren solution from sump to stock-vat, etc. An individual motor driving the pump is started and stopped by the switch *MS*. The float *F* can rise until the vat is nearly full, or lower until it is nearly empty, before forcing the weight-lever *WL* to one side or the other of the perpendicular, so that it falls, throwing the switch and starting or stopping the motor. This prevents the tank from overflowing, and avoids wasting current by running the pump after the tank is empty.

Storage-Bin Indicator

Fig. 5 shows a tell-tale for indicating when an elevated bin for crushed material is full, without the necessity of climbing to the top of the structure. The wing, or paddle, *W* is so hung and pivoted at *P* on the elevator-spout ES, over the storage-bin *SB*, that as the crushed material delivered by the elevator rises above the bin, it swings the wing *W* outward and upward. The arm *A*, attached to the wing, is connected by the rod or cord *RC* to the pointer P, placed near the ground-floor. When the wing rises this pointer swings down, showing to the operator that the bin is full.

Pump-Discharge Indicator

Fig. 6 shows a device to indicate whether a pump is discharging to full or part capacity. When the pump is on the lowest floor and the discharge is on the highest, several floors above, and at a considerable distance, this device saves time, labor, and trouble. The shallow pan *P*, hanging under the pump-discharge pipe *DP*, has a bottom outlet that is adjustable by a slide or damper. The pan hangs on the bell-crank lever *BCL*, which has attached to it a light cord *C*, passing over the pulley *P* to the indicator-weight *IW*. This indicator is placed at some convenient point in full view of the operator. The pan outlet is so adjusted by experiment that when the stream entering the pan is less than the full pump-capacity, the pan will but partly fill and the weight will partly overbalance it and descend a part of its stroke. When the discharge stops, the pan soon empties and the weight descends to the bottom of its travel, showing that the pump has stopped.

Electric-Conveyor Tell-tale

Fig. 7 shows an electric appliance to indicate the continued running or the stoppage of a tailing or other conveyor that may be placed at a long distance, or out of sight, from the mill. The pin *P*, in the end of the shaft of the tail-pulley *TP*, presses the contact-spring *CS* against the terminal piece *T*, at each rotation of the tail-pulley, making connection between the light wires *LW*, so as to flash a light at a convenient place in the mill at each turn of the pulley. If the light stops flashing, it gives warning of stoppage of the conveyor.

Metal Production of Japan in 1914

The yield of the principal mines was as follows:

Gold. Hidachi, $1,803,873; Sado, $367,167; Yamagano, $281,113; Kushikino, $238,605; Kosaka, $225,452; Kamaishi, $146,518; Tomiki, $105,902; Serigano, $83,803; Abeshiro, $81,087; Okayabu, $70,178; Nishinomiya, $67,680; Matsuoke, $66,145; Omori, $61,220; Okuchi, $56,387; Miyagi, $55,213; Ushio, $51,368; Horobetsu, $50,355; Ikuno, $50,290; and 37 other mines producing less than $50,000 each, $547,795; making a total of $4,476,500.

Silver. Kosaka, 956,885 oz.; Hidachi, 802,700; Tsubaki (closed in September), 460,668; Ashio, 320,035; Kamioka, 283,620; Ikuno, 221,968; Abeshiro, 232,914; Sado, 166,257; Kushikino, 126,084; Omodani, 119,838; Omori, 119,140; Takonai, 85,124; Kunitomi, 66,492; Yoshioka, 64,944; Ani, 60,969; and 45 other mines producing less than 60,000 oz. each, 578,061; making a total of 4,647,767 ounces.

Copper. Ashio, 24,025,589 lb.; Hidachi, 22,897,819; Kosaka, 16,991,684; Betshi, 16,829,118; Asarusawa, 4,717,545; Ikuno, 4,516,380; Abeshiro, 3,911,130; Agoya, 3,348,869; Ani, 3,103,557; Obiye, 3,092,844; Kamaishi, 2,637,396; Makimine, 2,241,389; Yaguki, 2,222,201; Kunitomi, 2,216,736; Arakawa, 2,077,409; Hibira, 1,742,165; Yusenji, 1,852,145; Yoshioke, 1,678,141; Nagamatsu, 1,424,246; Okura, 1,543,141; Hisaichi, 1,351,764; and 37 other mines producing less than 1,333,000 lb. each, 13,910,013; making a total of 139,676,531 pounds.

Coal. Muke, 2,226,700 short tons; Tagawa (Mitsui's), 1,092,285; Onoura, 880,000; Yubari, 774,400; Minenoike, 737,250; Futase, 660,500; Iriyana, 596,300; Yoshinotani, 575,000; Meiji, 550,700; Hokoku, 537,000; Namazuta, 522,000; Shinnyu, 468,500; Tadakuma, 454,100; Shiozumeo, 449,300; Yamano (Mitsui's), 446,000; Uchigo, 416,100; Aichi, 404,000; Kanada, 366,400; Shin-Yubari, 364,900; Matsushima, 351,000; Hondo (Mitsui's), 346,260; Koma, 343,400; and 59 other collieries producing less than 333,000 tons each, 8,099,115; making a total of 21,695,071 tons.

Sulphur. Horobetsu, 24,472,654 lb.; Numakiri, 24,314,530; Okushiri, 23,357,224; Kobui (Mitsui's), 21,593,009; Iwaonobori (Mitsui's), 20,766,445; and ten other mines producing less than 6,666,000 lb. each, 36,244,533, making a total of 150,548,300 pounds.

Petroleum. Nugata-Ken, 1,680,000 bbl.; Akita-Ken, 620,000; Shizuoka-Ken, 1370; Hokkaido, 3840; Taiwan (Formosa), 14,950; and other *kens* (prefectures), 616,080, making a total of 2,936,240 barrels.

A gold nugget found in 1900 in the placer workings of Esashi, on the northern coast of Hokkaido, weighed 205 momme (24.7 oz.), and was said to be the largest nugget ever found in Japan. But a nugget recently found at Tansen, Kankyo-Nando, Korea, is much larger than this, as its weight is 245 momme (29.5 oz.). It was bought by the Chosen Bank for 1100 yen, and is now on exhibition in that institution.

New System of Mining Coal at Dawson, New Mexico

On October 22, 1913, an explosion at the Stag Cañon Fuel Co.'s No. 2 mine resulted in the death of 256 men. This was caused by the ignition of dust during working hours through a badly directed shot, fired against the most rigid rules. In 1914, according to the annual report just issued, only five men were killed in the mines in the production of 1,355,938 tons of coal. According to the general manager, T. H. O'Brien, the following system has been devised:

In order to confine explosions, which in spite of every precaution are liable to accompany coal-mining, to the smallest economical area it has been decided to reduce the size of each mine to an average daily production of about 750 tons. Underground work, therefore, during the past year has been laid out with that object in view. In carrying out these improvements, barriers are being built, dividing No. 2 mine into what will hereafter be designated as mines No. 2 and No. 3. Similar subdivisions are being effected in No. 1 mine and in No. 5 mine.

In carrying out these precautionary measures the removal of the pillars formerly left between the rooms has supplied a large proportion of the year's output, and our experience has led us to decide upon a rather radical change in our methods of mining.

The plan, after a fair practical test, is to drive entries to the boundaries before turning rooms, and it has worked so satisfactorily that it is in contemplation to adopt this modification in all of the mines. This will hereafter result in recovering all the coal at one operation, and secure the advantages of the long-wall system of mining. If unforeseen obstacles should present themselves, there will be no difficulty in returning to the room-and-pillar system if experience proves that to be the most satisfactory method.

One of the most serious conditions to contend with in these mines is the dry and dusty character of the coal. To reduce the sifting of fine coal from the old-fashioned cars with their end doors, tight cars are being substituted, and changes made at the tipples to discharge these tight cars from rotary dumps. This alteration has been made at the tipple of No. 5 mine, and the 200 tight cars already ordered will be used in that part of the property. As soon as possible, similar alterations in equipment will be made at the other mines. Before each of these tight cars starts on its journey from the heading, its contents are thoroughly sprayed with water to prevent the fine dust being picked up by the strong ventilating currents. To moisten the mine air, adjustable sprays have been devised, which are working in a most satisfactory manner.

In order to further increase the moisture, radiators have been installed at the entrance of the mines. The temperature of the air has to be raised and the steam and water discharged into the elevated temperature. For this purpose boilers have been installed at mines No. 1, 2, 3, and 5. Mine No. 4 is supplied from the tipple boiler-plant.

Previous to this year the miners loaded their holes and connected their rooms with the system of shooting wires. This practice has been discontinued, and special men now do the loading and make the connection after the men have left the mine.

Mining Costs at Goldfield Consolidated

In 1914, from the mines of this Company, there was stoped 282,936 tons of ore at the following cost:

Item.	Total cost.	Per ton.
Superintendence	$ 2,828	$0.010
Foreman	4,050	0.014
Shift-bosses	11,190	0.039
Miners	123,651	0.437
Shovelers	117,949	0.416
Trammers	36,409	0.129
Timbermen	65,448	0.231
Cagers	10,575	0.038
Hoistmen	16,902	0.060
Top carmen	19,189	0.068
Shaftmen	11,062	0.039
Pumpmen	3,056	0.011
Nippers	8,922	0.032
Filling labor	70,633	0.250
Blacksmiths	6,022	0.021
Blacksmiths' helpers	999	0.004
Carpenters	3,632	0.013
Watchmen	3,727	0.013
Miscellaneous	16,480	0.058
Total labor	$532,723	$1.883
Timber lagging	$130,600	$0.462
Explosives	26,380	0.093
Illuminants	6,862	0.024
Drills, fittings	6,558	0.023
Pipe, fittings	1,200	0.004
Track, fittings	789	0.003
Cars, repairs	575	0.002
Iron, steel	1,532	0.006
Lubricants	1,158	0.004
Tools	2,230	0.008
Sundries	11,747	0.041
Total supplies	$189,629	$0.670
Engineering	$ 4,942	$0.017
Assaying	28,436	0.102
Mechanical department	9,834	0.035
Electrical department	3,229	0.011
Sampling	1,086	0.004
Surface	4,209	0.015
Power	32,790	0.115
Total departments	$ 84,526	$0.299
Grand total	$806,879	$2.852
Per cent of total underground		78.58

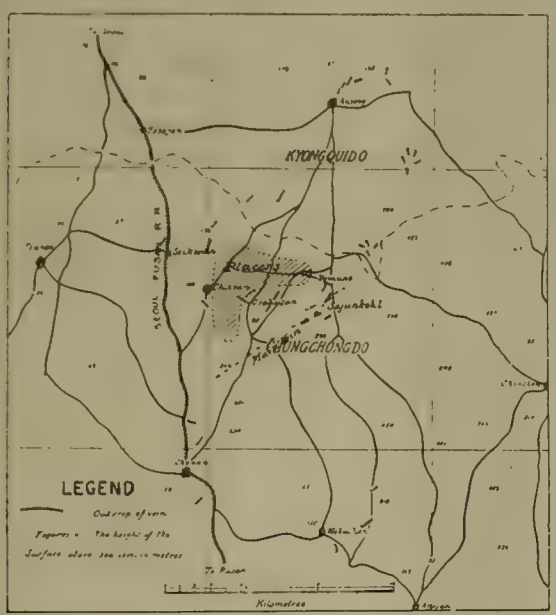
Development, which amounted to 30,028 ft., brought up the underground cost to $3.411 per ton, or 21.42% of the total of $1,026,808. Cross-cuts cost $7.52 per foot; rises, $6.62; winzes, $14.26; and diamond-drilling, $5.02 per foot for 379 ft. Timbering cost 73.6c. per ton; tramming, 13.6c.; hoisting, 20c.; pumping, 2.4c.; and surface charges, 17.8c. per ton.

Cyanide Plant of the Chicksan Mines, Korea

By CHARLES W. De WITT

*The ore treated at the reduction plant of the Chiksan Mining Co., Korea, is brought from four of the company mines, and from the small tribute mines. The largest shipments come from the Sajunkohl mine, situated about a mile and a half from the mill. The ore is quartz of medium hardness. The average assay-value in gold is $6.95 per ton. At the mine the ore is put into bins, and is then trammed over an 8% grade to the tipple-bins above the mill, where it is drawn through the mill-holes as desired. The capacity of the bins is about 3500 tons.

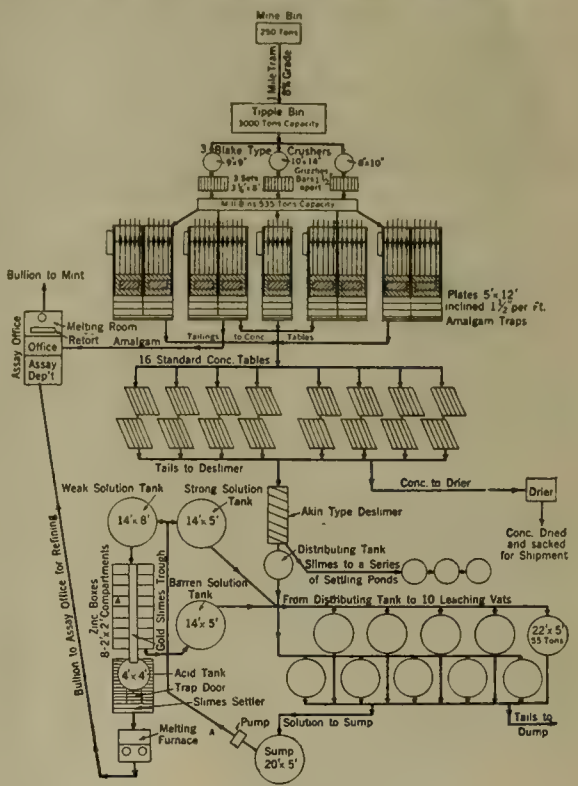
Ore from the Moonsukohl, Chung Tarrie, Yang Chun,



MAP OF CHICKSAN MINING CO. PROPERTY.

and the tribute mines is brought in by bulls and bull-wagons. The bulls carry from 350 to 800 lb.; the average wagon-load is about 1200 lb. One shovelful of ore out of every ten is taken as a sample. Considerable ore is brought from the outside mines, and this method of sampling is used to avoid mixing the lots. However, a series of bins will be erected in the near future and an automatic sampling-device installed so that the ore can be handled to better advantage.

Since 1907 our plant has been enlarged from a two-stamp to a 45-stamp mill. The course of the ore through the mill is shown in the flow-sheet. From the tipple-bins it is drawn through chutes into 1¼-ton cars and trammed to the mill, where it is dumped over grizzlies, 3¼ ft. wide by 8 ft. long, the bars being set 1½ in. apart. The oversize goes to three Blake crushers of the following sizes: 9 by 9, 10 by 14, and 8 by 10. The crushed ore drops direct to the mill-bins; it then gravitates through 9 Challenge feeders, which supply the 9 batteries. The stamps weigh 1250 lb. each and are operated at 100 7-in. drops per minute. The distributed



FLOW-SHEET OF MILL.

weight of the stamp is: stem, 610 lb.; tappet, 150 lb.; boss-head, 300 lb.; and shoe, 190 pounds.

The ore is crushed to 30-mesh, and is then run over amalgamating-plates, both inside and outside amalgamation being used. The plates are 5 by 12 ft. and have a slope of 1½ in. per foot. The pulp passes from the plates into Pierce amalgamating traps, and from the traps is distributed to the first series of eight concentrating tables. The middlings from these tables go to another series of eight tables on the floor below. The concentrate is dried, sacked, and shipped to the United States. After the completion of the de-slimer, the tailing will be run direct to vats in the cyanide plant; at present it is stacked before cyanide treatment.

In August 1913 the cyanide plant commenced operations. At that time six vats, 22 ft. diam. by 5 ft. deep, with a capacity of about 55 tons of damp sand, were

*A paper to be presented at the September (San Francisco) meeting of the American Institute of Mining Engineers.

used for leaching; during the year it was necessary to add four more vats of the same type to handle the mill-tailing. An Akins de-slimer is being installed and will be ready for operation early in 1915. The sand will then be run from the de-slimer through a rotating launder-distributer, which will supply the vats; slime from the de-slimer will be run into a series of settling-ponds, and if found to contain sufficient gold, will be cyanided after a large enough amount has accumulated.

At present the vats are filled and emptied by coolies, carrying 'jiggies.' This is an uncertain method, for when the planting and harvesting seasons come the coolies go to work on the farms, leaving the cyanide plant short-handed. For this reason the plant can be run to its full capacity only a few months of the year.

The sand in the leaching-vat is first treated with a 0.2% solution of potassium cyanide, supplied to the vat through a $2\frac{1}{2}$-in. pipe from the solution-tank. After about 7 hr. the solution is drained off, and while draining a 0.1% cyanide solution is run in; this is drained after a few hours, and at least two washings of water applied. The vats are then unloaded and prepared for a new charge, four days being taken for total treatment, including the loading and unloading of the vats.

The pregnant solution is pumped to the receiving-tank from which it flows to two 8-compartment zinc-boxes, having a total length of 20 ft., with compartments 2 ft. square. Zinc-shaving is used as the precipitant. The solution from the boxes is run into the barren-solution tank, and is then pumped up to the strong-solution tank, where it is made up to the required strength.

The gold slime is cleaned from the boxes and run into the acid-tank, where for three days it is treated with sulphuric acid. The slime is then run into a vacuum-settler and drained; after which it is dried over a large iron drying-pan, weighed, and melted, the resulting button being sent to the assay-office for refining and assaying.

The performance of the mill for the year ended December 31, 1914, was:

Tons crushed	46,402
Average assay-value	$6.956
Gross value (head assays)	$322,770
Bullion (21,872 oz.):	
Gold	$231,932
Silver	5,794
Concentrate (414.33 tons)	31,388
Total	$269,114
Milling cost, per ton crushed	$0.67
Average assay-value of concentrate	$75.75
Stamp-days	11,190.24
Stamp-duty per 24 hours, tons	4.12

The costs and recovery at the cyanide plant for the year 1914 were:

	Per ton.	Total.
Recovery	$0.799	$29,426
Cyaniding cost	0.335	12,462
Profit	$0.464	$16,964

Total recovery from reduction plant was:

Bullion (28,105.6 oz.):	
Gold	$259,013
Silver	8,062
Concentrate	31,388
Total output	$298,463

Water for the mill is brought from the creek through a small ditch about a mile long. During the summer or dry season the water-supply was insufficient to run the mill, so it was necessary to make settling-ponds; the water from these ponds is pumped back to the mill. The mill is operated by a 300-hp. Russell compound engine, which also drives a 75-kw. alternating-current generator, which in turn drives the other small 5 and 10-hp. motors and supplies the lighting service for the mine and camp. Power for the engine is supplied by three 150-hp. boilers.

PUBLIC INTEREST in the statistics regarding imported potash salts is keen, according to *Commerce Reports*, published at Washington, D. C., both by reason of their wide application in the manufacturing and other industries and the fact that the United States is still dependent on foreign countries for practically the entire supply thereof. The following table shows the imports of potash salts during February 1915 compared with that month last year. The figures are so grouped as to show those potash salts used chiefly as fertilizers, which are entered by the long ton, and those which are used in the arts and chemical industries, of which the unit of quantity is the pound.

	February 1914.		February 1915.	
Class of salts.	Quant.		Quant.	
Fertilizer salts:	Tons.	Value.	Tons.	Value.
Kainit	72,008	$321,723	1,852	$ 18,445
Manure salts	12,451	124,422	900	14,748
Sulphate of potash	5,098	210,327	1,378	59,804
Muriate of potash	13,172	431,820	22,818	836,368
Other potash salts:	Pounds.		Pounds.	
Carbonate of potash	1,674,685	49,110	1,317,849	46,015
Caustic potash	520,166	19,607	308,805	17,508
Nitrate of potash	22,699	928	.....	.....
Cyanide of potash	5,641	890	266,654	39,327
Other potash salts	638,112	52,119	456,011	42,429

THE EXPLOSION at the New River & Pocahontas Coal Co.'s mine near Layland, West Virginia, on March 2, killed or imprisoned over 160 men, and one was killed on the outside of the mine when passing the entrance. The chief mining engineer of the U. S. Bureau of Mines, George S. Rice, has written a paper on the rescue of 42 entombed men. The run of rescue-car No. 8 (133 miles in 196 minutes), work of the oxygen-apparatus crew, repairs to fan, the way the men bratticed themselves off from the rest of the mine, and other interesting events are all described. The recovery of the entombed men furnishes a splendid illustration of the wisdom of men who have escaped the direct violence of an explosion in bratticing themselves off, when the exits are filled with afterdamp; and of the importance of their keeping calm and collected under the trying conditions which prevail following an explosion.

CONCENTRATES

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Chemicals and supplies at the Nipissing low-grade mill cost $2.0457 per ton of ore treated in 1914.

Native mercury is often found in quicksilver mines; it is due to the reduction of cinnabar by acid waters.

Uranite is the hydrated phosphate of copper and uranium. It contains 61% uranium and 9% copper oxide.

Decorated glass is made by painting the surface with easily fusible glazes. After drying the glass is put in a kiln and heated sufficiently to fuse the glaze.

Platinum is derived entirely from detrital or placer deposits, but in the Ural region it has been traced to its source in dunite, an olivine rock rich in chromite.

Florence zinc is the name applied to the oxides of zinc made by the French process. The best known of these products are produced by the Vieille Montagne.

Chrome brick is advised as an interior lining of blast-furnaces for copper smelting at high altitudes, that is, over 10,000 ft., because such brick retards radiation and consequent freezing.

Analysis of subway dust in New York gave the following contents: metallic iron, 46%; iron oxide, 14.5%; lime and plaster, 12.1%; grease, 1.12%; and water and organic matter, 12.6%.

Feldspar, not felspar, is the correct spelling. Dana says that the dropping of the 'd' is "bad orthography." It arose from an error made in Kirwan's 'Elements of Mineralogy,' published in 1784.

Slag cement is made by chilling the slag by a stream of water, it is then mixed with slaked lime and finely ground. Lately cement has been made by mixing the ground slag with portland cement.

Counterforts are increases in the thickness of a wall or dam made at regular intervals for the purpose of strengthening it. Some civil engineers believe that they are ineffective for this purpose, and insist that a greater increase of strength would be produced by using the the same amount of masonry in increasing the thickness of the wall throughout its length.

Silver and mercury are lost to some extent in melting at the Nipissing refinery at Cobalt. Experiments are being conducted with the Cottrell process on the fume from the furnace, with a view to reducing losses.

Carnotite contains both uranium and vanadium. In a pure state it averages 63% V_2O_3, 20% V_2O_5, 10% K_2O, and 5% H_2O, but it is usually mixed with silica. It is a commercial mineral in Montrose county, Colorado.

More than 3000 technical articles dealing with almost every conceivable phase of nitrogen fixation have appeared in different languages. The patents applying to the subject in all its branches number into the thousands.

Creosote lowers the crushing strength of mine-timbers, especially if heat is used during the treatment. Cold saturated brine is a good fire-proofing material and has the least injurious effect on the crushing-strength of timber.

London price of spelter in pounds (£) per ton, if divided by 4 gives the New York equivalent in cents per pound, including the duty payable. This does not include any allowance for freight. Shillings and pence should, of course, be calculated as decimals of a pound.

Neat's foot oil is made by boiling the feet of cattle in water. It is an excellent lubricating oil, but is chiefly used in the manufacture of leather, and is frequently adulterated with other oils, since it is comparatively expensive. It takes its name from the old-Saxon word 'neat,' meaning ox or cow.

Moving pictures are dependent on chemical industry, since the transparent films are made from a solution of pyroxylin, or nitrated cotton, and camphor in wood alcohol or amyl acetate. This solution is poured on a smooth glass plate and allowed to evaporate, yielding a flexible and transparent film. It is estimated that the world's

production amounts to 200,000 sq. ft. of film daily. Their manufacture in the United States is controlled by patent No. 610,686. In the settlement of a recent infringement suit between $30,000,000 and $40,000,000 was paid.

ALLAYING DUST is of great importance in Rand mining, where water-drills, water-blasts, and water-sprays are used for the purpose. The first are used wherever practicable, blasts are used in development work, and sprays are placed at those points in the underground working where traveling dust might be expected.

UNDERGROUND crushing-stations are in operation in several important mines. The system reduces costs. It is gaining in favor. The latest property to have such a plant is the Dome at Porcupine. On the 425-ft. level of No. 2 shaft, a 36 by 54-in. Buchanan jaw-crusher, grizzly, 500-ton bin, and another crusher will reduce the ore for the stamp-mill. In March, this mine yielded 23,220 tons averaging $4.20 per ton.

TWO NITROGENOUS COMPOUNDS, nitrate of soda and sulphate of ammonia, constitute in value 80 to 85% of the total raw nitrogen compounds produced throughout the world. The value of their combined production in 1913 was between $190,000,000 and $200,000,000. It is estimated that 80% went to agriculture, corresponding to an annual per capita tax on the 600,000,000 inhabitants of the earth of 33 cents.

PROSPECTING by hydraulicking is a feature at the Nipissing mine, Cobalt. In 1914, 95.55 acres was washed at a cost of $499.47 per acre. The cost per cubic yard was 9.01c. Average depth of soil was 3.43 ft. There were 153 set-ups made, 35,540 ft. of 16-in. pipe taken up, and 33,769 ft. laid down, and 18,730 ft. of road constructed. The average pressure at the nozzle was 138 lb. The pump worked 79% of the possible time. Little ore was uncovered.

RE-GRINDING at the Winona copper mine in 1914 showed the following results:

Ore stamped, tons	123,339
Sand re-ground in Hardinge mill, tons	59,500
Costs:	Cents per ton ground.
Power, 1.054c. per kw.-hour	13.64
Labor	0.65
Pebbles, 0.8c. per pound	2.08
Silex lining at 1.436c. per pound	0.09
Steel lining at 5.242c. per pound	0.33
Sundry charges	0.43
Total	17.22
Cost per ton stamped	8.31
Cost per pound of copper obtained	3.86

COAL-TAR is a black oily liquid that separates from the gases produced in the destructive distillation of coal. It consists of light oils, pyridine bases, phenols, naphthalene, anthracene, heavy oils, pitch, complex organic compounds insoluble in benzene, water, ammonia, and dissolved gas. It is refined by removing the water and more or less oil by distillation, and may then be used to saturate roofing felt, to coat roofs, as a cheap paint, and for applying to wood that is to be buried in the ground. For the making of by-products it is distilled; yielding crude naphtha, heavy oil, dead oil or creosote oil, and pitch. From the first, benzol, toluol, naphtha, and a residue that is added to the second are made. Among the great variety of products made from the other three are phenol, cresol, ortho-cresol, meta-cresol, and para-cresol, xylenol, naphthalene, and anthracene. From these an almost infinite number of organic chemical products can be made.

CONSIDERABLE confusion exists, in the mining world especially, as to the meaning of the word 'tamping.' It originally included the compressing of a charge of explosives in the borehole, also the compressing of the inert material used to confine the explosive charge in the borehole so that it would not blow out. This tamping included the ramming of the powder itself so as to compress it as tightly as possible, to fill all the available spaces in the bottom of the borehole. With black-powder charges the clay, sand, or earth is also packed in as tightly as possible, as there is little chance of obtaining the full power that the black powder is capable of generating unless it is packed in and confined as tightly as possible. The earth, clay, etc., was also termed tamping. When dynamite and permissible explosives appeared, it was quickly recognized that they would not require to be compressed as tightly as the blasting-powder charges. To attempt to do so was highly dangerous. It was found, however, that the confining of the charge was as necessary in some kinds of work as confining of the black powder charge, and especially with permissible explosives. The compressing and forcing of the charge into the borehole being eliminated, the word 'tamping' came to mean the inert material used for confining the explosive in the borehole, according to the *Dupont Magazine*. In England, and in the literature of the U. S. Bureau of Mines, the word 'stemming' has been used to designate the clay, sand, or other inert material used to confine the charge of explosives, whether the explosive is blasting-powder or a high explosive. It is rather desirable that this word be used in this connection to avoid confounding it with the pounding of the explosive charge itself. When a manufacturer strongly recommends that the charge of permissibles be thoroughly 'tamped,' it means that the explosive charge shall be placed carefully and without forcing in the borehole, and the inert material be placed on top, at first placed lightly in place. After this it can be packed as tightly as can be done by pressure alone, without ramming, with a light wooden stick. If the word 'stemming' were used exclusively to designate the inert material for confining a charge of any explosive and the process of placing this material and packing it firmly in the borehole, a dangerous confusion of terms would be eliminated.

Nevada Minerals at the Exposition

This state is chiefly known on account of its mineral production. In 16 counties there are about 190 mining districts, containing nearly 800 producing properties. In 1913, a normal year, 5,367,211 tons of ores from 786 mines, yielded 570,589 oz. gold, 16,090,083 oz. silver, 90,693,751 lb. copper, 16,344,023 lb. lead, and 14,419,671 lb zinc, valued at $37,097,710.

In the Palace of Mines and Metallurgy at the Exposition, the display of Nevada minerals is excellent. It is neat and attractive, a credit to those who designed and arranged the booth. More than this, it is instructive. Just above the floor at the main entrance is a large map of the state in relief. The numerous north and south ranges and valleys are a feature of the topography. At the back of the booth are colored cubes representing the output of the various metals. A map shows the mining districts. Cases containing exhibits line the walls. Production charts show the yields for 10 years. Other charts show the yield per head of population. There are numbers of district maps, geologic sections, panoramic views and flowsheets of the important mills. The glass models are instructive. The Buckhorn mine is shown down to the 250-ft. level. The Nevada Hills is visible to No. 15 level. Part of the Goldfield Consolidated is on view. From National comes a horizontal and topographical view of the National mine, also a cross-section of the Charleston Hill. Methods of mine-timbering are shown by a model of the square-set system devised by Philip Diedesheimer at the Comstock. This is the original model. It has been exhibited elsewhere several times. There is also a model of the diamond triangular set at the Belmont mine, Tonopah. The Mackay School of Mines sent a head-frame, which was made there. As there are about 300 samples exhibited from mines and prospects, it is impossible to name them all.

Two of the show-cases contain high-grade gold ores from all over the State. Several polished pieces are exhibited by E. C. Smith. Stall Bros. of Humboldt county have $1500 ore. The Seven Troughs Coalition sends rich ore. Some malachite bloom is interesting. Polished Ludwig ore shows its structure. In the early days of Candelaria the assay-buttons were not parted, consequently a large amount of gold was not paid for. Some of these are shown by H. F. Whirlow. A small specimen of platinum ore from the Boss mine in Clark county is on view. This development last year caused considerable discussion. Two exhibits of miniature mining tools by G. L. Kennedy of Tonopah, and W. F. Reid of Goldfield, are worthy of mention. They show skilled work in their manufacture.

Tube-mill pebbles have been discussed frequently in the *Press*. Most of them used in America have come from Europe. Now the supply for Nevada is available from the American Onyx Co.'s quarry and plant at Manhattan. Rough and finished pebbles are shown.

What are termed the mineralogical cases in the exhibit contain interesting specimens from widely-separated districts. They include copper, antimony, sulphur, coal, graphite, wolfram, molybdenite, nickel, opal, salt, mica, diatomaceous earth, alunite, gold, silver, iron, platinum, and tin. Structural materials are building stones and gypsum. In connection with the last named, it might be stated that most of the plaster used at the Exposition came from the deposits at Mound House in Storey County.

The other displays in the booth consist of cases, each containing the individual rocks, ores and mill products of the large mines, as follows: Nevada New Mines Co., Rawhide; Goldfield Consolidated Mines Co., Goldfield; Jumbo Extension, Goldfield; Nevada Wonder, Wonder; Rochester district rocks and ores; Seven Troughs Coalition, Lovelock; National Mines Co. National; Consolidated Nevada-Utah Corporation (controls Amalgamated Pioche); Round Mountain Mining Co.; Nevada Bunker Hill Mining Co., Bullion; Nevada Consolidated Copper Co., Ely (on a stand by itself is a slab of 99.5% copper weighing about 500 lb.); Buckhorn Mines Co.; Nevada Hills Mining Co., Fairview; and Mason Valley Mines Co. To those interested in quicksilver, the exhibits of the Nevada Cinnabar Co., at Ione, Goldbanks Mercury Co., at Goldbanks, and Mercury Mines Co. at Ione, are of great interest. Cinnabar occurs in rhyolite, quartzite, and limestone respectively. Near Mina some ore occurs in limestone. The exhibits include furnace charge, residue, condenser sublimate, and quicksilver. At Ione the Scott furnace is used, and at Goldbanks the Adamson. The Tonopah Belmont Development Co. exhibits average and rich silver ore. In a small case is some briquetted precipitate, and bar No. 1915, weighing 2050 oz. MacNamara Mining & Milling Co., West End, Montana, and Tonopah companies are together.

Comstock men will be disappointed in the display from the lode which has yielded nearly $400,000,000 in silver and gold. It includes crushed timber, the Burleigh drill (the first Rand machine used, weighs about 500 lb.) compared with the latest type, a large piece of ore from the Mexican mine, and silver-gold ore from 1650 and 1950 ft. in the Con. Virginia, and 2100 ft. in the Ophir. The mining booth is in charge of J. H. Price.

Minerals of New Zealand at the Exposition

New Zealand is essentially an agricultural country. In 1914, its population of about 1,100,000 people exported materials valued at £26,261,447. Of this, metal and minerals was £1,674,974. In 1913 the mineral production amounted to £3,187,191. The total to date is approximately £124,000,000. Gold and silver contributed £85,500,000; coal, £21,000,000; and kauri gum, £17,000,000. The balance of £500,000, distributed over several other minerals, shows that little attention has been paid to them. Some occur in small quantities, and one or two as large deposits. Apart from these facts, several mines in New Zealand are great producers and have attracted world-wide interest.

In the Palace of Agriculture at the Exposition, the exhibits of agricultural products from the Dominion of New Zealand loom large against the small mineral display. The latter includes the following: gold-silver ore from the Thames district, which has a production of £7,000,000; the Waihi, Grand Junction, and Talisman mines in the North Island; and the Blackwater, and New Big River mines in the South Island; also auriferous gravel from Ross Flat, and gold-bearing black sand from Hokitika, the latter has produced several million pounds worth of gold to date; gold conglomerate from the Golden Crescent mine at Weatherstone. Gold scheelite from the Dominion mine; samples of coal; kauri gum of all grades in the E. Mitchelson and other displays; iron ore from Parapara, where is about 64,000,000 tons of good grade material; iron-sand from Taranaki, where the beaches contain enormous quantities of good grade; silver-telluride ore from the Silverstream mines, sulphur from White island and hot springs in the Taupo region of the North Island; oil, refined products, wax, and coke from the Taranaki Oil Wells Co.; oil-shale from Orepuki; cinnabar from Mackaytown, near Karangahake and Waihi; manganese ore from south Wairoa; copper-molybdenite ore from Mt. Radiant; silver-lead ore from Wangapeka; phosphate rock from Clarendon, Otago; native copper from Aniseed valley; Greenstone from Westland; Wilson's portland cement; and granite, marble, and limestone for building, including the well known Oamaru stone.

Final returns from the Hauraki peninsula of the North Island in 1914, show that the yield of gold and silver was worth £913,953. This is an increase of £53,505. The Waihi-Karangahake districts contributed £875,734 of this amount. The banner year was in 1910, when they produced $1,296,115.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

TORONTO, ONTARIO

ASSESSMENT WORK MUST BE DONE.—DOME, JUPITER, REA, PIKE LAKE, PORCUPINE PET, PEARL LAKE, LA ROSE, SALVADOR, TEMISKAMING, AND RIGHT OF WAY MINES.

A stimulus to development has been given by the decision of the Lands, Forest, and Mines Department of Ontario to allow no further extension of time for assessment work on claims. Last year, on account of the War and the financial depression, the Government relaxed the stringency of the mining regulations. It provided that the period between August 15, 1914, and August 15, 1915, should be excluded in computing the time within which work should be done. The Government has had numerous requests for a further extension. It is now officially announced that these will not be granted. This decision will tend to relieve the unemployed situation that has for some time presented a serious problem. It will encourage prospecting and development.

At the Dome mine, Porcupine, electric storage-battery locomotives, hauling cars carrying 5 tons each are to be used to

PROSPECTING BY HYDRAULICKING. THIS IS A FEATURE OF SURFACE WORK AT THE NIPISSING MINE, COBALT.

collect ore from the stopes.——The Jupiter, which has been closed down since the McKinley-Darragh company abandoned its option last fall, has contracted for a supply of power. It will be shortly re-opened. It has a small orebody blocked out on three levels.——At the Rea, now operated by the Mines Leasing & Mining Co., a diamond-drill is putting in flat holes on the 300-ft. level. The mill is treating 40 tons per day. The extraction is about 86%.——Highly satisfactory results of development at the Pike Lake are reported. The vein on which the shaft is being sunk shows a width of 18 ft. Assays are high. Several veins in the property show free gold.——The Porcupine Pet has closed down. The company has made a voluntary assignment to creditors. A 5-stamp mill has been saving some gold during the last year. Working costs have been heavy on account of the ore being spotty.——A plan is on foot for the financial re-organization of the Pearl Lake. It is proposed to organize a new company capitalized at $2,500,000 to offer 2,000,000 shares to shareholders in the proportion of 400 new to every 500 now held, at 11c. per share. This money will defray the Company's liabilities amounting to $220,000. The remaining $500,000 will provide funds for further development.

The annual report of La Rose Consolidated was discouraging. Exploration work undertaken last year has resulted in no important discoveries of ore. The properties have been almost exhausted of high-grade ore. Ore reserves have been reduced to 859,919.——The Temiskaming & Hudson Bay has secured an option on the Wright claims, known as the Salvador property. It contains a smaltite vein carrying low silver content. Development has been encouraged by the favorable results of work on adjoining properties.——At the Temiskaming the end of a rich ore-shoot has been found in an old drift on the 450-ft. level.——Work has been resumed at the Right of Way. Three drills are working. ——The Columbus is to be pumped out and operations resumed.

The Hon. G. Howard Ferguson, Ontario Minister of Lands, Forests and Mines, is making his first visit to the mining districts of northern Ontario, in order to familiarize himself with the conditions and requirements of the mining industry.

JOPLIN, MISSOURI

ZINC CORPORATION DRAINS LARGE AREA.—NEW ZINC SMELTING CO. ORGANIZED.—GOVERNMENT PROTECTS INDIAN LAND-OWNERS.

Four large pumps have been installed, and two more are to be, by the Zinc Corporation on its recently acquired tract of 770 acres situated in the centre of the south Carterville, Missouri, district. On the Luscombe land, which comprises a portion of the new lease, two 6-in. pumps are at work. In ten 24-hour shifts they lowered the water in the old mines to a depth of 180 ft. Mining was formerly done at this point. Work on this property was stopped many years ago. The main reason was the water. Through the draining of the Luscombe lease, a large part of the south end of the Cornfield lease also is drained. This will mean a resumption of work on this property. Two 4-in. pumps are working on the Ohio lease of the Burgner land, also held by the Zinc Corporation and included in the 770 acres. The water here has been lowered to the bottom of the old drifts, a depth of 175 ft. Deeper mining is contemplated. The two pumps yet to be installed will be on the Homestead tract. T. J. Franks, local manager for the Zinc Corporation, thinks that the entire tract will be drained by May 20. Several companies are planning to take sub-leases on the property.

S. Y. Ramage, who recently purchased 40 acres of the Schifferdecker land, also is interested in a new zinc smelter to be started at Pittsburg, Kansas. It will have a capacity of 300 tons of concentrate per week. The old North Pittsburg smelters have been taken over by the new company, which will be known as the Joplin Ore & Spelter Co. Only Joplin concentrate will be used. Turner & Co., of New York, are associated with Mr. Ramage in this venture. The plant will be arranged to run at full capacity by May 15. These smelters, which will have 1344 retorts, were last operated by the Cockerill Zinc Co. Another smelter at Pittsburg, Kansas, to resume operation within the past few weeks is that of the Pittsburg Zinc Co., owned by J. G. Starr, of Joplin, and the Lanyon interests of St. Louis. The plant has been leased to the American Metal Co. It is understood that Joplin ores will be used in conjunction with western ores.

Scores of speculators in Joplin, Galena, and Baxter Springs, Kansas, Miami, Oklahoma, and other cities of the Missouri-Kansas-Oklahoma zinc and lead district, are affected by the decision of the Supreme Court of the United States. This

reverses the decisions of lower courts relative to the rights of Indian land-owners to sell their royalty rights in mining properties. The lower Courts held that the Indians could barter their royalty rights as they wished. The Supreme Court prevents the Indians from so disposing of their rights. It provides that suit may be brought against those who have purchased such rights to force them to return the money they may have received from royalties. The Indians were found, as a rule, to be willing to dispose of their rights for ridiculously small sums. A state official of Oklahoma is owner of a right which he purchased for $300 from an Indian named Arthur Buffalo, a Quapaw. On this lease is situated the famous Turkey Flat mine, the royalties from which have aggregated almost $100,000 since the Quapaw relinquished his rights to it. The Court also maintains that overlapping leases are void. It was the custom of lessees to procure renewals each year from the Indians. The Court holds that the leases expire at the time specified in the first lease taken out. This will affect many large lease-holders who procured leases about 10 years ago, and who have been renewing them for periods of 10 years each year or so, following the procuring of the first lease.

Morrison & Co. have sold their soft-ground mine on the Connor land, south of Webb City, Missouri, to T. F. Coyne. He will immediately begin construction of a mill to replace the old hand jig-plant that has been in use at this property for several years. Although this lease is surrounded on three sides by hard, sheet-ground mines, the ore formation at this immediate property is in soft ground requiring heavy timbering. The ore occurs at 235 ft. This is about 30 ft. deeper than the level of the customary sheet-ground development at the surrounding properties.

The initial turn-in of concentrate has just been made from the remodeled mill of the Jasper County Mining Co.'s No. 1 plant on the Connor land, south of Webb City. Operations are conducted at 220 ft. in sheet-ground. The mill, which has a capacity of 300 tons, is practically new. The old plant had not been operated for many years. Formerly it was worked under the name of the McKinley Mining Company.

G. L. Cole is constructing a 300-ton concentrating plant on the Calumet lease, west of Neck City, Missouri. Mining is conducted in soft ground at a depth of 180 feet.

Firm zinc-ore prices at $55 to $60, basis of 60% metallic zinc, are stimulating much small activity throughout the district. Operators are looking for better ore prices in view of the strength of the spelter market.

CRIPPLE CREEK, COLORADO

New Leasing Company.—Ore in the Trail.—Elkton.—Drainage.—Isabella.—Portland Lessees.

The Cripple Creek Deep Leasing Co. is the name of a new syndicate in this district. It was organized by H. A. Riedel and A. P. Mackey of Denver. It has leased the ground between the sixth and eighth levels of the Jerry Johnson mine.

The Trail mine, whose west side-line parallels the Cresson, but which has been idle for some time, is back on the list of shippers again. Chris Eby and associates drove into this ground from the 1200-ft. level of the Dexter. They have opened a 4-ft. vein that returns about $100 per ton. They have now a stope nearly 100 ft. long on this shoot. Since the ore generally resembles the bonanza ore of the Cresson, great things are predicted for this lease.

The outlook at the old Elkton is bright once more. This is due to the good ore being mined on the No. 15 level. The cutting of another water-course in the Roosevelt drainage adit a fortnight ago lowered the water sufficiently to enable work on this level to proceed. The management reports the ore found to be most satisfactory. This mine is the next in line to be immediately benefited by the drainage adit. The contract now to be let calls for completing the adit to the Elkton shaft. The water at the end of April is receding in that shaft at the rate of six inches per day.

The Isabella is developing well again. On the ninth level of the Lee shaft, on the Buena Vista vein, or possibly on a vein parallel to it, a new shoot is yielding $25 per ton for coarse rock, and $150 to $200 for screenings. On the ninth level of the same shaft the Theobold lease is producing a good tonnage that will average 5 oz. per ton. The vein is well defined, and giving every indication of being persistent.

The Portland company recently decided to lease what is known as the tunnel level of No. 2 shaft. Several lessees have been successful in finding ore. One set, Miller & Co., have opened a vein one foot wide which assays about 20 oz. per ton. The stope now being cut will be 60 ft. long, with ore still showing in the face of the drift. The Portland company is working two shifts, employing about 400 men. It is keeping the local mill and that at Colorado City going full blast.

Lessees on the Vindicator are doing remarkably well just now, especially the Shatz lease on the 800 ft. level of the main shaft. This lease has been in operation about two years. It has brought splendid returns since the beginning. Another good one is the Brunner on the 1100-ft. level of the same shaft. Returns for this ore average $100 per ton continuously. The company is at work on the No. 17 and 18 levels in good ore. Average shipments on company account return between 2 and 4 oz. per ton.

SALT LAKE CITY, UTAH

Beaver, Salt Lake, and Summit County Notes.—Alta District.—Ohio Copper Company.

In Beaver county the Leonora mine in the Star district, situated between the Moscow and Cedar-Talisman mines, is doing some interesting work to expose the vein on the 400-ft. level. Production continues from the 150-ft. level.——The Rob Roy owners, who have been quiet for a long time, are entering on a development campaign due to some encouraging results of recent prospecting.

In the Alta district of Salt Lake county, the Cardiff mine, which was the scene of a rich development a few months ago, continues to be the centre of attraction. It has caused a considerable boom in that whole Cottonwood section. The limits of the orebody have not yet been determined. Net profits in sight are somewhere near $1,000,000. The company has shipped 1500 tons to date extracted in developing the orebody. This ore nets $30 per ton. On September 8, 1914, the stock sold for 3c., on April 26, 1915, it sold for $3.50. As the ore occurs on a limestone-quartzite contact that has been little explored, and is quite extensive, a good deal of the Alta excitement is justified.

A. S. Ross and others of the Pittsburgh-Idaho company have exercised an option on the control of the West Toledo Mining Co.'s stock. This property adjoins the Cardiff. The company will be re-organized.——The Michigan-Utah company has reorganized with a strong directorate. Bondholders took stock in the new company. The company owns 1000 acres, including the City Rocks and Grizzly veins. These are credited with a gross production of about $800,000.——The finding of high-grade ore in a rise in the Alta Tunnel & Transportation Co.'s property has aroused great interest. This tunnel, which crosscuts many of the best veins of the district at great depth, will be a great benefit in drainage, transportation, and prospecting. It is now 1200 ft. long. It starts in Silver Fork and Big Cottonwood, and heads almost due south for a point near the southern boundary of the Michigan Utah property, making a total contemplated length of 5000 ft. Among other veins it will intersect are the Prince of Wales, Richmond-Teresea, Alta Con., and Michigan-Utah.——By May 1 the Alta Con. and Wasatch mines will be able to use the roads for freighting ore.——The South Hecla expects to begin shipping on June 1.

The American Flag mine is to begin shipping to the Park

City mill, Summit county, next week. With the completion of this mill the American Flag now has a market for the low-grade ore developed in the past. Sommer Schmidt is in charge. The Thompson-Quincy Co. has reorganized under the name of New Quincy. Development is to be started. The property is well situated adjoining the Daly-Judge and Daly West.

The Ohio Copper Co., Salt Lake county, which has been in trouble, has apparently profited by having its copper tied up by the Court. The mine has been shut down by the Court for some months. Meanwhile copper has risen to 18 cents per

MAP OF UTAH.

pound, so that by this increase in value the company is much stronger financially than it was before. The Bingham Central Railroad Co. had a suit against the Ohio for $22,000. The Ohio had a counter suit for $135,000. The Salt Lake Engineering Co. had a suit for $36,000. Unsecured creditors also had a lien. There are promises of an early adjustment of the financial difficulties.

The Utah Metals & Tunnel Co. has come into the field as a shipper, the ore going to the Murray smelter.——There is unusual activity in Stockton. Lessees in the Hidden Treasure mine are keeping six ore-teams busy.

GOLDFIELD, NEVADA

TAILING TREATMENT.—JUMBO EXTENSION AFFAIRS.—ATLANTA VENTILATION.—PLACER GROUND.—BOOTH, ORO, SILVER PICK, KEWANAS, GREAT BEND.

With the dry weather, the Goldfield Consolidated will begin the treatment of its vast accumulation of tailing, a Lidgerwood cableway having been erected at a cost of $90,000 for the purpose of conveying this product back to the mill. Exhaustive tests throughout the large area of the tailing-pond indicate a return sufficient to insure a substantial profit from this source. Changes or additions to the mill-equipment for this operation involved little expense. The 100-stamp mill is treating a little over 1000 tons daily, the ore coming from the Mohawk, Combination, Laguna, Clermont, and Grizzly Bear mines, all of which are connected at various levels. From the Mohawk workings, on the 450-ft. level, drifts are being advanced into the Combination Fraction, which adjoins the Mohawk on the south, and is under lease to the Consolidated.

On the railway-spur at the Jumbo Extension mine, cars are being spotted for the shipment of some 300 tons of ore that has accumulated from development in extending the rich 524 drift. During April, 6 carloads, approximately 300 tons, was shipped to relieve the congestion in the bins. This ore yielded net returns more than sufficient to defray the operating cost for the month. Under the stipulations with the Booth company, entered into subsequent to the filing of the apex suit by the latter, all funds realized from production are impounded in the bank, but both companies have called special meetings of stockholders for the purpose of ratifying the agreement in settlement of this litigation, and immediately following such ratification the apex suit will be dismissed and all restrictions placed upon the Jumbo Extension company's operations will be removed. The dividend of 5c. per share, declared in January and payable to stockholders of record February 1, will then be paid, and it is probable that another dividend will be disbursed shortly. The capital stock of the Jumbo Extension company is to be increased from 1,250,000 to 1,750,000 shares, and out of the increase 300,000 shares will be transferred to the Reorganized Booth company in settlement for all claims of extra-lateral rights within Jumbo Extension territory. The latter company will resume operations with approximately $250,000 and 200,000 shares of stock in its treasury, and with a large tonnage of high-grade shipping ore available for immediate marketing. At the Velvet shaft, now 300 ft. deep, the new equipment is being installed, and sinking will proceed with all possible speed to a depth of 1017 feet.

In the Atlanta, air has been obtained for the workings on the 1750-ft. level by connecting vertical rise 1010-A, from the 1750-ft. level, with a winze sunk from the extended 1400-ft. level of the adjoining Grizzly Bear mine of the Goldfield Consolidated. Connection between the air-rise and the drift in ore, at the top of another incline-rise, 115 ft. above the 1750-ft. level, ensures good ventilation. Stoping will now proceed on this ore, with shipments for the present at from 30 to 40 carloads of 50 tons each per month. Drifts will be advanced into the Grizzly Bear claim, the south half of which, below the 1400-ft. level, is under lease to the Atlanta company.

Tests of the placer ground on the Sandstorm and Kendall groups have shown a gold content of from $3 to $10 per cubic yard over a considerable area, and for an average depth of 18 inches. Further tests to determine the best process of treatment have been delayed by storms.

On the 500-ft. level of the re-organized Booth, a drift near the foot-wall is progressing in ore sampling from $8 to $12 and of a character suitable for cyanidation. If any tonnage is developed here the product will probably be treated by the Goldfield Consolidated.——Goldfield Oro, adjoining the Booth, has exposed many seams of pay-ore in large masses of highly mineralized quartz, on the 700 and 800-ft. levels.——Silver Pick Con. has completed sinking its main shaft to 700 ft., and is cutting a station here, from which a cross-cut will be driven west for the shale contact and the large vein that dips toward the shaft.——At a depth of 840 ft. the Kewanas is extending drifts northwest and southeast along the latite-shale contact, the northern drift following a wide fissure that extends into the shale.——Development work is in progress on more than two dozen properties in the district.

The Goldfield Great Bend company has placed an order for new surface equipment, including a 6-drill compressor, a 42-in. by 10-ft. air-receiver, and a 75-hp. Westinghouse motor. The new equipment also includes a two-stage Cameron pump and new head-frame. The 75-hp. electric hoist has been installed at the vertical shaft, the unwatering of which will drain all the old workings. J. K. Turner is consulting engineer for the company, and work will be under the direction of Jack Campbell, who was in charge of the famous Reilly lease on the Florence and the almost equally productive Quartzite lease.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press

ALASKA

Cordova

A small dredge is to be constructed this season for C. Herron at Six-mile creek, Cook inlet, near Seward. The ground was prospected by a Keystone drill last year.

Fairbanks

A new Heilig stamp-mill has been started at the head of Fairbanks creek. A 14-ton lot from the Mizpah mine yielded $1150. Goyette and Ward, Hoover, Moreno, Huddleston, McNeil, and others have a fairly large tonnage to be crushed.

Juneau

March returns from the mines on Douglas island are as follows:

Details of operations.	Mexican.	Treadwell.	United.
Development, feet	373	1,130	1,238
Stock of broken ore	-16,653	-43,128	-16,572
Stamps working	120	540	270
Ore crushed, tons	19,985	76,787	43,547
Concentrate treated, tons	447	1,795	963
Total gold recovered	$40,733	$156,490	$93,433
Average per ton milled	2.04	2.03	1.85 to 2.55
Operating profit	$16,755	$70,931	$36,573
Construction	3,793	14,411	10,907
Net profit	12,962	56,520	25,665

Nome

In the *Press* of April 10, placer mining on the Seward Peninsula was discussed. Transportation in the Kougarok was mentioned. K. Knott and C. Philipson, dredge engineer and superintendent of the Kougarok Dredging Co., of Nome, returned to Seattle on the last trip of the *Victoria*. Contrary to the belief of many old-timers in the territory, particularly transportation men, the caterpillar engine, sent up last season to transport the company's freight, was a decided success. Freighters at Nome wanted $120 per ton for taking the dredge 65 miles into the Kougarok district. The Caterpillar transported 10 tons, or the first load of freight, for less than $20 per ton. It was hauled over ravines, gullies, and tundra, up 25 to 40% grades at 2½ to 3 miles per hour. Owing to the lateness of the season in getting into Nome, this company stored a considerable portion of the outfit, but is now prepared immediately to install and operate as soon as navigation opens in the spring.

ARIZONA

The local papers have been discussing the recovery of gold from various placer deposits of the State. They are all dry, and some method must be devised to treat them. Rich gravel occurs in the Plomosa and La Paz districts of Yuma county, Weaver in Yavapai, San Domingo, Leviston, and Old Hat in Maricopa, Quijota and Greaterville in Pima, and many others.

Cochise County

Officials of the Mascot Copper Co., whose mine is at Dos Cabezos, were in Douglas last week. According to Mr. McCauley, 1,500,000 tons of copper ore is blocked out. The Mascot and Western railroad from Wilcox to Mascot will be finished in about six weeks. Ore shipments, amounting to 200 tons daily, will be sent to the Copper Queen smelter at Douglas.

An increase of wages was announced at Bisbee on April 29. The average extra pay is 8%. About 6000 miners and smeltermen will be affected. The increase is due to the advance in copper.

Gila County

Construction at the Inspiration is proceeding at the usual pace. Concreting the main east shaft is practically completed. When the guides are in, the Nordberg hoists described in the *Press* of April 17 will be tested. The air-compressors are ready for work. They consist of two Ingersoll-Rand machines of 1400-cu. ft. capacity each for 100 to 1000 lb. pressure. The latter is for the Porter locomotives. Another I.-R. engine delivers 7000 ft. per minute. The other compressor is a Nordberg of 3000 ft. capacity. One of the three 3000-kw. Curtis turbo-generators was recently tested. The General Electric guarantees were beaten.

At the Iron Cap there are 25 men employed. Stoping is under way between the 650 and 800-ft. levels. Five cars of ore have been shipped. This contained from 8.45 to 11.80% copper.——The Calumet & Arizona company is preparing to mine at full capacity. The carpenter-shop at the smelter was burned on April 27. Damages are about $2000.——In the suit of C. A. Barrett *v.* the Ray Consolidated for $30,000, the plaintiff was awarded $500. He was injured in the mine at Ray, Pinal county. It was the first case tried (at Phoenix) under the State's employers' liability act.——The Old Dominion company at Globe has posted a notice regarding increased wages. Under the new scale a miner who at 15c. copper receives $3.75 per day will, with the metal at 16c., get $3.90; at 17c., $4; at 18c., $4.15; at 19c., $4.25, and all others in the same proportion.

A complete display of the minerals of Gila county will be the next attraction added to the headquarters of the Gila branch of the Arizona chapter of the American Mining Congress.

The International smelter, at Miami, is to be blown in on May 10.

Mohave County

It is reported that at a depth of 60 ft. in new ground, 400 ft. from the west boundary of the Gold Road mine, a wide body of rich ore is being opened.

Yavapai County

It is reported at Jerome that the Copper Chief company will erect a 150 to 200-ton stamp-mill and cyanide-plant. A large tonnage of ore has been developed.

CALIFORNIA

Gold and silver received at the San Francisco mint in April amounted to 374,680 oz. and 126,655 oz., respectively. This was from other besides California producers. Coinage executed was worth $2,231,500. The stock of bullion, etc., on hand at the end of the month totaled $280,142,358.77.

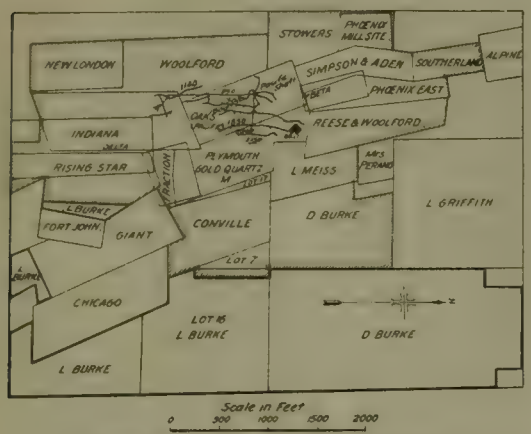
Amador County

On April 25 the Argonaut company paid its regular quarterly dividend of $60,000. The monthly output is about $60,000. An electric hoist is being installed at 3900 ft. in the incline shaft. The bottom level is at 4200 feet.

The report of the Plymouth Consolidated Gold Mines for the year ended December 31, 1914, has just been received from London. It makes interesting reading. Plans accompany it.

Development totaled 1816 ft., at a cost of 60c. per ton. Sinking and enlarging the main shaft (Pacific) curtailed this work. It is vertical to 1600 ft. Then it is inclined to 2150

ft. Cross-cuts were driven to intersect the drifts on the lode at 1850 and 2000 ft. Stations and ore-bins were cut at 1600, 1850, 2000, and 2150 ft. On the 1500-ft. level the main south drift was extended from 191 to 468 ft. From 300 to 392 ft. the vein was 77 in. wide, averaging $7.44 per ton. A rise above this level opened $5.28 ore over 79 in. width. At 2000 ft. the north drift averaged $6.48 per ton over 58 in. between 116 and 167 ft. The south drift opened $9.84 ore, 71 in. wide, between 48 and 121 ft. Stoping revealed greater widths of ore than were exposed by development on the various levels.



PLYMOUTH CONSOLIDATED PROPERTY. CLAIMS HATCHED, COMPLETELY HELD; DARK LINES, UNDERGROUND RIGHTS ONLY.

The grade has not been maintained over the increased widths.

Of the 44,773 tons of ore extracted, the following were the sources: development, 1455; surface dump, 3895; 950 ft., 1214; 1500 ft., 1510; 1600 ft., 14,530; 1850 ft., 15,073; and 2000 ft., 7096 tons. Mining cost $1.67 per ton.

The 30-stamp mill started in August. It treated 44,773 tons of ore. By amalgamation and concentration the yields were 5799 oz. gold and 1736 oz. silver, and 3654 oz. gold and 1133 oz. silver respectively. The yield was $4.36 per ton. The extraction was 88.24%. Tailing assayed 57c. per ton. Treatment cost 42c. per ton. Bullion and concentrate realization cost 29c. per ton. Revenue totaled $195,000. Costs totaled $3.26 per ton. A profit of $33,600 was made. Depreciation and other charges reduced this to $1060. Stores on hand are valued at $13,500.

Calaveras County

(Special Correspondence.)—The Finnegan and Finnegan Extension claims, at Carson Hill, four miles south of Angels Camp, have been acquired by the Carson-California Mining Co. This is composed principally of Denver men. The property has been under option for several months. A thorough examination has been made, including a 30-day mill-run. Results were so satisfactory that the present 10-stamp mill is to be doubled at once. A cyanide plant may be added. E. N. Hawkins is consulting engineer, and R. H. Toll superintendent.

Carson Hill, April 26.

Kern County

In commemoration of the twentieth anniversary of starting mining at Randsburg, *The Randsburg Miner* issued a special illustrated number on April 23. It states that there are nearly 100 gold mines in operation in the district. Short descriptions are given of the Yellow Aster, which has 100 stamps, the Black Hawk, Merced, King Solomon, Napoleon, Sunshine, Placer company's dredge, Consolidated, Red Dog mill, Baltic mill, Butte Lode, Atolia tungsten area, and the Southern Sierras Power Company.

Modoc County

Roads are being constructed to the Modoc mine in the High Grade district.——Some good developments are reported from the Quartzite, Tamarack, and other claims.

Nevada County

Construction material and machinery for the new mill at the Brunswick are arriving. The new railroad spur is proving useful in facilitating handling supplies. A cyanide plant is to be erected.

Concentrate from the Golden Center worth $10,000 is being treated at the Pioneer works near Nevada City.——Some good ore is being opened at 800 ft. in the Union Hill mine.

Plumas County

Two auto-trucks are now hauling copper concentrate from the Engels mine at Taylorsville to Keddie on the Western Pacific line.

It is reported that J. J. Reilly has sold a fourth interest in the Van Winkle claims for $20,000.

COLORADO

Gilpin County

At 1200 ft. in the Old Town mine, in Russell gulch, the Roberts and Hutchins lease has opened 12 ft. of rich gold ore for over 70 ft. A shipment of 25 tons to the Iron City mill returned about 6.4 oz. per ton.

Lake County (Leadville)

On April 26 the first water pumped from the Penrose shaft started to flow down Fourth street, Leadville. Great interest is being taken in this work.——Zinc sulphide ore mined here is being sold mostly to local buyers in the state.——The demand for manganese is increasing.——Lessees at the Hayden on Fryer hill are producing 20 tons of 22% carbonate of zinc ore.

Ouray County

In March the Camp Bird mine produced 2290 tons of ore. The profit was $36,000.

Teller County (Cripple Creek)

Smelters are now receiving 8% of the district's ore production. Formerly they handled only 5%.——The New York Trust Co., trustee under the mortgage on the properties of the United States Reduction & Refining Co., commonly known as the Mill Trust, has filed suit in the United States District Court for the appointment of a receiver on account of a default in the interest on the $2,650,000 of first-mortgage bonds outstanding. This means that all properties, including the Standard mill and the Colorado No. 2 mill at Colorado City, and the Union mill at Florence, will be sold. It will remove all chance of opposition to the Golden Cycle Mining & Reduction Co., recently reorganized by A. E. Carlton. These plants are out of date. The United States company was founded by Charles M. MacNeill and Spencer Penrose. The rates charged were so high that when J. T. Milliken bought the Golden Cycle mine he erected his own mill. From that day the trust began to lose money.——McGillvary and partners, lessees in the El Paso, have opened a shoot that averages $50 per ton without sorting.——Four carloads (30 tons each) of ore from the Cresson were shipped recently. The average value was about $1200 per ton. The Golden Cycle mill is treating this ore.——A 100-ton treatment-plant has been erected at the Jerry Johnson by F. T. Caley. He has a lease down to 650 ft. Below this the Cripple Creek Deep Leasing Co. has the ground. The shaft is down 925 ft. The output of the mine to date is approximately $1,750,000.

IDAHO

Bonneville County

Work has been resumed at the Carbon gold mine in the Mt. Pisgah district, 12 miles southwest of Soda Springs, on the Oregon Short Line. The main shaft is to be retimbered. A hydroelectric plant is proposed for Eagle creek, 2½ miles distant. About 160 hp. can be developed. A 10-stamp mill is ready for crushing. About 12,000 tons of $6.15 ore is opened. F. A. Putnam is in charge.

Shoshone County (Coeur d'Alene)

Dividends paid by Coeur d'Alene companies in April totaled $638,850.

Construction of the aerial tramway of the Interstate-Callahan company connecting the mill with the railway at Sunset station, began two weeks ago. Between 70 and 80 men are employed. It is anticipated that the line, about 10,500 ft. long, will be completed and ready to operate not later than May 15.——In the suit of the Stewart Mining Co. *v.* the Ontario Mining Co. and others over apex rights, the U. S. Supreme Court has decided in favor of the latter. This upholds decisions of the State District and Supreme Courts.——On May 4 the Bunker Hill & Sullivan company paid dividend No. 212. This amounted to $81,750. The total to date is $16,119,000.——An excellent contract has been made by the Success company for the sale of its lead-zinc-silver ores. There are 130 men employed at the mine and mill.——The Federal company's Frisco and Morning mines are to be further equipped and developed. A 2500-cu. ft. Ingersoll-Rand compressor has been ordered for the latter.

MONTANA

The revised itinerary of the U. S. Bureau of Mines Rescue Car No. 5 in this State is as follows: Stockett, May 2 to 8; Sand Coulee, 8 to 15; Belt, 16 to 22; Lehigh (mail address *via* Windham), 23 to 29; Roundup, May 30 to June 5; Klein, 6 to 12; Billings, 13 to 14; Bear Creek, 14 to 19; Washoe, 19 to 26; Red Lodge, June 27 to July 3; and Billings, July 3.

Granite County

Development of the phosphate deposits near Philipsburg is to be commenced by the Montana Phosphate Co. J. D. Fields is in charge of the organization. A U. S. Geological Survey bulletin just issued shows that the production of phosphate rock in the United States in 1914, as shown by the quantity marketed by States, was 2,734,043 long tons, valued at $9,608,041. Output in the preceding year amounted to 3,111,221 tons worth $11,796,231. The War has interfered with foreign business, hence the decrease. Florida yielded 2,138,891 tons; Tennessee, 483,203 tons; and South Carolina, 106,919 tons. Western States produced only 5030 tons.

Silverbow County

The large electric hoist at the North Butte mine has been tested. It is capable of raising 7 tons of ore per trip. From a depth of 4000 ft. it can haul 200 tons per hour. Drums are 12-ft. diameter. The steel rope is 1⅜-in. diameter.

The report of the Anaconda company for 1914 shows that the plant treated 3,748,726 tons of ore at Anaconda and 488,244 tons at Great Falls. Metal output was 223,720,292 lb. copper, 8,314,116 oz. silver, and 99,651 oz. gold. Some of this was from custom ore.

Open-cut mining has been resumed at the Bullwacker. The mill will not be operated. One hundred tons of ore per day is to be sent to the Pittsmont and Washoe smelters.

In the long suit of minority shareholders (Peter Geddes and others) in the Alice company *v.* the Anaconda company, the former was given a verdict on May 1 by Judge George M. Bourquin. Briefly, the dispute was one in which the minority holders wished to stop an executed sale of the Alice mine to the Anaconda. They consider the price too small. The decision ordered that a re-sale be made. If no better price is secured, the previous transaction remains undisturbed.

NEVADA

Clark County

'A Gold-Platinum-Palladium Lode in Southern Nevada' is the title of Bulletin 620-A, written by Adolph Knopf, issued by the U. S. Geological Survey. It may be obtained free from the Director of the Survey at Washington, D. C. The deposit consists of a mass of fine-grained quartz inclosed in dolomites of Carboniferous age. The precious metals are especially associated with a rare mineral that is known by the rather unwieldy name plumbojarosite, a hydrous sulphate of iron and lead. The mineral is locally known as greenish talc. This name accurately describes its main physical properties. Pockets of the pure mineral carry 100 oz. or more of platinum and palladium and several hundred ounces of gold to the ton. This richness points to a concentration of the precious metals in the oxidized ore by surface solutions, so that in depth the pockets of extremely high-grade ore, such as are now being extracted, will give place to ore of moderate grade.

Elko County

In a special copper edition of 44 pages, *The Contact Miner* describes the present condition of the Contact district and its possibilities. The area has been worked for over 40 years. Some promising properties are the Brooklyn, Contact Copper, Copper Shields, Delano, Carria, Nevada Copper, and others. Contact is 20 miles south of the Idaho line, on the Little Salmon river, which almost encircles the district. Flotation processes have proved successful on the ores produced.

Esmeralda County

The Atlanta shipped nine carloads of $20 ore to the Western sampler during April. Rise No. 1011-A is in $27 ore. Some contains copper. No. 1012-A is up over 65 ft. in $8 ore.——At 500 ft. in the Reorganized Booth, the drift is opening $10 ore.——The winze below 500 ft. in the Sandstorm-Kendall is to be sunk deeper.

The estimated production of the Goldfield Consolidated company for April is as follows: Ore mined, 30,822 tons; gross extraction, $317,000; operating expenses, $169,500; and net realization, $147,500.

Nye County

In the suit of the Jim Butler-Tonopah Mining Co. *v.* the West End Consolidated Mining Co., involving the ownership of ore in part of the latter's property, Judge Mark A. Averill, on April 30, decided in favor of the West End company. The case was one of extralateral rights, of great importance. Editorial reference to the dispute appears in this issue of the *Press*.

The pending suit of the Tonopah Mining Co. of Nevada *v.* the Tonopah Extension Mining Co. has been settled out of court by the directors in Philadelphia. A side-line agreement has been arranged. At 400 ft. in the Extension the west stope on the Egyptian vein is 20 ft. wide. On the 1260-ft. level the Murray vein has been cut. It is also 20 ft. wide. At 1170 ft. the shoot is 35 ft. wide. The weekly output is 1680 tons.

Eight mines at Tonopah produced 10,665 tons worth $217,930 during the last week of April.

Storey County

On May 3 the United Comstock Pumping Association had succeeded in lowering the water below the 2700-ft. level.

OREGON

Josephine County

(Special Correspondence.)—The mines of western and southern Josephine county, in and about the old mining town of Kerby, are more active this season than they have been for many years. The westward extension of the railroad from

Grant's Pass to Crescent City, California, has much to do with this awakening. A number of the larger properties are low-grade, and need adequate transportation. The assurance of this has stimulated mine-owners and mining companies to resume work on claims and properties that were practically abandoned. Copper, platinum, silver, iron, chrome, manganese, and limestone ores also occur in commercial quantities, and are being developed.——The new owners of the Takilma mines and smelter, Gunnell and Reddy, are preparing for the summer's work.——Prospectors are going forward up the Siskiyou trail from Holland, up around the old Briggs mine at an elevation of 4000 to 5000 ft.——Though there is considerable snow on the Siskiyous and the coast ranges, old

SOUTHWEST OREGON AND NORTHWEST CALIFORNIA. A NEW RAILROAD IS TO BE CONSTRUCTED FROM GRANTS PASS TO CRESCENT.

surface miners predict a shortage of water for placering this spring and early summer. The reason given for this is that the snow fell on dry ground. Mr. Wimer, manager of the Deep Gravel hydraulic mine, this being one of the most important in southern Josephine, states that his observations, covering many years in this district, lead him to believe the present season will be short, as the snow will melt without raising the streams, most of the water being absorbed. He is, however, making good use of the existing supply, and operating steadily.——The Logan and Simmons hydraulic placers have two to three giants in continual operation. The manager, John Logan, says this has been a fine season for these mines, and a number of very satisfactory clean-ups has already been made.——Among the quartz gold properties of this district that are making good showings with development done is the January First, on Sucker creek, owned by Harry Siskron. Ore is being packed out by burros and treated in a distant mill, and returns a profit.——The Little Gem mine, nearby, owned by D. K. Sutherland, is also opening satisfactorily.——One of the highest mines of the district is the Bird, at an elevation of 5300 ft., on Bollon creek. It is owned and being developed by Herz & Tibbits.

Philomath, April 28.

UTAH

The metallurgical treatment of the low-grade and complex ores of Utah is the subject of a preliminary report, 'Technical Paper 90' of the U. S. Bureau of Mines, by D. A. Lyon, R. H. Bradford, S. S. Arentz, O. C. Ralston, and C. L. Larson. It is issued jointly by the Bureau and the department of metallurgical research of the engineering station of the University of Utah. The paper consists of 38 pages, and should be procured by all mining men in the State. The discussions include cheaper treatment of silver ore, lack of zinc smelter in the State, the milling problem at Park City, low-grade ores of Tintic, characteristics of the ores of Utah, present processes, and possibilities of other methods.

Salt Lake County

The Arthur and Magna mills of the Utah Copper Co. are operating at full capacity. The payroll is now about $320,000 per month. In the suit of the company against the county for excessive taxation, the latter authorities had to pay $31,790. Two other cases are pending for nearly similar amounts.—— The Koehring cyanide process is being installed at the Wasatch Utah company's mine at the mouth of Little Cottonwood cañon.——In March the Utah Apex shipped and treated 3738 and 9890 tons of ore respectively. Operating profit was $10,920.

Utah County

To drain and afford easier development of the American Fork district mines, it is proposed to drive a 2000-ft. adit. Water has prevented shafts from being sunk below 100 feet.

WASHINGTON

Snohomish County

(Special Correspondence.)—The Eclipse Consolidated Mining & Investment Co., of Seattle, has a quicksilver mine in this county. Ore reserves are estimated at 78,125 tons. The average content is 2.25% mercury. The ore also contains a large value in gold and silver. One furnace is in operation. Others are to be built in May.

Seattle, April 27.

Stevens County

After a lapse of 15 years, 45 tons of silver-lead ore from the Bonanza mine, near Bossburg, has been sent to the Trail smelter. In the early days this property produced nearly $1,000,000.——The United Copper mine has shipped 2842 tons of ore this season to Trail. Twenty-five additional men are to be taken on. Fifty stamps are being added to the mill.

CANADA

British Columbia

A three years' lease on the Kootenai gold mine, near Nelson, has been taken by the General Mining & Milling Co. of Spokane, Washington. The price is about $85,000. A 20-stamp mill has been working for 18 years. It will be remodeled. The output to date is about $1,000,000. Twenty-three sets of lessees are working. A lower adit is to be driven. This company is to erect a mill on the Flying Dutchman, 15 miles north of Nelson. E. V. Boog is in charge.

The Rocher de Boule Copper Co., operating near Hazleton, has sent 900 tons of ore to the Granby smelter. The ore will average $50 per ton. The present output is between 100 and 125 tons per day. An aerial tramway, 3½ miles long, connects the mine with the Grand Trunk railroad. D. Williams is in charge.

Ontario

Diamond-drilling is being done at 300 ft. in the Vipond. A winze is being sunk from 300 to 400 ft. The mill yielded $77,000 in the first quarter of 1915.——In March the Hollinger mill treated 25,780 tons of ore averaging $11.53 per ton. Owing to power shortage, operations were curtailed somewhat.—— At the Cobalt Reduction Co.'s mill the new slime plant was started last week. It has a capacity of 170 tons per day.

KOREA

On May 6 the Oriental Consolidated Mining Co. paid dividend No. 29, of 50c. per share. On 429,390 shares issued this is equal to $214,695.

PERSONAL

C. S. Herzig is at New York.

Charles M. Rolker is at New York.

Walter Harvey Weed is here from Boston.

Howard F. Wiebum was in Oregon recently.

L. A. Smith is at Lebong Donok, in Sumatra.

D. M. Riordan is now residing in San Francisco.

W. R. Lewis has returned to London from Siberia.

W. B. Cogswell is here from Syracuse, New York.

W. W. Mein is at Oakland on a visit from New York.

Leon J. Pepperberg has gone to Texas and Oklahoma.

Scott Turner sails from New York for London on May 1.

H. C. Wilmot has gone to Oregon and Idaho on professional work.

G. E. Stephenson has gone from London to Western Australia.

Rensselaer H. Toll, of Denver, is at Angels Camp, California.

H. W. Faulkner, recently in Mexico, has been on a visit in England.

Herman A. Prosser now has his office at 120 Broadway, New York.

E. N. Skinner is now with Hayden, Stone & Co., at their New York office.

L. L. Moore is superintendent at the Gold Road mine, at Oatman, Arizona.

Wallace E. Pratt expects to return to the United States in July for a vacation.

J. H. Collbran passed through San Francisco this week on his way from Korea to New York.

M. S. Brandt is engineer to the Seneca Consolidated Gold mines in Plumas county, California.

H. C. Dudley, of Duluth, passed through San Francisco, going from Arizona to the Coeur d'Alene.

L. D. Ricketts and J. C. Greenway were at the Fairmont hotel during the week; they have returned to Warren, Arizona.

J. V. N. Dorr was in San Francisco this week and has returned to Denver, where he will remain for the rest of the month.

William F. Jahn, metallurgical engineer, from San Juancito, Honduras, is sojourning in San Francisco on his way to New York.

F. Sommer Schmidt has been appointed superintendent of the American Flag mine and consulting engineer to the Park City Milling Co., at Park City, Utah.

Frederic R. Weekes, for the past five years connected with the New York office of A. Chester Beatty, will continue his engineering practice at 71 Broadway, New York.

David W. Smyth, formerly floor-member of the firm of Thompson, Towle & Co., is now a member of the firm of Filor, Bullard & Smyth, the former firm having been dissolved.

H. A. Morrison, formerly shift-boss for the Globe Consolidated at Dedrick, California, has left for Aurora, Nevada, where he has accepted a position in the mill of the Aurora Consolidated.

Durward Copeland, Professor of Metallurgy and Ore Dressing in the Missouri School of Mines and Metallurgy, is at New York preparing for a trip to England, the Straits, and other tin-producing countries.

S. C. Thomson, formerly consulting mining engineer to S. Neumann & Co., and J. N. Bulkley, formerly consulting mechanical and electrical engineer to the General Mining & Finance Corporation, have opened joint offices at 120 Broadway, New York.

Lead Production in 1914

By C. E. Siebenthal.

(Advance statement, U. S. Geological Survey.)

World's Production of Lead

Short Tons

Country.	1911	1912	1913
Australia	109,789	118,387	127,867
Austria-Hungary	21,605	23,589	26,565
Belgium	48,832	56,438	55,997
Canada	11,795	17,968	18,849
France	26,014	34,282	30,864
Germany	181,218	194,666	199,627
Great Britain	28,660	32,187	33,620
Greece	15,763	15,983	20,282
Italy	18,408	23,699	23,920
Japan	4,630	4,960	3,968
Mexico	137,347	132,276	68,343
Russia	1,102	1,102	1,102
Spain	193,013	205,799	223,767
Sweden	1,213	1,433	1,653
Turkey in Asia	13,668	13,779	15,322
Other countries	22,597	13,448	6,834
United States (domestic, refined)	391,995	392,517	411,878
Total	1,227,648	1,282,513	1,270,458
United States percentage of world's production	32.0	30.6	32.4

Domestic Production of Lead

Short Tons

	1912	1913	1914
Domestic ore:			
Alaska	45	6	.....
Arizona	3,891	4,901	5,602
Arkansas	.....	.....	52
California	811	3,294	3,698
Colorado	37,039	42,840	41,198
Idaho	127,780	137,802	177,827
Illinois	513	619	427
Iowa	.....	.....	34
Kansas	1,937	1,504	1,043
Kentucky	91	16	16
Missouri	162,610	152,430	194,275
Montana	2,517	3,256	4,386
Nevada	5,699	6,142	5,996
New Mexico	2,511	1,821	741
North Carolina	34	10	.....
Oklahoma	2,500	3,214	3,916
Oregon	21	37	17
South Dakota	12	7	2
Tennessee	.....	.....	.....
Texas	30	108	89
Utah	60,664	71,069	88,976
Virginia	85	878	143
Washington	53	9	2
Wisconsin	3,301	2,639	1,818
Undistributed	120	63	99
Zinc residues	3,131	3,765	4,125
Total from domestic ore	415,395	436,430	534,982
Foreign ore:			
Africa	1,774	5,976	2,942
Canada	29	16	2
Central America	.....	.....	.....
Mexico	7,407	4,512	2,386
South America	2,332	2,617	1,821
Other foreign	30	102	488
Foreign base bullion:			
Canada	.....	.....	.....
Mexico	76,805	37,359	21,689
Total from foreign ore and base bullion	88,377	50,582	29,328
Grand total, derived from all sources	503,772	487,012	563,810

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, May 6

Antimony	28	—28¾
Electrolytic copper	19¼	—19½
Pig lead	4.45	— 5.45
Quicksilver (flask)	$70.00	
Spelter	15	—15¼
Tin	45	—46½
Zinc-dust, 100-kg. zinc-lined cases	17	

On account of the rise in spelter, zinc-dust is higher. Carload lots are sold at 15c. per pound. Zinc sheets are also high.

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, May 5.—Copper is easier, lead is dull; urgent demands for spelter have subsided.

On the following page of this issue appears the first of a weekly letter from New York covering the metal markets.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Apr. 29	18.63	Mch. 24	14.90
" 30	18.75	" 31	15.37
May 1	18.75	Apr. 7	15.75
" 2 Sunday		" 14	16.03
" 3	18.63	" 21	16.85
" 4	18.50	" 28	17 93
" 5	18.50	May 5	18.63

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13 60	July	13.26	....
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.61	Oct.	11.10	....
May	13.97	....	Nov.	11.75	....
June	13.60	....	Dec.	12.75	....

Exports during the week ended April 17 totaled 10,098,634 lb., valued at $1,504,985. Of this, 5,702,566 lb. went to England, 2,298,396 lb. to France, 1,360,329 lb. to Italy, and 560,335 lb. to Russia by way of Siberia. Imports amounted to 9,645,745 lb. in ore and matte and 2,528,538 lb. in bars, etc.

March yields of Chino, Nevada Con., Ray, and Utah Copper were 1,416,087, 4,535,192, 5,632,168, and 10,203,882 lb. respectively. Calumet & Hecla has sold ahead of production 45,000,000 lb. at 15 to 20c. per pound.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending	
Apr. 29	50.62	Mch. 24	50.33
" 30	50.50	" 31	50.14
May 1	50.50	Apr. 7	50.04
" 2 Sunday		" 14	50.06
" 3	50.25	" 21	50.18
" 4	50.12	" 28	50.60
" 5	50.00	May 5	50.33

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	....
Feb.	57.53	48.45	Aug.	54.35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	50.25	Oct.	51.12	....
May	58.21	....	Nov.	49.12	....
June	56.43	....	Dec.	49.27	....

The silver market shows strength for a few days, then quotations fall. Evidently there is a lack of support, or too much is placed on the market for sale. On May 1 about 350,000 oz. left San Francisco for the Orient. Last week the Nipissing shipped 250,501 oz. to London via New York.

ANTIMONY

Little can be said of antimony so far as English brands are concerned. Their quotations throughout April were nominal at 32c. for Hallett's, and 35c. for Cookson's. All of the business was in Chinese metal, the prices of which ranged from 20 to 21c. England's reason for placing an embargo on the exportation of antimony is due in large part to its use as a hardener in shrapnel bullets. The shot which the shells scatter contains 10 to 12% of antimony.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date		Average week ending	
Apr. 29	4.20	Mch. 24	4.15
" 30	4.20	" 31	4.15
May 1	4.20	Apr. 7	4.23
" 2 Sunday		" 14	4.20
" 3	4.20	" 21	4.20
" 4	4.20	" 28	4 23
" 5	4.20	May 5	4.20

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3 80	....
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	....	Nov.	3.68	....
June	3.90	....	Dec.	3.80	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Apr. 7	80.00	Apr. 21	80.00
" 14	80.00	" 28	70.00
		May 6	70.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60.00	Aug.	80.00	....
Mch.	39 00	78.00	Sept.	76.25	....
Apr.	38.90	77.50	Oct.	53.00	....
May	39.00	....	Nov.	55.00	....
June	38.60	....	Dec.	53.10	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
Apr. 29	12 50	Mch. 24	8.59
" 30	12.50	" 31	8.50
May 1	12.13	Apr. 7	8.75
" 2 Sunday		" 14	9.12
" 3	12.13	" 21	9.37
" 4	12.00	" 28	11.04
" 5	12.00	May 5	12.21

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	5.22	9.05	Aug.	4.45	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9 78	Oct.	4.75	....
May	4.91	....	Nov.	5.01	....
June	4.84	....	Dec.	5.40	....

The American Zinc, Lead & Smelting Co. has sold to the General Electric Co. 150 tons of spelter at 17c. per pound for June and July. On May 1 zinc ore at Joplin was in good demand at $70 to $75 per ton, basis of 60% metal. Highest price paid was $78. Weekly production is about 5400 tons. Shipments are over 6000 tons. Stocks are therefore decreasing. The Picher Lead Co. has leased the Carlinville zinc smelter of 1536 retorts, at Carlinville, Illinois.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	....
Feb.	39.76	37.23	Aug.	50.20	....
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	....	Nov.	33.51	....
June	30.72	....	Dec.	33.60	....

On May 5 tin was dull at 39.50c. per pound.

ALUMINUM

Spot aluminum is nominal at 19 cents.

Eastern Metal Market

New York, April 30.

SUMMARY

The strength of copper is unimpaired. Tin is lower following larger arrivals. Lead is quiet at unchanged prices. Spelter is scarce and stronger. Chinese and Japanese antimony is stronger, while English brands continue nominal.

COPPER

In the past few days there has been a good business in both electrolytic and Lake copper, with the latter in greater demand. It is estimated that the domestic consumption for ordinary industrial purposes is about 60% of normal, which is something of an improvement. The urgent call, however, continues to be for metal to be used in the manufacture of munitions of war. Electrolytic is quoted today at 18.62½c., cash, New York, and prime Lake at 21c. cash. It remains true that the prices of choice brands of Lake are subject to private negotiation and at least 23c. is paid for some of them. More ordinary brands sell at 21 to 22c., and arsenical brands at 20c. or less. Producers of prime brands of Lake are sold up to August, and there is not much electrolytic to be had for early delivery.

Following the rising market, the American Smelting & Refining Co. announced the base price of hot-rolled sheet-copper in April as follows: April 8, 21c.; April 13, 21¼c.; April 14, 21½c.; April 17, 22c.; April 19, 22½c.; April 22, 23c.; and April 28, 24 cents per pound.

SPELTER

Large consumers of spelter in the manufacture of galvanized sheets are showing anxiety over the future supply of the metal. They do not want to commit themselves to forward deliveries of sheets unless they know that the necessary spelter will be forthcoming. Spot metal is quoted today at 14.50 to 15c., and only an occasional car can be found. Sales of prime Western have been made at 14c. for future delivery. Metal has been offered at 13.25c. to 13.50c. for June and July, and at 12.25c. for deliveries scattered through the remainder of the year. The ordinary differential between New York and St. Louis prices no longer exists. London has been much excited in the past few days. On April 28 it advanced £5 10s. to £64 10s., thereby breaking all records for sharp advances in the spelter market. Another effort to halt the market was made on the floor of the New York Metal Exchange on April 28, 100,000 lb. being offered for May delivery. It was sold in two lots of 50,000 lb. each, bids being accepted at 13.25c. and 13c. These prices are not taken, however, as being a true index of the open market. The interests that sold are the same as sought to bring the market down a few weeks ago, and with some success, although this time it was the metal and not a price which was offered. The chief demand continues to be for the choice grades used in the making of cartridge metal, and fancy prices are obtained. The base price of sheet zinc was announced on April 28 as 16c. f.o.b. smelter, an advance of ½c. per pound.

TIN

Activity of late has been almost entirely confined to futures, with the spot market nominal at declining prices. The quotation today was 39.50c., against 55c. April 14. The cause of the decline was the heavy arrivals, particularly from the Far East in the last few days of April. The steamer *Chinese Prince* arrived with 400 tons from Singapore, 125 tons from Penang, and 75 tons from Batavia and Hongkong. The *Shimosa* arrived with 550 tons from Singapore, 400 tons from Penang, and 25 tons from Hongkong; the *Dardanus*, with 575 tons from Batavia, while there also were fair arrivals from London and Liverpool. In the month 4310 tons arrived. Much of this tin will be applied against old contracts, and it is predicted that another scarcity will exist shortly. The quantity now afloat is 2200 tons, 725 tons of which is from Banca. The deliveries for the month were fair, amounting to 3200 tons, 1100 tons of which came to the East by way of Pacific ports. In stocks and landing April 30 was 3041 tons. The trade continues to be greatly hampered by the regulations and restrictions imposed by the British government. The Tin Committee of the New York Metal Exchange has been directed to continue its efforts to obtain a modification of England's requirements, and in the meantime sellers will not be liable on their contracts to deliver unless consumers supply the necessary agreements. It also was decided that sellers were not liable on April contracts if the necessary agreements were not received in time.

LEAD

The market is quiet. London quotations have been up and down alternately, though in quotations here there has been little change. The New York price is 4.20c. and that at St. Louis 4.10c., the latter being fixed by independent producers. The great war demand for copper and spelter does not seem to be shared by lead, much as the latter metal is associated with ammunition. A recent break in London is attributed to manipulation by interests who sought to buy to advantage, with a view of then letting the price rise again.

ANTIMONY

In the past few days the mere offering of antimony was sufficient to cause a scramble. Yesterday there was large buying of spot and future Chinese metal, and the market advanced to about 30c. per lb. It was quoted at 27 to 28c. theretofore. Cookson's is nominal at 35 to 36c., and Hallett's is unquotable. Future Chinese antimony has sold at 27 cents.

ALUMINUM

Prompt shipment metal, 98 to 99% pure, is quoted at 19.25 cents per pound.

EXPORTS OF METALS, APRIL 1 TO 30, 1915

Copper	15,472 tons	Spelter	4854 tons
Lead	5,963 "	Tin	74 "

Schools and Societies

The UNIVERSITY OF UTAH summer session of five weeks will commence on June 7. The faculty for 26 subjects will consist of 45 instructors.

The AMERICAN PETROLEUM SOCIETY will hold its annual meeting at San Francisco from October 25 to 30. Besides the reading and discussion of papers special excursions to the oilfields of California and Oklahoma are being arranged.

The St. Louis branch of the A. I. M. E. held its annual meeting, dinner, and excursion on May 1. W. L. Saunders and Bradley Stoughton were present, also H. W. Gepp, of Broken Hill, New South Wales. The new zinc smelter of the Granby company at East St. Louis was visited.

The department of Mining Engineering and Metallurgy of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY has received through the courtesy of Charles Hayden, '90, a member of the Corporation, an interesting addition to its laboratory equipment. This is a complete working unit of the Janney oil-flotation apparatus. The machine is fitted with more than the usual adjustments for various ores. It has an electrical control to enable it to be worked at different speeds, also observation windows for observing the action.

Copper Production in 1914

By B. S. Butler

*The smelter production of primary copper in the United States in 1914 was 1,150,137,192 lb., compared with 1,224,484,098 lb. in 1913, a decrease of about 6.1 per cent.

The total value of the 1914 output, at an average price of 13.3c. per pound, is $152,968,246, against $189,795,035 in 1913.

In the following table the production for 1914 is apportioned to the states in which the copper was mined. The total is made up of fine copper contents of blister produced, and of the smelter output of ingot and anode copper from Michigan. The production of 1913 is given for comparison.

Production of Copper in the United States in 1913 and 1914

[Smelter output, in pounds fine.]

	1913	1914		1913	1914
Alaska	23,423,070	24,980,847	Pennsylvania	245,337	422,741
Arizona	404,278,809	382,444,922	Philippine Islands	22	
California	22,492,265	29,784,173	South Dakota	4,549	
Colorado	9,052,194	7,310,066	Tennessee	19,489,654	18,061,112
Idaho	8,711,490	5,875,205	Texas	39,008	34,272
Maryland		12,248	Utah	148,057,450	100,589,660
Michigan	155,718,286	158,009,748	Vermont	5,771	
Missouri	570,204	73,519	Virginia	46,961	17,753
Montana	285,719,918	230,805,845	Washington	732,742	683,602
Nevada	85,209,536	60,122,904	Wisconsin		10,098
New Mexico	50,196,881	64,204,703	Wyoming	362,235	17,082
North Carolina	180	19,712	Undistributed	40,803	55,381
Oklahoma	11				
Oregon	77,912	5,599		1,224,484,098	1,150,137,192

The total production of new refined copper in 1914 was 1,533,781,394 lb., a decrease of 81,286,388 lb. from the 1913 output.

The production of electrolytic, Lake, casting, and pig copper from primary sources and the production of secondary copper by the regular refining plants in 1913 and 1914, is shown in the following table:

Production of Primary and Secondary Copper by the Regular Refining Plants in 1913 and 1914

[In pounds.]

	1913		1914	
	Domestic.	Foreign.	Domestic.	Foreign.
Primary:				
Electrolytic	1,022,497,601	378,243,869	991,573,073	323,358,205
Lake	155,715,296		158,009,748	
Casting	22,606,040		21,506,325	
Pig	36,004,986		39,334,043	
Total primary	a 1,236,823,913	a 378,243,869	a 1,210,423,189	a 323,358,205
	1,615,067,782		1,533,781,394	
Secondary:				
Electrolytic	14,862,577		27,702,968	
Casting	22,360,182		4,224,052	
Total secondary	37,222,759		31,926,980	
Total output	1,652,290,541		1,565,708,374	

a The distribution of refined copper of domestic and foreign origin is only approximate, as an accurate separation at this stage of manufacture is not possible.

The figures for Lake copper include the Michigan copper that was electrolytically treated.

In addition to the secondary material treated by the regular refining companies, plants that treated secondary material exclusively produced a total of 224,000,000 lb. of copper as copper and in brass and other alloys of copper, making a total production of 256,000,000 lb. from secondary sources. Of this total at least 80,000,000 lb. was produced by re-melting clean scrap produced in the process of manufacture of copper and brass articles.

If the output of plants treating purely secondary material is added to the production of the regular refining companies, the contribution of domestic plants of the United States to the world's supply of copper for 1914 is found to be 1,790,000,000 pounds.

In addition to the output of metallic copper, the regular refining companies produced bluestone with a copper content of 8,602,861 pounds.

*Advance statement of U. S. Geological Survey.

Returns from all producing companies show that the following stocks of electrolytic, Lake, casting, and pig copper were on hand at the beginning and end of the year 1914:

Stocks of Refined Copper

	Pounds.
January 1, 1914	90,385,402
January 1, 1915	173,640,501
Increase during 1914	83,255,099

In addition to the stocks of refined copper, there were reported as at the smelters, in transit to the refineries, and at the refineries, blister copper and material in process of refining to the amount of 203,067,571 lb., on January 1, 1915, as compared with 247,789,811 lb. on January 1, 1914.

The apparent consumption of refined new copper in the United States in 1914 was about 711,268,000 lb. In 1913 it was about 812,268,000 lb. The method employed in determining the quantity of copper retained for domestic consumption is shown in the following table, which does not include stocks of copper held by consumers:

Apparent Domestic Consumption of Refined New Copper in 1912, 1913, and 1914

[In pounds.]

	1912	1913	1914
Total refinery output of new copper	1,568,104,478	1,615,067,782	1,533,781,394
Stocks at beginning of year	88,372,105	105,497,653	90,385,402
Total available supply	1,656,476,673	1,720,565,435	1,624,166,796
Refined copper exported	a 775,000,658	a 817,911,424	a 748,902,137
Stocks at end of year	105,497,653	90,385,402	173,640,501
Total withdrawn from supply	880,498,311	908,296,826	922,542,638
Apparent consumption	775,978,332	812,268,689	711,624,158

a Exports of pigs, ingots, and bars reported by the Bureau of Foreign and Domestic Commerce.

If to the 711,624,158 lb. of new refined copper is added the 256,000,000 lb. of secondary copper and copper in alloys produced during the year, it is found that a total of about 968,000,000 lb. of new and old copper was available for domestic consumption.

Copper Selling Prices in 1914

The following table from *The American Metal Market* shows the averages received by the selling agencies in 1914. Phelps, Dodge & Co. received the highest.

	Sold, pounds.	Prices, cents per lb.
Phelps, Dodge & Co.:		
Copper Queen, Detroit, Moctezuma	141,662,324	13.72
Calumet & Arizona	52,667,920	13.72
United Metals:		
Utah Consolidated	7,584,391	13.57
American Smelting & Refining Co.:		
Ray Consolidated	57,004,281	13.41
Tennessee Copper	12,871,113	13.706
American Metal Co.:		
Old Dominion	23,903,958	13.71
East Butte	8,175,579	13.5685
A. Lewisohn & Sons:		
Miami	32,879,447	13.3488
Shattuck-Arizona	10,846,918	14.1293
Calumet & Hecla (Lake):		
Tamarack	1,074,808	12.80
Isle Royale	6,601,235	13.16
Ahmeek	13,634,000	13.08
L. Vogelstein & Co.:		
United States Smelting	17,946,659	13.404
United Verde	32,449,116	13.553
Direct:		
Mohawk (Lake)	11,094,859	12.47
Quincy (Lake)	15,356,380	13.3

New Machines and Devices

Information based on letters and catalogues from manufacturers.

A New Cupel

The Joseph Dixon Crucible Co., Jersey City, New Jersey, has put on the market what it calls 'Dixon's wonder cupels.' These are made in three sizes, $1\frac{1}{4}$, $1\frac{1}{2}$, and $1\frac{3}{4}$-in. diameter. It is claimed that these cupels will be a veritable joy to refiners and assayers. Absorption of silver is much less than with cupels made from bone-ash, when used under similar condition. They are made of such strength that they will not break in handling. The cupels are packed in lots of 100, 500, and 1000.

A DIXON WONDER CUPEL.

On account of the War it has been a question for some time if it would be possible for foreign firms to supply United States laboratories and refiners with clay crucibles. The Joseph Dixon Crucible Co. has now a fairly complete line of assay crucibles, scorifiers, and goods of a like nature. So far the sale has not been of so great volume that the company has been able to compete in price with foreign makers. As scarcity increases, and larger orders are secured, there is little doubt but that as low, or possibly lower, prices can be made than imported goods of a similar nature now command.

Power Transmission at the Exposition

An instructive working exhibit arranged by the Dodge Manufacturing Co., of Mishawaka, Indiana, is open for inspection at the Palace of Machinery at the Exposition in San Francisco. Two forms of the Dodge 'American' system for transmission of power by manila rope are shown. The first is a direct drive from a motor to an intermediate shaft, horizontally. The second drives from this intermediate shaft vertically over idlers, thence horizontally to other idlers, thence down to the horizontal shaft. This shaft is mounted on floor-stands fitted with a friction-clutch that connects with an extension shaft that has a flexible-coupling and two pulleys driving a group of various types of conveyors. These conveyors consist of an oscillating-conveyor, a Zimmer shaking-conveyor, and three ordinary conveyor-belts. The first two mentioned are new for this particular service. This conveyor system, as shown, is attracting considerable attention among the mining men for handling and screening ore.

Among other interesting features in the exhibit is the 500-lb. flywheel running about 100 r.p.m., supported by the Dodge ring-oiling babbitted bearings, operated by a black linen thread (one strand) running over its periphery.

The method of lubricating what is known as the capillary bearing is shown. This is produced by a slotted block of wood placed in an opening in the bottom of the bearing, reaching down into a reservoir of oil underneath the shaft, held against the shaft by a coil-spring. The oil works through the slots up to the shaft by capillary attraction.

Two forms of friction-clutches, the Dodge split and the Dodge safety, are shown. The Dodge flexible coupling is another new feature. It consists of two flanges and a series of elliptical springs so arranged as to give freedom and flexibility to the coupling, even though the shaft may be out of line. This coupling is distinguished by not having any sliding or moving parts, the springs being held rigidly in place. There is also displayed Dodge wood split-pulleys, with bushing system; iron-spider, wood-rim pulleys, solid or split; standard iron split-pulleys; pillow-blocks for all services; line shaft-hangers; floor-stands; demonstration of methods of lubricating shaft bearings; demonstration of additional power required to turn shaft when out of line; example of action of capillary attraction feeding oil to shaft; collection of photographs illustrating process of construction; samples of Dodge 'Firmus' rope for power transmission; and samples of a long-fibre manila used in making 'Firmus' rope.

Metal Hose at the Exposition

A simple yet attractive exhibit in the Palace of Machinery is that of the Pennsylvania Flexible Metallic Tubing Co., of Philadelphia, Pa. It consists of copper and steel flexible tubing from $\frac{1}{8}$ to 8-in. diameter. Also connections. The pipe is suitable for liquid or gas. Three arches of 6-in. hose comprise the entrance to the booth. This tubing is used considerably at mines. At Panama over 200,000 ft. was employed. Severe tests were given. The company also shows an automatic barrel-filler. This cuts off the flow when the receptacle being filled has sufficient in it.

Manufacture of Spiral-Riveted Pipe

Spiral-riveted pipe has been in use for many years. Engineers and users of this class of pipe are familiar with its construction and the merits claimed for it over other types. In its manufacture, a strip of sheet-steel is wound into helical shape, with one edge overlapping the other for riveting the seam. In the process used by the American Spiral Pipe Co., of Chicago, the sheet is drawn and formed in such a manner that there is obtained a metal-to-metal contact in the spiral seam, stretching the steel on the outer lap slightly offset, in order that the pipe may be more nearly smooth on the inside. The riveting is done cold by compression, or squeezing under enormous pressure, not by percussion or hammering. This insures complete filling of the rivet-holes with slight countersink. The pipe comes from the machines in a continuous piece, and is cut to any desired length.

SPIRAL-RIVETED PIPE IN THE KLONDIKE. THAT USED BY THE YUKON GOLD CO. IS FROM 10 TO 42-IN. DIAMETER, OVER 30,000 FT. LONG, WITH A MAXIMUM HEAD OF 530 FEET.

Due to the mechanical construction of the pipe, the seam is the strongest part. This has been proved by hydraulic

tests for bursting pressure. This type of pipe has found a wide use in mining and the allied industries, where it has been profitably employed in connection with hydraulic power-plants also in hydraulic-mining operations.

The accompanying picture shows spiral-pipe with monitor connection as used at the Yukon Gold Co.'s property in the Klondike. At this particular installation there is between six and seven miles of spiral-riveted pipe, from 10 to 42-in. diameter. It is used for handling a head of water of 530 feet.

In the fourth edition of Catalogue No. 5, consisting of 80 pages, with illustrations, the AMERICAN SPIRAL PIPE WORKS, of Chicago, describes its products. This is an interesting publication. Besides showing the pipes and special fittings made, there are pictures of installations at the Homestake Mining, Yukon Gold, Henderson Light & Power, Sao Paulo, Brazil; Gotok Mining, Dutch East Indies; Incaoro Mines, Bolivia; Johnstown Water Co., Pennsylvania; Newhouse Mines, Utah; Ford Motor Co., and other mining and water companies.

Commercial Paragraphs

The April issue of the *Magazine* of the E. I. DU PONT DE NEMOURS POWDER Co., Wilmington, Delaware, contains some interesting notes on blasting for road construction, storing and thawing explosives, tamping and stemming, and electric blasting in coal mines.

The Isbell concentrator is the subject of Bulletin 1072 of the DENVER ENGINEERING WORKS Co., Colorado. Construction, operation, and points of superiority claimed are described. The table will treat feed containing from 6-mesh to slime, without previous sizing.

The sale of Nuttall gears, pinions, and trolleys, manufactured by the R. D. Nuttall Co., Pittsburgh, for the electric railway, mining, and industrial fields in the Chicago territory, has been transferred to the WESTINGHOUSE ELECTRIC & MFG. Co., 39 South La Salle street, Chicago.

In the annual report of the Inspiration Consolidated Copper Co., Arizona, the general manager, C. E. Mills, states that in the reduction of 14,000 tons of ore per day to 48 mesh MARCY ball-mills will be used. They will be fed with 1½-in. ore from the SYMONS disc-crushers.

The Sprague Electric Works of the GENERAL ELECTRIC Co. has issued two booklets on electric fans. These are for desks or ceilings, of all sizes, and are made for direct or alternating current. Prices are also given. The firm also publishes a folder on the 'Greenfielduct, the Pipe of Quality.'

In Catalogue U, the BROWN HOISTING MACHINERY Co., Cleveland, Ohio, describes its Brownhoist transfer-cars and larries. Cars of 60-ton capacity are used at the Bethlehem Steel, Dominion Iron, and other large companies' plants. The reciprocating gates used on bins give good service.

Electrically-driven centrifugal pumps are now unwatering the Penrose shaft of the Down Town Pumping Co.'s area at Leadville, Colorado. They were made by the PROVIDENCE ENGINEERING WORKS, Providence, Rhode Island. The drainage of this ground is expected to result in considerable ore being opened.

Three 30-in. LAGONDA multiple strainers are being added to the present equipment of the Duquesne Light Co., Pittsburgh, Pennsylvania. With this latest installation the plant will have a total of eight 30-in. Lagonda strainers. This company has also one 6, one 12, and one 14-in. strainer installed in its Rankin station.

Leschen's Hercules for April contains interesting illustrated notes on construction where its wire-rope is used, namely, at a gravel plant in Illinois, at the Alaska Gastineau mill at Juneau, Capitol of Utah at Salt Lake City, and constructing a 105,000-hp. hydro-electric plant in Alabama. Care of hoisting cables is discussed.

Type 'A' transformers of large capacities, type 'M' demand indicators (maxicators), type 'P' demand indicators (printometers), and commutating pole direct-current crane and hoist motor CO-1800 line are illustrated and described in *Bulletins* 45,201, 46,100, 46,101, and 48,100 of the Fort Wayne Electric Works of the GENERAL ELECTRIC Co. An index to active bulletins published is also to hand.

Oil-engines of the Diesel type are discussed in Bulletin 1532 of the ALLIS-CHALMERS MANUFACTURING Co., Milwaukee, Wisconsin. This particular design is of the horizontal type, operating on the true Diesel principle, using the open fuel-injection nozzle. The bulletin briefly describes the construction, governing, oils, cycle of operation, and shows indicator-cards of an engine using 12°B. Mexican crude oil.

For the power-plant of the San Luis Mining Co., Sinaloa, Mexico, sectionalized Pelton-Francis turbines and accessories were made by the PELTON WATER WHEEL Co., of San Francisco. Some parts were carried by mules, others by Indians. Three wheels will soon be in operation. Water for the plant comes from the Piaxela river. About 100 miles from Mazatlan the stream makes a wide ox-bow curve, flowing several miles through rock, then returning at one point within a few yards of its previous bed. Here the hydro-electric plant was built. Sectionalized wheels were described in the *Press* of February 6.

The report of the INGERSOLL-RAND Co. for 1914 shows that the net revenue was $1,967,723, only $50,177 less than in 1913. After paying interest, dividend, depreciation, etc., the surplus was $973,586. Two bulletins have recently been published by this firm. Form 3015 deals with portable air-compressors. These machines have been devised especially for contractors, miners, factories, and others using air-driven tools on work of a temporary nature. Form 4032 discusses the Jackhamer mounting, type JM-6. The mounting is for this machine, with or without water-feed, for flat, shallow holes in metal mines, and for use in coal mines.

Elevating, conveying, crushing, screening, power-transmission machinery for the mill, factory, and mine. 6 by 9 in., 384 pages. Illustrated. General catalogue No. 83. The JEFFREY MANUFACTURING Co., Columbus, Ohio, 1915. Among the 64 different industries using Jeffrey machinery are cement mills, chemical works, clay works, coal mines and accessory plants, dredges, filtration plants, foundries, irrigation works, mine ventilation systems, metal mines, power-houses, quarries, sand and gravel plants, and smelters. A great variety of screening and conveying systems is manufactured by this firm. Transmission of power by chains is gaining in favor. They are described in this publication in detail. A line of rope pulleys and friction-clutches is also made. Prices are given with each product mentioned.

An improved combination ore-feeder and ore-bin gate is being made by the E. H. MOYLE ENGINEERING & EQUIPMENT Co. of Los Angeles. In this patent the table of the feeder constitutes, and is, the bottom of the orebin. This arrangement is claimed to eliminate the old-style vertical ore-bin gate at the front of the bin, that was previously used to regulate the ore to the old-style feeder, located at the back of the mortar. This caused a considerable amount of trouble by reason of the clogging up of the vertical ore-bin gate.

Patents 1,121,117 and 1,121,118 have been granted to E. H. Moyle for a mortar for stamp-mills. They relate to improvements in mortars. The main object is to provide a means for distributing the ore to be crushed to each stamp separately, and to distribute the ore by circular means around the stamps. Other improvements claimed are in connection with access to stamps, prevention of cupping in dies, larger screen area, and increased capacity.

Mining and Scientific Press

Edited by T. A. RICKARD

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TONOPAH is one of Nevada's famous mining districts. Just now it attracts attention on account of new discoveries and apex litigation. We publish articles on these allied phases of mining activity. Next week Goldfield will be our subject.

TONOPAH, NEVADA

WITH this issue also we begin a series of technical reminiscences by Dr. Albert R. Ledoux, of New York, ex-President of the American Institute of Mining Engineers. These will be found interesting and instructive, especially to the younger members of the profession.

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Buyers Directory—Page 21
Advertisers Index—Last Page

TABLE OF CONTENTS

EDITORIAL Page.

Notes 749

The Lusitania 750

Tonopah 750
Litigation seems likely to overshadow mining.

The Search for Platinum 751
Possibilities opened by a recent discovery.

Industrial Journalism 752
Our Editor's views of its true function.

DISCUSSION

SPECULATION IN MINES.
By Courtenay De Kalb 753
An experienced engineer points out that all business is speculative.

AUTOMATIC DRESSING OF AMALGAMATING PLATES.
By E. S. Boalich 753
An account of an ingenious method of overcoming a difficulty in stamp-milling ore containing galena.

METALLURGICAL PRACTICE AT PORCUPINE.
By Noel Cunningham 754
Further discussion of this topic.

POWDER AND ITS PECULIARITIES.
By G. L. Sheldon and Harry East Miller 754
An experienced miner relates some instances of the peculiar action of powder, and a consulting chemist offers an explanation.

HEULANDITE IN OREGON.
By Graham J. Mitchell 755
A record of the occurrence of this mineral.

ARTICLES

INDUSTRIAL JOURNALISM.
By Horace M. Swetland 756
An address by a veteran publisher, delivered before the New York University Forum on Industrial Journalism.

STOPING METHODS AT THE NEVADA WONDER MINE.
By Thomas M. Smither 757
Waste-filling is employed. The waste material for filling is mined from the walls of the stopes through inclined rises. The chutes and manways are timbered, using a minimum amount of timber. The disadvantages are that low-grade material must be left, and shoveling is required.

Page.

ASSAY OF CYANIDE SOLUTIONS.
By C. E. Roadhouse 760
The methods to be used in an assay-office depend not only on the results desired, but also on the arranging of the work so that can be performed with a minimum of effort. The method described gives satisfactory results, requires little manipulation and almost no watching during operation.

TECHNICAL REMINISCENCES—I.
By Albert R. Ledoux 761
The first of a series of reminiscences by an engineer whose work has brought him into contact with men of various types in many different parts of the world.

APEX LITIGATION. JIM BUTLER *v.* WEST END.
By H. V. Winchell 763
The decision handed down in this case establishes the two new points that a vein may have an apex within a claim even if it does not come to the surface, and that from an apex which resembles the crest of an anticline extra-lateral rights may be claimed along both limbs of the anticline. This further complicates the already hopelessly involved apex law.

IDAHO MINERALS AT THE EXPOSITION 768

DEPARTMENTS

CONCENTRATES 766

REVIEW OF MINING 769
Special correspondence from Houghton, Michigan; Cripple Creek, Colorado; Platteville, Wisconsin; Miami, Arizona.

THE MINING SUMMARY 772

PERSONAL 776

SCHOOLS AND SOCIETIES 778

THE MARKET PLACE:
Lead Production in 1914. *By C. E. Siebenthal* 776
Metal Prices 777
Eastern Metal Market 778

COMPANY REPORTS 779
Alaska Gold Mines Company; Anaconda Copper Mining Company.

NEW MACHINES AND DEVICES:
Wood Tank and Pipe at the Exposition 780
Drag-Line Cable-Way Excavator 780
Commercial Paragraphs 780

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EDITORIAL

T. A. RICKARD - - - - Editor THOMAS T. READ - Associate Editor

MINING in the North is favored this year by an early break in the ice on the Yukon. The first steamer left Lake Lebarge for Dawson on May 5.

TRADE between Pacific ports, notably Seattle and the Orient, is breaking the record. The Great Northern Steamship Company has added Vladivostok to its ports of call. Mining engineers going to Siberia should note this fact.

PREPARATIONS are well under way for the use of flotation at Cananea, both for the treatment of current tailing and that which has been stored from previous operations. A machine devised for the purpose by Mr. David Cole will be used.

AMONG the survivors from the *Lusitania* disaster was Mr. Scott Turner, who at one time was on the staff of this paper and since then has made an honorable reputation for himself in a wider field. With his many friends we rejoice in his escape.

IN this issue we publish the first of a series of articles by Mr. Albert R. Ledoux, embodying technical reminiscences of a most interesting character. These were prepared for publication on our urgent solicitation, and will, we feel sure, be widely appreciated. Dr. Ledoux, as he is usually known in the profession, received his degrees of A.M. and Ph.D. from the University of Berlin, having previously spent three years in the Columbia School of Mines. He started business at New York in 1880 and since that time he has had a wide range of successful practice, as is well indicated in the articles we are fortunate in being able to publish.

WITH deep regret we record the death of Franklin Guiterman, on May 10, at New York. During recent years he was prominently associated with the Guggenheim mining and smelting enterprises, more particularly the New River coal company, in West Virginia. Before the big smelter consolidation was made by the Guggenheims, he was manager of the Durango plant in Colorado, and still earlier he was secretary of a clearing-house established at Denver for the distribution of the regional ore-supply. In this work he showed exceptional ability and tact, as he had previously as secretary of the Colorado Scientific Society. A graduate of Freiberg and a man of pronounced intellectual activity, Franklin Guiterman was a capable metallurgist, a sagacious man of business, and a good citizen.

MEXICAN MINERAL production figures have been almost impossible to secure of late. A supplement to *Commerce Reports* for April 30 contains interesting reviews of several states during the year 1914, as supplied by the respective United States Consuls. The declared exports of minerals were as follows, compared with those for 1913, the latter being in parentheses: Chihuahua—crude metals and ores, $3,661,820 ($4,390,-885); actual production, copper, 1,484,622 lb. (2,365,-056 lb.); gold, 10,998 oz. (13,127 oz.); lead, 24,040,508 lb. (33,985,575 lb.); silver, 5,052,439 oz. (5,490,594 oz.); and zinc (estimated), 107,977 lb. (8134 lb.) Aguascalientes—copper bullion, $1,399,873 ($8,816,376); and lead bullion, $189,177 ($938,051). Durango—gold, $36,-372 ($104,176); silver, $182,958 ($622,585); lead, $64,-794 ($181,634); and copper, $40,277 ($470,196). San Luis Potosi—bullion, $189,429 ($1,109,191). Tamaulipas—crude oil, $6,180,909 ($7,130,632). Nueva Leon—ore, $68,337 ($111,618); and bullion, $1,846,143 ($5,-210,835). Sinaloa—Silver and gold bullion, $584,687 ($2,502,430). These figures show exactly the result of the disturbed state of the Republic. Credits have been completely disorganized. Large producers will not resume operations until conditions become more stable. The supply of labor is insufficient and precarious. Supplies are difficult to transport to the mines, even when they are landed at ports. Currency is continually fluctuating and depreciating. Coke, cyanide, and dynamite have been confiscated. Retrenchment and uncertainty have prevailed in all lines of industrial enterprise or commercial activity. Railroad traffic has been hampered greatly. Such are the opinions voiced by the Consuls. Nevertheless, it is remarkable with what

tenacity operators cling to their mines and how they manage, despite misrule, to produce so large a volume of metallic products.

The Lusitania

The tragic end of this great steamship has caused a wave of emotion round the world. We shall not dwell on the political aspect of the event. To engineers the sinking of the ship appeals, among other reasons, as the destruction of one of the greatest feats of engineering, for the *Lusitania* in her hull, her machinery, and her internal arrangements as an ocean carrier was one of the proudest works of man. As a favorite among the vessels facilitating the crossing from New York to Liverpool, she was well known to a great number of mining engineers and metallurgists in every corner of the earth, and, as such, she with her officers, particularly the kind and genial purser, J. A. McCubbin, had won a special place in the regard of our nomadic profession. Fortunately on her last voyage she carried an unusually small quota of those engaged in metal mining, the larger portion of the business men aboard coming from among those dealing in war supplies and otherwise participating in the more deadly business to which millions of thinking men are now devoted. The news of the disaster had an effect recalling vividly the loss of the *Titanic*, but in this case the tragedy of the sea gained in horror from the fact that it was the deliberate action of man, not the accidental interference of Nature. For that reason to most of us the loss of life loomed larger than a ten-fold bigger casualty on the battlefield. It will sear the minds of even those that look on the European conflict as a cinema show, and it cannot fail to impress the wide world with the brutality of the destructive forces that have been let loose by the incidence of war.

Tonopah

In our last issue we referred to the outside activities of several of the leading companies in this famous silver-mining district of Nevada. From these it might almost be inferred that the district was decadent. Such an inference would be unjustifiable. True, the reckless days of bonanza discovery are largely past, but a large measure of progressive and expansive development continues. In the older part of the district—the portion identified with the early developments on Mizpah hill, at the foot of Mt. Oddie—the ore outcropped in vein-fractures traversing trachyte; the principal veins, the Mizpah and Valley View, being cut-off at a depth of 600 feet by an intrusion of rhyolite, accompanied by faulting. The Tonopah claim itself never yielded any ore below the 6th level, although numerous drill-holes were sunk 1500 to 2000 feet deeper. The premier company of the district is now gleaning from old workings. But in the two western claims, the Red Plume and Sand Grass, between the Tonopah Extension and the Midway properties, the work of development is proceeding on veins that show no bottoming of the ore. Elsewhere in the district the orebodies make no showing on the present surface, or, to use the terms of a much-abused law, they have no "top or apex" into the daylight of today. Fortunately, superficial prominence affords no measure of the persistence of ore at Tonopah, for the veins that outcropped were of brief continuity as compared with the lodes uncovered under the eruptive flows that cover the surface of a geologic yesterday. Under a cap of andesite the miner found lodes that not only followed the contact between the earlier and later eruptives, but vein-fractures and lode-channels that transgressed many of them. Despite a geologic structure that was complicated further by faulting of a manifold character, the miner, aided by the geologist, was enabled to trace the ore-bearing fractures and channels to a horizon far below that reached by the short-lived veins that had first invited exploitation. At the present time important orebodies have been uncovered in systems of fracture both in the trachyte and along its contact with rhyolite and breccia, and these orebodies are being followed westward under the flat that extends at the foot of Mt. Oddie. The rock encasing these new discoveries is later than the dislocation that interrupted the veins of the eastern area, hence they have escaped the geologic amputation associated with the intrusion of the rhyolite, more particularly. Recent developments westward, as we have stated, are encouraging, especially in the workings from the Murray shaft of the Tonopah Extension mine; also in the Tonopah Merger shaft northward. It is rumored that the West Tonopah is to be re-opened, while still farther west a new head-frame indicates the resumption of work at the Bonanza, on the strength of an important find in the Monarch Pittsburg, where a wide lode traversed by rich stringers was uncovered last February. By a joint agreement made between the owners of adjoining properties, the pumping in this territory is being done through the Victor shaft, so that the burden of unwatering and drainage is being performed systematically. All this is of good augury. Another cheerful note is furnished by the North Star mine, on the southwest slope of Mt. Oddie, where the lowest level, at 1250 feet, has found an orebody in a down-thrown block of trachyte. Apart from this peculiarity, the ore is remarkable locally on account of the increased proportion of gold. At Tonopah the average ratio of silver to gold quantitatively is 100:1; in this North Star orebody the ratio is about 12:1. Ore assaying $35 to $40 contains 1.35 to 1.5 oz. gold with 9 to 15 oz. silver per ton. The exploratory work at this place is meagre as yet, but it is highly promising and it is peculiarly interesting as indicating an increased proportion of the more valuable metal. As against these promising features there comes the threat of apex legislation, like a Banquo's ghost at the feast of the mining operators. The Jim Butler *v.* West End suit, just decided in the lower court, suggests the uncertainties of litigation, and we do not hesitate to express the hope that other disputants will be warned by it from going to law. It is no secret that the Jim Butler owners

were offered $125,000 and 'fifty-fifty,' that is, one half of the proceeds from ore below the disputed line; it being further suggested that the Jim Butler company should mine the ore while the West End people were to mill it. The ore in dispute was supposed to be worth $1,000,000. The Jim Butler company disdained the compromise outlined above and went to court, losing the first round of the contest. Meanwhile, with a good sense highly to be recommended, the Tonopah and Tonopah Extension companies have settled another apex quarrel, and we hope that this example may be followed. In a district where a real apex or outcrop is rare, it is unwise to make an appeal to the blind lady with the scales. For example, in one locality three separate veins unite in depth to form a lower contact. Which of these three veins is to give the apex right to that contact? And if not one of these three veins reaches the present surface, is the right of apex to be granted to one of them or all of them? Manifestly it will be more profitable to be a lawyer than a miner at Tonopah unless the good sense of the community exerts a restraining influence on litigious mine-owners. If the new discoveries of ore are to stimulate any measure of real prosperity in the district, it will be necessary to make such reasonable compromise as may ensure the spending of money in exploratory work underground, not in punitive expeditions in the courts. Given such a policy, we expect to see a healthy expansion of productive activity at Tonopah.

The Search for Platinum

Platinum ranks as one of the precious metals because of its value, approximately double that of gold. It also qualifies as belonging to the first rank of the so-called 'noble' metals, since it resists attack by both acids and alkalies; but according to use it might well be regarded as one of the necessary metals of industry, since its applications are almost entirely those of every-day work, its employment in the fabrication of jewelry being a recent fact that happily has attained no great vogue. Because of its freedom from attack by chemical reagents this metal has become essential to chemical research and engineering and no chemist ever has more platinum ware than he thinks he needs. As already indicated, the demand is persistent and strong, while the supply is limited. The mode of occurrence of platinum is essentially the same as that of placer gold, with which it is, indeed, found widely distributed in small amount. Some years ago there was much excitement throughout the United States over the discovery of the presence of small quantities of platinum in gold-bearing sand in many localities. The prospector was quickly disillusioned, however, for it was soon proved that the amount present was so small and the cost of recovering it so great that the sand could not be exploited at a profit. Fortunately for the chemist, however, platinum is found in large amounts in placer deposits in the Southern Ural mountains of Russia. There in the Perm, Tcherdinsk, South Ekaterinburg, and north and south Verchotur districts some 275,000 ounces of platinum is secured annually, about half of it by dredging and the remainder by ordinary washing operations. The Choco district of Colombia produces about 12,000 ounces per annum, also from placer deposits. The yield of the rest of the world is almost negligible, the production of all sources combined in the United States being only about 1000 ounces; one-half from placer operations and the remainder from the refining of copper and gold bullion. Russia is thus in the enviable position of controlling the world's supply of platinum, a situation that consumers do not regard with equanimity, since it would be perfectly feasible for the Government of that country to place an export-tax on platinum and make the foreign consumer pay it. Indeed, simply as a result of trade conditions, the selling price of platinum has doubled in the past decade. The search for platinum has, therefore, not only the stimulus of the high price of the metal but the added incentive of the desirability of finding domestic sources of supply.

The common practice of the gold miner after finding placer deposits is to hunt for the 'mother lode' from which they were derived. In the case of gold such search is not infrequently successful, but in the case of platinum deposits it has been uniformly unsuccessful. Until recently only in two cases has platinum been found in veins of any importance, in both instances associated with copper. The nickel-copper ores of the Sudbury district in Canada contain an appreciable amount of platinum in the form of the mineral sperrylite, the arsenide. About fifteen years ago sperrylite was also discovered in the copper ores of the Rambler mine, a short distance southwest of Laramie, Wyoming. This attracted much attention, but the deposit proved small in extent and the mine was quickly exhausted. This served to subdue the hopes of those who had seen in the finding of this deposit the possibility of discovering other lodes containing a recoverable amount of platinum, and though many copper mines have been developed since that time, in none of them has platinum been detected.

Recently a fresh field for the discovery of lode-platinum has been afforded by a find of that metal in a new association in the Boss Springs district of southern Nevada. This deposit consists of a mass of fine-grained quartz enclosed in Carboniferous dolomite. The platinum occurs associated with plumbo-jarosite, a hydrous sulphate of iron and lead, in notable amount, pockets of the pure mineral carrying as much as 100 ounces of platinum and palladium per ton. Statements as to the geology of the deposit are authentic, since it has been examined by Mr. Adolph Knopf for the United States Geological Survey. The vital question is whether the ore will prove to be non-persistent, as in the case of the Rambler mine, or whether masses of large size can be uncovered. If so, then the search for similar deposits in this and other districts will be much accelerated. This discovery serves to illustrate the fact that it is not safe to generalize too much regarding mineral associations. Platinum was not known to occur in lead deposits in

dolomite, and most geologists would have considered them an unlikely place for search until the find in Nevada put a new face on the matter.

An addition to the present domestic sources of platinum has also recently been made. The use of jigs on dredges to recover gold lost on the tables was described in our issue of November 28, 1914. It is proposed to use the jigs on the dredges of the Natomas company, recovering the gold from the jig-concentrate by grinding in Hardinge mills. The concentrate contains about $2 worth of gold per ton, and Mr. Charles Janin has recently made the important discovery that platinum, with its allied and equally valuable metals, is present. It is not yet certain whether this can be recovered cheaply, but if it proves practicable the platinum output of the United States will be nearly doubled thereby.

Industrial Journalism

On another page we publish a portion of an address on this subject delivered recently by Mr. Horace M. Swetland. We owe an apology to Mr. Swetland for giving so small a part of his address, which should be read in its entirety in order to be properly appreciated. While the subject is only related indirectly to the technology of mining, it interests us keenly. Industrial journalism has developed into a great institution, aiding and stimulating the application of science and system to the production and sale of manufactures. In America, more than anywhere else, this form of journalism has been one of the most serious and successful phases of press activity. Every division of industry has one or more periodicals devoted to the interests of those engaged in it; indeed, the term 'class journalism' is often used as a synonym, suggesting specialization in behalf of particular departments of industrial activity. Mr. Swetland himself mentions, as examples, several publications that are notable exponents of the textile trade, and we may add that he himself is the protagonist of the automobile business. At one time he was the publisher of our immediate contemporary and competitor at New York, so that he has an understanding of another branch of journalism, for we differentiate between the industrial and the technical phases of journalism. The latter may be included within the former, but it is, or should be, distinct from it. The distinction is not always visible to the unaided eye. What industrial journalism aims to be is told explicity by Mr. Swetland: its purpose is to serve the manufacturer and those supplying the raw material for manufacture. It holds out both hands frankly in solicitation for advertising patronage; to it the editor is a necessary evil; the business manager is the centre of productive activity. In short, the business of publishing such papers is frankly commercial, and they succeed exactly as they fulfil their function. "The constituent of the industrial press does not buy his paper to be entertained." He asks only that it shall be "of service to him in his business." He regards it merely as a commercial mentor and "leaves the problem of making the paper to the publisher," not the editor, who receives his orders from the controlling capitalist, who, in turn, goes in and out of the business as he sees chances to make money therefrom. There is no waste of sentiment and no continuity of tradition. The sole aim is to produce an effective device for merchandising by means of advertising. We trust that this description will not seem unkind just because it is plain. The work done by this branch of journalism is tremendously useful, and even if it is wanting in any lofty ideal, it is safe to say that it stands on a higher level than most of the daily press. We wonder whether Mr. Swetland and the other speculative publishers in New York will concede that technical journalism aims, even if it fails, to operate on a different basis? The technical periodical looks for readers, and all the support thereby implied, in a profession, not a trade. What is the difference? Well, the member of a profession does his work for the love of it, for the sake of doing it well, and in order to win an honorable livelihood; a tradesman does his work merely as a means of making money. A surgeon and a plumber are alike in some respects, but different in others; a society of mining and metallurgical engineers resembles an organization of plumbers, with a difference. How great that difference may be we leave to the reader to decide for himself. Our own idea is that it is considerable. The technical paper endeavors to give the information required by a particular profession; it aims to express the ideals of that profession; it takes its policy from the editorial, not the business, department; it is based upon the expectation of meeting the requirements of the particular profession. If it succeeds in these purposes, it is read by the members of that profession, and therefore its advertising pages become an effective medium for the display of the trade ministering to the requirements of that profession. On the advertising the prosperity of the enterprise depends, of course, but the editorial independence from the trade is essential to retaining the confidence of the readers. So long as the reading pages command the respect and confidence of those that have the say in the buying of the manufactures used in the profession, to the interests of which the paper is dedicated, so long will the advertising pages furnish an effective medium for merchandising those manufactures. Thus the trade meets the profession on neutral territory and business is stimulated without loss of integrity or independence on either side. That at least is the theory underlying the activities of the *Mining and Scientific Press*. It is well occasionally to make a confession of faith. We believe that by ministering to the current thought and knowledge of the mining and metallurgical profession, through reading matter carefully prepared, we shall cause a large proportion of the members of the profession to read this periodical; we also believe that if they read it, it will become an effective means of advertising the machinery and supplies used in mining and metallurgy. If we can do the first, the second will follow. That is technical journalism.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment

Speculation in Mines

The Editor:

Sir—It may be an open question whether mining is a more venturesome business than others. We are constantly reminded by statisticians that the majority of commercial and manufacturing enterprises fail. A bare 10% of the carefully calculated schemes of business men survive the uncertainties in production of raw materials, the vagaries of the markets, and the errors in judgment and foresight of those responsible for the operation. Nearly all endeavor in the world of business is a game of hazard. The miller who must grind grain and the spinner who must spin cotton to escape the financial perils that beset a halted enterprise is compelled to tempt fortune in the market, to take chances in making purchases when prices are reeling, and to risk consumption of his wares at remunerative figures. The merchant confronts identical difficulties, too obvious to necessitate illustration. Men plan and theorize, calculate and philosophize, while not a few consult mediums, and most of the time they are only guessing, and nine-tenths of the time are guessing wrong. Let us say, then, not merely that mining is speculative, but that business is speculative.

Surely no more than nine-tenths of the mines hopelessly and forever swallow the capital invested in them. It is necessary at this juncture to make haste to settle upon definitions, without which endless and aimless discussion must ensue. We must recognize that a mine is not a simple hole in the ground, nor a promoter's prospectus, nor yet a gudgeon's dream. A mine is a mineral deposit which has undergone sufficient development to warrant somebody who is supposed to know in seriously proposing it as an object on which worthily to spend money with a view to economic production. It is precisely like any other business. Someone thinks he sees an opportunity advantageously to make and sell mining-machinery, or pumps, or automobiles; many thousands see the vision but fail to materialize it; while out of the struggle for success emerges a Chalmers, a Deister, a Deane, and a Ford.

There must be a risk in developing a mine. It is commonly called a gamble. On the other hand, how safe are the chances for money placed in the hands of the enthusiast endowed with that poetic gift called imagination, who believes that the world has need of a new machine-shop and of him as its manager? Yet out of such visions come the successes that the world applauds. Out of the courage of the prospector, out of the faith of the men who follow up his discoveries with their money and their effort, come our Copper Queens, our Homestakes, our Nevada Cons., our Utah Coppers; and facing it fairly none can say that, save in exceptional cases, there exists a larger proportion of the speculative element in the development of these enterprises than in the creation of The Cotton Products Co., B. Altman & Co., The National City Bank, and the *Mining and Scientific Press.*

Keeping in mind that all enterprise is venturesome, it may be said that the evils of speculation in mining become more acute with a loosening of the money market and a tendency to rush incautiously into the business without taking advantage of engineering guidance and restraint. It is the mad spendthrift who disturbs the rational course of mining investment that is based upon well ordered technical formulae of probabilities.

COURTENAY DE KALB.

Tucson, Arizona, May 3.

Automatic Dressing of Amalgamating Plates

The Editor:

Sir—In 1909 I was assayer for the company which was at that time operating the Duplex mine, at Searchlight, Nevada. The mill, an antiquated 10-stamp affair, was in charge of Charles Hammil, one of the many clever mill-men to be found in the mining camps of the West.

The ore contained so much galena that the plates became coated with a heavy lead slime, which acted much like grease, after a run of only a few minutes. In spite of this fact the gold was surprisingly free, and it had become the custom to hang up one battery every half hour for the purpose of giving the plates a dressing in the ordinary way. Though this operation was quickly performed, the aggregate time lost was sufficient to appreciably cut down the daily capacity of the mill, the stamp-duty of which was already too low.

After giving the matter due thought, Mr. Hammil built over the plates, largely with his own hands, an endless brush something like a belt-conveyor. The motion of the brush was against the current and the plates were thereby kept bright and clean. It is further believed that a saving in float gold, which under ordinary conditions would have never come in contact with the plates, was effected. A set of brushes was installed on the plates from one battery and tailing-samples carefully taken and checked against corresponding samples from the adjoining plates. Good results were strikingly

evident from the first. The pulp below the brushes consistently ran from 25 to 40c. lower than the pulp from the other side. Unfortunately the plant was shut down shortly after this, and, to my knowledge, the experiment has never been tried again; there nor elsewhere.

The construction of the brush was simple. The bristles consisted of ordinary broom straw, mounted on wooden strips as long as the plate was wide. These strips were fastened, at the ends, to chains which passed over, and meshed upon, small sprocket-wheels set on shafts at the ends of a frame made of 1-inch gas-pipe. The frame was strongly fastened at the end next the mortar only, by hinges. At this end, of course, was the drive-pulley. The other end was free to be hoisted out of the way by means of a small block and tackle. A discarded belt was mustered into service and thrown over the line-shaft and the good work was begun. It is regretted that more definite data are not at hand but the above facts, such as they are, are offered with the hope that they may be of use to somebody.

E. S. Boalich.

Washington, D. C., April 24.

[Possibly the galena might have been kept in motion, and thus prevented from lodging on the plate, by giving it a higher velocity over the plate. The statement that the stamp-duty was low might indicate that too little water was used in the battery. Perhaps some of our readers will contribute a record of their experience with a similar ore.—Editor.]

Metallurgical Practice at Porcupine

The Editor:

Sir—I have read with much interest Mr. Poirier's notes on ball-mill performance at the Porcupine Vipond in your issue of April 17. Mr. Poirier is well qualified to speak with authority on the subject. Possibly one statement that he makes might be open to question, namely, that the tonnage of ore ground per horse-power is "double that of stamps." A performance with stamps that could readily be maintained at both the Dome and Hollinger, breaking from 2½-in. ring through ¼-in. mesh, was as follows:

Tons per 24 hours per 10 stamps	150
Horse-power, per 10 stamps	25 to 30
Tons per 24 hr. per hp	5 to 6

I believe the Vipond is treating about 100 tons per day, and that the intermediate crushing equipment consists of a pair of rolls and two 4-ft. Hardinge ball-mills. In order to break down double the tonnage per horse-power the duty of this equipment must be 10 to 12 tons per 24 hours per horse-power. In other words, 10 horse-power or less would be required to drive a set of rolls (the size of which I do not recollect) and two 4-ft. Hardinge ball-mills. The statement in my article to which apparently Mr. Poirier takes exception was "Power per ton of ore ground appears to be slightly higher than with stamps for the production of identical results," and I think that Mr. Poirier will find that this is borne out in Porcupine practice. It is a point of much interest at the present time, and as a sincere believer in the ball-mill, I shall be glad to find myself in the wrong if Mr. Poirier has data from actual practice to prove his point.

Noel Cunningham.

Denver, May 1.

Powder and Its Peculiarities

The Editor:

Sir—It is curious how differently powder acts under conditions apparently similar. I have been at the side of a man carrying a box of powder, when it fell and did not explode. Again, I have known it to fall from a man's shoulder and kill every one near-by. I once had a mule loaded with grain and 100 lb. of powder; the cargo became loose and frightened the mule, which ran away, scattering the powder for a hundred yards and even breaking sticks of it, but without any explosion. A number of years ago a pack-train of 22 mules loaded with powder out from Mazatlan, Mexico, disappeared. It is presumed a box fell off when loading. At any rate the whole pack-train, including the men, was killed. The remains proved insufficient for burial.

Once a partner of mine was thawing powder at an open-air fire while we were eating dinner. It caught fire and as we needed that powder badly, he grabbed a shovel and deliberately beat the fire out with it. I yelled, trying my best to stop him, and then, as he kept on, I ran; but there was no explosion. Later his carelessness caused the loss of his eyesight. While working in a 240-ft. tunnel we tried to fire six holes at the breast. One would not spit and, after lighting the others, we again tried to ignite it, but were finally obliged to run. The fuse still declined to spit, and the result was a misfire. My partner insisted on returning (probably 6 to 8 minutes later) to re-light it, while I built a fire to warm our coffee. I tried my best to persuade him to wait until after dinner, but he went and was just over the hole when it exploded. This fuse, examined afterward, showed no evidence of having been burnt. [The fuse declined to 'spit' and the result was that this one hole misfired.—Editor.]

A friend had an experience with defective fuse in the bottom of a shaft. The fuse would not light. He and the others waited the full noon-hour, when, upon entering the shaft, it exploded. I have known an ignorant man to throw powder down a 40-ft. shaft to a miner without it exploding. That miner, however, did explode; climbing the ladder, he chased the other man off the property. The latter never returned. I have seen boxes of powder thrown down a bank, 60 to 75 ft. high, sometimes breaking the boxes, and still without exploding. I have seen loose sticks thrown from one car to another loaded with rocks and bounce off the car without exploding. Again, powder has been known to explode from a very slight shock or fall.

I have seen two or three tons of powder burn up without explosion and again have seen it explode from the heat of a stove while being thawed. A few years

ago a ship-load was lost at the entrance to the Bay of Altata, at Sinaloa, Mexico, and after several months it was salvaged. It was so badly damaged that new powder had to be used with it in order to make it explode, but, the price of powder being high, it was all used.

The action under similar conditions of powder of the same make and strength is so different, that the utmost care should always be exercised when handling any explosive.

G. L. Sheldon.

Ely, Nevada, April 15.

The Editor:

Sir—The detonation of nitro-glycerine and its compounds, among which the best known are dynamite and gelatine-dynamite, can only be brought about by one of the two following causes: First, the elevation of the temperature of the nitro-glycerine to its explosive point, namely, in the neighborhod of 400°F., but this does not apply to the entire mass of the nitro-glycerine; it is only necessary for the smallest particle of nitro-glycerine. The heat liberated by the explosion of this smallest particle is quickly communicated to the adjacent particles and progressing with lightning rapidity, in geometric ratio, detonates the entire mass as if by a single impulse. Second, by the synchronous vibrations responding to a wave of detonation set in motion by an exploding mass of nitro-glycerine. This second cause may perhaps be referred to the first; for sound, heat, and light are all forms of energy and are convertible.

Strange stories are often told regarding the erratic behavior of dynamite, and a veil of mystery is generally thrown about the resulting accidents. These stories are often correct, but there is no mystery. It must be borne in mind that dynamites, even those of the same grade or degree of strength, are often not the same, that is, they differ in composition. Again dynamites of identical grade and composition often differ as to their physical properties. For instance, take two dynamites of the same composition, in the one that is the drier the 'dope' ingredients are further away from the saturation point; this will render it less sensitive than the other.

The question is often asked what makes a dynamite sensitive. Instead of answering this question, let us consider how a dynamite can be made less sensitive. When nitro-glycerine—a heavy liquid—was first discovered it was used as such and it was soon found that it was far too sensitive. Nobel incorporated kieselguhr, or infusorial earth, with nitro-glycerine and called this compound 'dynamite.' The modern dynamite contains an active absorbent, one that enters into the combustion of the explosive, and is ever so much more powerful than a kieselguhr-dynamite with the same percentage of nitro-glycerine. It is superior in every respect but one, and that is, it does not hold the nitro-glycerine as firmly as the infusorial earth did.

What is it then that renders a nitro-glycerine compound permanently less sensitive? Here again we have two causes: First, anything that dissolves in, remains with, and dilutes the ultimate particles of nitro-glycerine. When once in solution and with the proper solvent there cannot be any stratification. This insures less friction between the ultimate particles of nitro-glycerine and then, again, these particles will be hampered in their effort to vibrate synchronously in response to a detonating wave. Second, anything that will dissolve in, become a part of, and hold rigid the ultimate particles of nitro-glycerine, preventing friction and hampering vibration, will render the nitro-glycerine less sensitive. This is accomplished by collodion cotton dissolving in nitro-glycerine and converting the same into blasting gelatine or with 'dope' into gelatine-dynamite.

Dynamites are not the same, neither as to chemical composition nor as to physical condition and the latter is largely influenced by atmospheric conditions—temperature and barometric pressure. All explosive phenomena must be referred finally to an elevation of a particle of nitro-glycerine to the explosive point. This may be occasioned by a sharp blow or fracture of a frozen crystal of nitro-glycerine or the gradual storage of heat generated by some slow process of oxidation akin to spontaneous combustion. The 'dope' materials are in general bad conductors of heat.

Harry East Miller.

Oakland, April 28.

[At our request, Mr. Miller has given increased value to Mr. Sheldon's letter by furnishing the above information. Mr. Miller is a recognized expert in such matters, and we are much obliged to him.—Editor.]

Heulandite in Oregon

The Editor:

Sir—Among some mineral samples recently sent to the University of Oregon for identification I found a specimen of heulandite. As there is no record of this mineral having been found in Oregon before, it is of interest to record this occurrence. This mineral was found on Rowe river ½ mile below Dorena, Lane county, Oregon. It occurred as the lining in a cavity in basalt.

Graham J. Mitchell.

Eugene, Oregon, May 4.

[Heulandite is a hydrous silicate of lime and aluminum, belonging to the group of minerals known as the zeolites; so named because they appear to boil before the blow-pipe. It usually occurs in basaltic rocks and has been recorded at many places in the eastern United States. It is found occasionally in metalliferous veins.—Editor.]

No. 1 converter at the Washoe plant, Anaconda, has produced 60,000,000 lb. of copper from matte; also 15,000,000 lb. from white metal transferred to it from other converters. The total was 75,000,000 lb., in slightly over 12 months. It is a 20-ft. diameter Great Falls basic-lined type.

Industrial Journalism

By HORACE M. SWETLAND

*Industrial publications must at all times be considered as serving three separate and distinct functions of an industry, and usually these three functions are served by separate and distinct publications, inaugurated by distinct individuality, and usually operated by separate and distinct ownership. The paper serving the first of these three functions is one devoted to the interest of the manufacturer, and having a circulation among the superintendents, experts, and owners in one special line of manufacturing, and an advertising constituency among those who supply raw material or machinery to this line of production. An illustration of an industrial publication, serving this function, is the *Textile World Record*, published in Boston, reaching the industry of textile manufacture, and having subscribers among the textile mill-owners, superintendents, and experts, and an advertising patronage from persons furnishing raw materials and machinery used in the manufacture of textiles.

The second function of industrial journalism has to do with the merchandising of the manufactured product, and has its circulation among the jobbers, dealers, or merchants selling this special product, and an advertising constituency consisting of the manufacturers of this product, illustrated by the *Dry Goods Economist*, with a circulation covering the dry-goods merchants and jobbers, and an advertising patronage from the manufacturers of textiles.

The third function of industrial journalism is served by a publication devoted to the interest of the ultimate consumers of the product of a special industry, educating them to a proper selection of the manufactured product, and the correct uses and service of this product, illustrated by *Vogue*, an industrial publication devoted to the interest of the user or consumer of the product of the textile manufacturer, and sold to them by the textile dealer.

These three phases of industrial journalism must be kept well in mind, namely, the paper devoted to the interests of the manufacturer, the merchandising paper serving the dealer, and the paper devoted exclusively to the interests of the consumer. At present, industrial publications sometimes endeavor to serve two or more of these functions, but eventually each industry of sufficient importance and of a sufficiently distinct character to require journalistic representation, will be served by a publication devoted especially to one and only one of these elements.

Industrial journals differ from all other forms of journalistic production in that they are not basically constructed to please and entertain the reader, and thus create and maintain a great sale for a publication. Unless the publisher knows the journalistic requirements of his constituency, and raises his reader to the level of his publication, he should retire to the ranks of yellow journalism. No doubt, the evolutionary process will serve the industrial press for some time before the rank and file arrive at a true conception of their mission. But all the great papers of the industrial press today are conducted on this basic principle of making the paper which the industry needs, while the number who are trying to please or entertain a class of industrial readers are growing continually less, and are joining the ranks of those who try to please everybody. Not that a constituent of the industrial press is less susceptible to entertainment or pleasure than the average reader, but he does not buy his industrial paper to be entertained. He has subscribed to the publication with the sole idea that it will be of service to him in his business, and he reads it in his thoughtful moments. If he were competent to dictate the kind of a paper he should have, the need for the publication would be very much lessened. He, therefore, should leave the problem of making the paper to the publisher, just as he leaves the painting of his pictures to an artist, and we wish to disclaim, once and for all, any successful policy on the part of the industrial press of trying to find out what the industry wants, and then pandering to the palate of ignorance or prejudice. The service of the industrial press, for this one basic principle, is of great value to an industry, just as the text-book is of value to the student, and as the picture designed and executed by the artist is superior to the conception of the ordinary purchaser.

The services of a competent journal, devoted exclusively to one of the three phases of an industry, may be classed as general and specific. The general or indirect service probably exceeds the specific or plainly apparent benefits, just as the indirect results from advertising exceed the direct returns. Just as the subtle influence of a great sermon, a great message, or a great editorial, rings true and awakens sentiment and feeling, which, in turn, inaugurates great reforms, so the promulgation, discussion, and reiteration of the great problems of an industry make possible a more intelligent solution than can be secured by individual effort.

Not that the editor of an industrial publication has supreme knowledge of all matters pertaining thereto, or assumes to be more wise than the combined intelligence of his constituency, but if he is even moderately successful in fulfilling the great obligation of his calling, he has command of, and access to, more sources of information than the layman. An editor is not expected to know everything. He is not a walking encyclopedia, but his work is intelligently indexed to the extent of quickly availing himself of the latest information from field or laboratory, and standing thus apart from active participation, with a clear field for perspective observation, unbiased by contingent individual conditions, he is able to reflect a consensus of intelligent opinion, of the greatest value and of lasting benefit to his readers. And in doing this he will find his chief reward.

*Part of address delivered before the New York University Forum on Industrial Journalism, March 24, 1915.

Stoping Methods at the Nevada Wonder Mine

By THOMAS M. SMITHER

The Nevada Wonder vein is of the fissure type, inclined at an angle of 75°; the foot-wall is rhyolite; and the hanging wall rhyolite, or occasionally dacite. The orebody itself, in most cases, is much fractured and crushed; the gangue consists principally of quartz, feldspar, and kaolin. The average width is five or six feet. No water is encountered. The walls in the lower levels are insecure and cave away in large masses, thus rendering useless both the stull system of support and the shrinkage system of stoping; although the shrinkage system was used to great advantage from the 400-ft. level to the surface, where the walls were fairly firm and stood well.

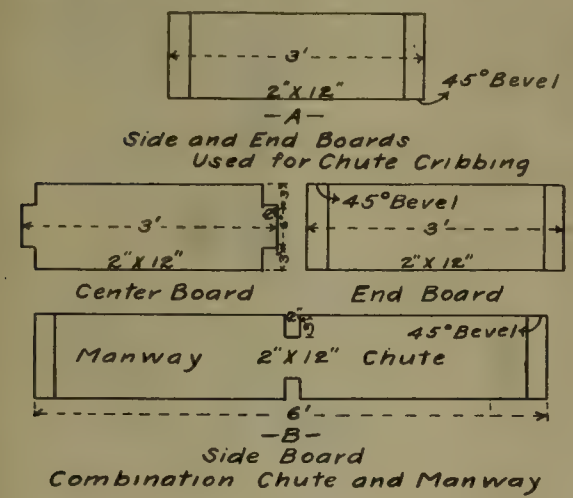


FIG. 1.

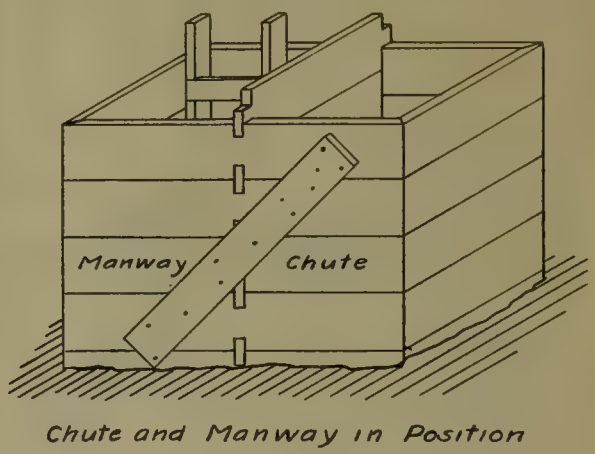


FIG. 2.

The method at present employed is a waste-filling system. The salient features are:

1. The mining of waste material for filling, from the walls of the stope, by inclined rises.

2. The cribbing system of chutes and manways, using a minimum amount of timber.

As the waste broken during development cannot always be economically transported to the stopes requiring filling, the method of breaking waste by means of inclined rises was adopted. The small amount of timber required by this method is an important consideration, as all supplies are hauled from Fallon, Nevada, the nearest railroad point, which is 60 miles distant, thus making the cost of timber somewhat excessive.

The cribbing used for ore passages are cut from 2 by 12-inch Oregon pine lagging, to the dimensions shown in A, Fig. 1, and are built up by placing upon the 2-in. edge (Fig. 2). When both a chute and manway are desired, the cribbing is cut as in B, Fig. 1. A 24-in. swinging circular saw is used to cut the cribbing; it is of the American, Style D, type, and is self-contained and electrically driven. This saw has been arranged for the purpose at the mine, and is also used to cut stulls and other timber. The saw and the details of the arrangement for cutting the cribbing are shown in Fig. 3 and Fig. 4.

The first thing done is to start the stope by making one cut above the back of the drift. A row of stulls and posts is then placed in position. The stulls are covered with a layer of 3 by 12-in. planking, and chutes and foundations for cribbing are built in (Fig. 5). The first few sets of cribbing are constructed of 3 by 12-in. lagging instead of the usual 2 by 12, to secure a firm foundation. A rise for waste is next started and sufficient waste is broken to cover the flooring to a depth of 2 or 3 ft., for protection of the timbers. The waste is then leveled off and covered with a plat of 2 by 12-in. plank to receive the broken ore. The waste-rises are started as near the back of the stope as possible, by this means securing a greater length of service.

The stoping now proceeds in a series of steps. The ore in one end is drilled and shot down; sufficient is then drawn out to leave just enough head-room for a miner and a Waugh drill to operate efficiently. The back is next drilled with 5-ft. holes, and the holes left unloaded until required. This drilling upon the broken ore gives the miner a safe position close to the back and at the same time prevents falling masses of ore from mixing with the filling. As soon as the drilling is completed, as much ore as possible is drawn out through the chutes; the remainder is shoveled into them and where necessary wheel-barrows are used. The plat is next taken up and waste-filling begun.

The chutes and manways are first built up several sets and temporarily held in position by a brace of

plank, spiked across them, as shown in Fig. 2. The edges of the cribbing are toe-nailed together. The inclined rises are next driven upward until enough waste is broken down. This waste runs into the stope by gravity and is leveled off by the shovelers, and the plat of 2 by 12-in. lagging laid upon it. The filling is carried to within three or four feet of the back, and is level with the topmost edge of the chute-cribbing.

While the waste-filling is in progress, the miners drilling the ore are continually advancing toward the opposite end. A uniform procedure is maintained, one end above a manway, the opening is closed with a cover of 2 by 12-in. plank, nailed together. This cover is removed as soon as possible after blasting, for ventilation and entrance purposes.

When about to break through to the level above, the system of timbering shown in Fig. 6 is used to support the filled stope overhead. By this means all of the ore is removed and the ground solidly filled.

The advantages of this method, where weak and swelling walls are present, are:

1. The secure and safe support of the stopes.

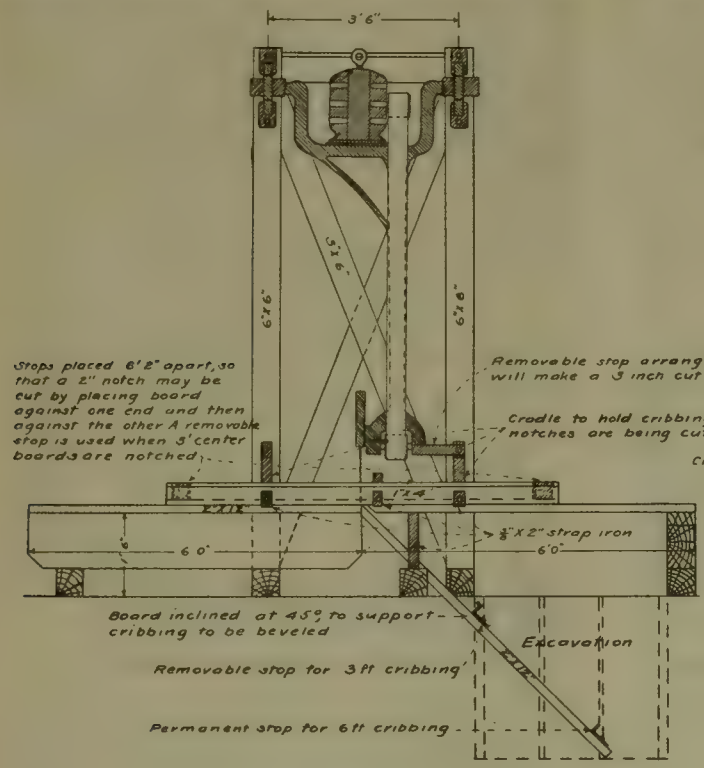

3'6"
5'6"
6'2"
6'2"
Stops placed 6'2" apart, so that a 2" notch may be cut by placing board against one end and then against the other. A removable stop is used when 3' center boards are notched.
Removable stop arranged so that saw will make a 3 inch cut
Cradle to hold cribbing while notches are being cut
1"x4"
2"x12"
6'0"
6'0"
3"X2" strap iron
Board inclined at 45° to support cribbing to be beveled
Excavation
Removable stop for 3 ft cribbing
Permanent stop for 6 ft cribbing

FIG. 3.

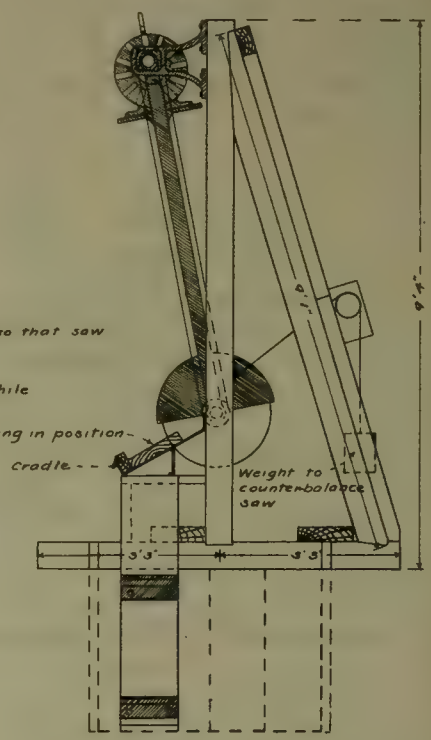


FIG. 4.

being filled with waste, while ore is broken at the other; upon arriving at the far end the miners return to the original starting point and proceed as before. A 5-ft. strip, the full length of the stope, is removed each time, 40% 1⅛-in. E.L.F. Hercules gelatin being used for blasting. When speed is necessary more miners are used and stoping proceeds from both ends to the middle.

The waste-rises are driven alternately into the foot and hanging walls, by Waugh machines, at an angle of from 40 to 50°. The rises are placed so that one is between every two chutes, and they are used for two or three fillings. The heights of the rises vary, depending upon the amount of waste required, but they seldom exceed 30 or 40 feet.

A combination chute and manway is carried up at each end of the stope, with as many as are necessary at intermediate distances. One manway is always open, and more when possible. When ore is to be shot down

2. The minimum use of timber, where timber is an expensive item.
3. The waste-rises serve as cross-cuts, for prospecting.
4. The elasticity of the method. The required tonnage can be broken down at any time, since the back is kept drilled ahead of requirements.
5. The removal of the ore, as no pillars are left.

The disadvantages are:

1. Low-grade material, which might be worked economically at a future date, must be left. At the Nevada Wonder mine, however, little is lost in this manner.
2. The shoveling required.

These disadvantages are more or less present in all waste-filling systems and under the conditions described are of minor importance.

In conclusion, I wish to state my appreciation for information given by Mr. J. A. Burgess, superintendent, and Mr. W. Frazee, foreman.

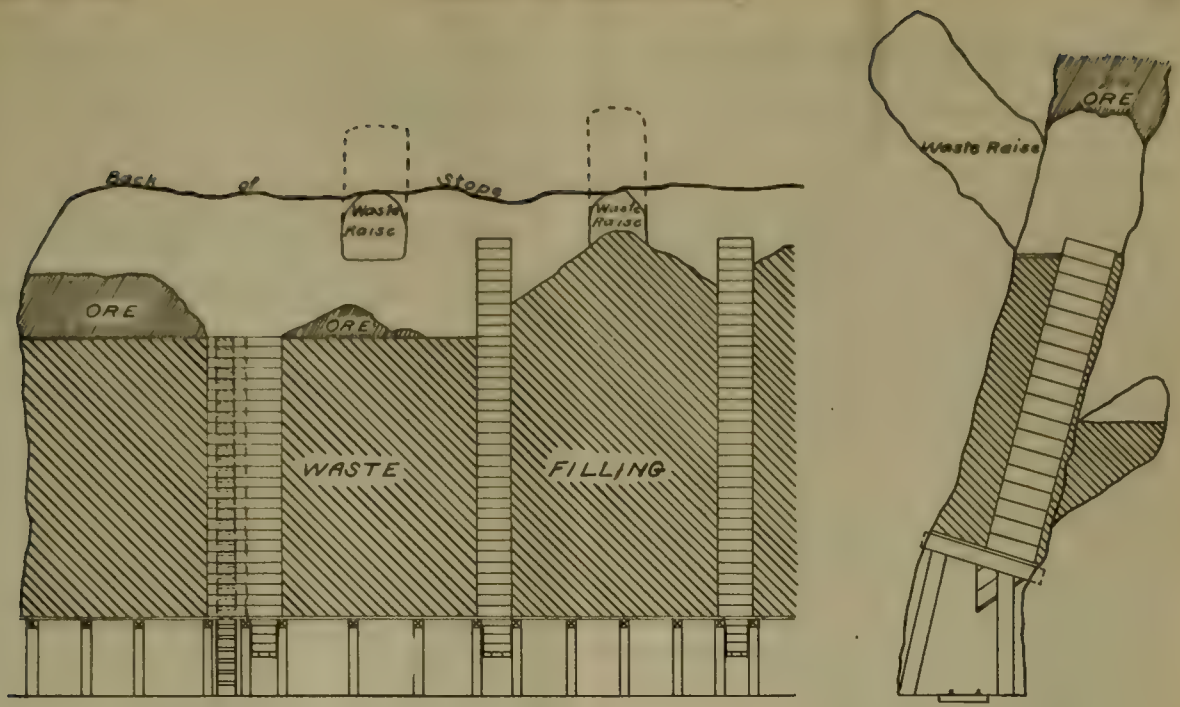

Back of Stope
Waste Raise
Waste Raise
ORE
ORE
WASTE
FILLING
Longitudinal Section of Stope
ORE
Waste Raise
Transverse Section

FIG. 5.

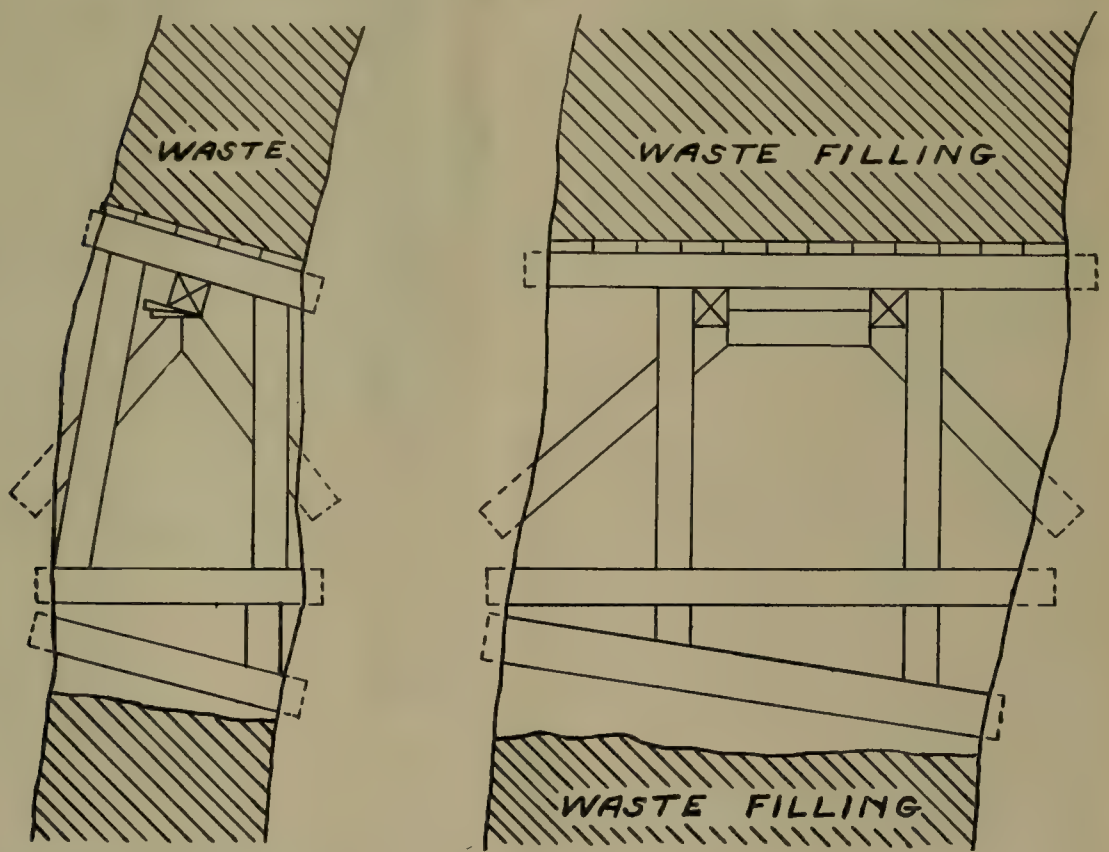

WASTE
WASTE FILLING
WASTE FILLING
Average width of vein
Wider Vein

FIG. 6.

Assay of Cyanide Solutions

By C. E. ROODHOUSE

In the laboratory of the modern cyanide-plant it is essential to make use of processes of determination that not only are accurate, but that combine well with one another in the daily routine. With these points in mind I have evolved the following modification of the Chiddey process of determining gold and silver in cyanide solutions. It is not widely different from other excellent modifications that have been proposed from time to time, but it possesses the advantages of producing complete precipitation and of requiring little manipulation and almost no watching during operation.

To avoid scorification of lead sponges the solutions must be fairly free from slime and colloidal matter. Cloudy solutions that refuse to settle or filter can usually be cleared by adding a little lime-water, boiling a moment and then filtering. Slime or colloidal matter in the solution will be collected in the sponge, and will cause the molten lead to scatter during cupellation.

For solutions of ordinary grade a 5 assay-ton charge is desirable; 10 A.T. is usually sufficient on precipitation-tailings and low-grade solutions, but in case of very low-grade solutions it is advisable to run two or more 10 A.T. charges, and to combine the buttons for cupellation; 1 to 2 A.T. is sufficient for rich solutions.

For the small charges use 400 c.c. beakers of squat form, and 600 c.c. beakers for the larger ones. Beakers of these sizes are preferable to smaller ones, since they allow the formation of flat sponges of large diameter that hang together well, and that permit more rapid solution of the zinc than do the ball-like sponges formed in small beakers. The solution of lead acetate may vary in strength, but the 20% solution of C. P. salt is a convenient one to use. It should be acidified with acetic acid just sufficient to render it stable.

After many tests with sheet aluminum, sheet-zinc, zinc-dust, and zinc-shavings I have come to rely on the latter as being the most dependable for all conditions and grades of solutions.

Fine, freshly cut zinc-shavings will produce perfect precipitation and coherent sponges in solutions where the other precipitants mentioned fail. It is necessary to use shavings that are not oxidized appreciably.

After measuring the charges of cyanide solution, add 20 to 25 c.c. lead-acetate solution and 1 to 1½ grams of zinc-shavings. By using the shavings in long strips as they come from the lathe the operator can cut off the correct amount without weighing, after a little practice.

Place the charges on the hot plate, fill beakers up to three-quarters full with hot water, and bring to boil as rapidly as possible.

Just before the boiling-point is reached, add 1 to 2 c.c. acetic acid and allow to boil a minute. The addition of acetic acid at this stage produces firm sponges that do not break up later under the action of HCl on the zinc; but if added before this point is reached it does not always give as good results.

After boiling a minute pour off solution closely, add 150 c.c. hot 10% HCl, set back on hot plate, and cover with watch-glasses. Ten to twelve minutes of rapid boiling will dissolve the zinc; then fill the beakers with cold water, decant, wash once more with cold water, squeeze the sponges into cubes, and dry. It is always advisable to wrap the cubes in lead-foil to prevent the lead from separating into several buttons while cupelling.

The accuracy and reliability of this method depends upon:

(1) The dilution of the solutions with water.

(2) The use of zinc-shavings for the precipitant.

(3) The addition of acetic acid at the proper time to form solid sponges that will permit rapid solution of the zinc without disintegration.

(4) The pouring-off of the original solution before adding HCl.

If the last two points be carefully followed, disintegration of sponges will be rare indeed. Prolonged boiling in HCl will cause it; but this need never happen.

Based on average speed of manipulation in conjunction with other work, 12 assays will require about 45 minutes, as follows:

	Minutes.
Preparing charges and placing on hot-plate	6
Time required to bring to boiling and to boil 2 min.	15
Time required for decanting solutions, adding HCl and dissolving zinc	18
Washing and squeezing into cubes	6

To facilitate manipulation it is a good plan to add lead-acetate solution from a dispensing burette with a large bore through the stop-cock; also to prepare HCl solution in quantity and to heat enough for the day's run at the same time that the charges are heating. The acid solution can be added sufficiently accurately without measuring. The acetic acid may also be added from a smaller burette without removing beakers from the hot-plate.

While there may be some solutions that will fail to give satisfactory results with this method, I have not thus far found them; I do find that it gives more consistent results on a great variety of solutions than any other that I have used.

MINERAL PRODUCTION of Tasmania in 1914 was worth £1,007,038, against £1,415,700 in 1913. The principal materials were as follows:

Product.	1914.	1913.
Bismuth	£ 1,666	£ 1,627
Coal	27,853	25,367
Copper, blister	477,361	364,732
Copper ore	18,680	10,932
Gold	111,475	141,876
Osmiridium	10,076	12,016
Shale oil	75	130
Silver-lead ore	96,225	319,997
Wolfram	4,327	7,040

On account of the Tasmania mine at Beaconsfield being closed, the gold yield decreased, while the silver-lead output was seriously affected by the war.

Technical Reminiscences—I

By ALBERT R. LEDOUX

At the request of the editor of the *Mining and Scientific Press*, I set down without any attempt at 'fine writing' some reminiscences that he has been kind enough to intimate might be of general interest.

In view of the recent death of Lord Rothschild, it seems timely to commence with an account of some of my experiences with this great firm which have extended over twenty years. The beginning of this most pleasant and interesting relationship came about 'by accident' as we call it, as indeed, have many of the most interesting experiences of my life.

I happened to be in London and met in the street Mr. Abraham Lazarus, then head of the well known firm of metal-brokers, Lewis Lazarus & Sons. He seemed unusually glad, and rather surprised, to see me; he looked at his watch and asked me if I had any engagement at the moment, for, he explained, Mr. Alfred de Rothschild was in the midst of an important negotiation concerning a matter that involved a certain mining and metallurgical enterprise in another country, and had asked him to find some man in London who knew something about the properties involved in the transaction and to bring him in that day, at one o'clock. Mr. Lazarus had been searching the city in vain; it was then a quarter to one. I told him I would be very glad to serve him and the Messrs. Rothschild, whom I had never met, and that I had some knowledge of the properties in question. I went immediately with him to New Court and was introduced to 'Mr. Alfred,' as he was known, who impressed me as a man accustomed to trust everybody, and above petty suspicions, for without knowing anything of my antecedents or business, he immediately frankly explained the situation, asking me if I knew Mr. Blank, who was either interested in the mine or was acting as an intermediary in the contemplated transaction. I said that I knew Mr. Blank well, but our relations had never been such as would prevent my giving Mr. de Rothschild any information I had; that my knowledge of the properties in question had come without placing me under any obligations to anyone. Mr. de Rothschild pulled out of his desk a memorandum of figures and a statement concerning the character and grade of ore, cost, and method of treatment. These he said he wished to verify. I was able to express an opinion as to the accuracy of the statements and figures in most cases, and to give him suggestions as to pertinent questions that he should ask the other party at their meeting, which was to take place that afternoon.

Mr. de Rothschild asked me to breakfast with him the next morning at his residence on Park Lane. I remember the impression his beautiful and artistic home made upon me at that time—its magnificent paintings, and particularly the fact that I awaited my host in the library, where a table bore many priceless souvenirs, some set with jewels, many made of gold, and some bearing autographs of kings and other great men who had presented them. I could not help wondering whether it was the custom to leave all visitors—even strangers—alone in such a room. I remember also that the breakfast, while elaborate for my benefit, was not shared by my host, who confined himself to tea, toast, and ripe figs.

He told me that the other party to the negotiation had seemed greatly surprised at Mr. de R.'s sudden acquirement of accurate knowledge of conditions, and showed me the answers that had been made to the inquiries suggested by me. These I discussed, pointing out where they agreed or disagreed with my impressions, and suggesting further inquiries. I offered to hold myself at the disposal of Mr. de R., and he, in turn, asked me to communicate to him any new suggestions that might occur to me.

That day, I had occasion to go to Swansea to inspect a new metallurgical process. On my way down, an idea came to me that I thought might be valuable and I decided to telegraph to Mr. de Rothschild; but I did not think it wise to be explicit in a telegram addressed to so prominent a man, not knowing who in Swansea or in London might see the message. I had been introduced to Mr. de R.'s private secretary, Mr. Roche, and addressed my telegram to him, asking that he tell 'Mr. A.' so and so. I found afterward that this precaution had greatly pleased my client.

I never knew or inquired what was the result of the negotiation, but called at New Court before going to the Continent to ask if I could be of any further service. I was told to call again before I sailed for America; this I did some weeks later. There never for a moment entered my mind any thought of being compensated financially for my advice and suggestions. I had been greatly pleased and interested in being admitted for a moment to the inner circle of this group of financiers of world-wide reputation and never expected to be called upon for any additional service. The day before I sailed, I called to say good-bye, and was asked if I would be willing to hold myself ready to advise Mr. de R. in any matters in America about which I might have knowledge and concerning which he might desire to consult me. Nothing was said about compensation for my prospective services; but when I arose to leave, as if just then recollecting something, Mr. de R. said: "Oh, by the way, Mr. Ledoux, after you left I learned that Rio Tinto shares were likely to go up, purchased some for myself and took the liberty of buying some for you, in your name. The shares have gone up, so there must

be a profit on your book account; perhaps you would like to sell out and take it." I said I would gladly do so. He then rang for a clerk and asked him "how Mr. Ledoux's account" stood. This clerk stated that on such a day Mr. Ledoux had bought through them so many shares of Rio Tinto at such a price; that the market that morning was so and so. Mr. de R. said, "Mr. Ledoux wishes to take his profit. Telephone to sell his shares and bring him the net proceeds." In a few minutes the clerk returned. With renewed apologies for having presumed to represent me in a financial transaction without my permission, Mr. de R. handed me Bank of England notes for a sum that I would have considered greatly in excess of any compensation due me for the time I had expended.

I mention this transaction as typical of Mr. de R.'s method of doing business, and because it is so different from what one might expect from many people, however important. From that day to this, it has been a pleasure for me to render service to the Messrs. de Rothschild, and never has there been any agreement as to compensation for services rendered. They are usually requested in a cable, but the remuneration is never forgotten at the proper time.

Of course I cannot make public particulars of these professional services that from time to time have been rendered; but I will mention one because of its unusual character and the interesting events that led up to it.

I must digress here to say something as to the beginning of my acquaintance with the late Marcus Daly. I had known the late James B. Haggin for some years, and have many interesting memories in connection with our business and personal relations. At the time of which I am about to write my firm represented the Anaconda company in handling shipments of rich ore, sent to Great Britain for smelting and refining, and in the export of Anaconda copper matte just then beginning; but I had never met Mr. Daly himself. One summer my mother was at a seaside resort in New Jersey, and I went down to spend the week-end with her. She pointed out two ladies who she said were named Daly and were from somewhere in the West, a mother and daughter. She said that they did not seem to know anybody, so she had introduced herself to them, had taken them for several drives, and found that her attentions were gratefully accepted. That afternoon while we were all upon the piazza, a man drove up and greeted the Daly ladies affectionately. My mother and I noticed them looking toward us as they talked. Later, Marcus Daly came up to me and asked if I was the Ledoux that had a laboratory in New York and had been handling Anaconda products. He said his wife had told him of my mother's courtesy, which she greatly appreciated, as did he; that it was probably not in his power to do anything in return for my mother, but that if ever he could serve me in any way, he would be glad to pay through me a debt which he felt he owed to my mother.

Some six months later, my wife and I were occupying the private car of a transcontinental railway for which I was doing some field-work. We were sidetracked in the yards at Butte. I received a cipher message from my office in New York, saying that a cable had just been received from the Rothschilds, asking me to go to Montana and try to ascertain whether Hamilton Smith and Louis Janin, who were examining the Anaconda mine for the Rothschilds, were likely to make a favorable report. This seemed to me a pretty large contract! I had met Smith and Janin at the Silver Bow Club and everybody knew that the Rothschilds had an option on a certain interest in the Anaconda, for it had been so stated in the papers. Of course I could not honorably seek to find out anything from Hamilton Smith, even if it were possible, but I ascertained that he expected to take some three weeks more for his examination. I was at an utter loss what to do, when I remembered Daly. I decided to take him into my confidence, and showed him the cable. He expressed himself delighted at the opportunity to serve me and said that the task imposed was not impossible of fulfilment, if I were willing to work hard. He showed me a copy of the option, which contained the vendor's statement as to ore reserves, costs at Butte and Anaconda, statements of the tonnage being mined and the grade of the ore. Together with Daly I went over the records at Butte and at Anaconda, spent several days or nights underground, and satisfied myself that the conditions of the option would be met unless it were that the grade of ore proved too low. I did not feel justified in arriving at a conclusion based on the assay-sheets alone, and I hit upon a plan for checking them. In those days, the ore from the various shafts of the Anaconda properties was assembled in car-loads in the railroad-yards, where trains were made up for hauling to Anaconda. When these trains were made up, the flat cars bumped together and there was spilled along the tracks a considerable quantity of ore, which fell off the sides, so that there was a double ridge a quarter of a mile long. Once a day, this ore was shoveled into empty cars. At midnight I took a coal-hod and shovel from my car and walked down one side and up the other of the ore-train, taking a shovelful of this ore at regular intervals. The samples were assayed next day at Butte. The results checked closely with those of the laboratory of the mine at Butte and with the report of the sampling at Anaconda; I felt sure therefore that the question of grade must be answered affirmatively by the Rothschilds' engineers, so, within a week from the time I had received the cable, I replied that in my opinion, the report of Smith and Janin must be favorable. This turned out to be the case.

Since that time, I have been frequently at New Court, have watched the beginning of many important affairs, and have had personal knowledge of the great power of this banking-house—not only in finance, but in influencing social and economic conditions of many countries. I shall mention one illustration.

I happened to meet the late Theodore Armstrong,

President of the Pennsylvania Salt Manufacturing Company. He told me that he was in London endeavoring to secure a contract for 250,000 tons of Rio Tinto 'pyrites' partly for his own works and partly for the Standard Oil subsidiaries, which he represented. He said that he feared his contract would fall through because the Rio Tinto company insisted that he take the 'pyrites' free on board at Huelva; that the Spanish government had permitted the entrance to the port to become filled up to such an extent that only boats of comparatively small draft could cross the bar; that he could pay the price asked for the pyrite if he could get large ships into the harbor, upon which the freight-rate was somewhat less than upon smaller vessels. I took Mr. Armstrong to New Court and introduced him to Mr. Alfred de Rothschild. I knew that he was interested in the Rio Tinto and thought possibly the introduction might lead to a somewhat lower price being quoted, under the circumstances. Mr. de Rothschild, upon learning that the contract was not to begin for a few months, said that Mr. Armstrong could sign it with confidence and that the difficulty would be removed. I never heard what steps were taken, but a few weeks afterward I saw in a Paris newspaper the statement that the government of Spain had ordered immediate steps to be taken to dredge the bar at Huelva to permit the free entry of large vessels. Evidently Mr. de Rothschild had spoken the timely word.

Apex Litigation. Jim Butler v. West End

By H. V. WINCHELL

The elaborate opinion accompanying the decision handed down on April 30 by Judge Mark Averill of Tonopah in the above entitled cause is in many respects of unusual interest. Noteworthy because of the array of legal and technical talent engaged, it is also important in establishing a precedent as to the law in exceptional geological conditions and in deciding questions that have not heretofore arisen in mining litigation.

Although apparently simple in its intent and wording, the apex law of the United States, designed by its framers to apply to an ideal condition, has been so stretched in the endeavor to cover all classes of metallic mineral deposits that it is now in a state of great complexity and confusion; and not even the most learned and experienced legal practitioner can say in advance what will be the ruling of the courts under conditions slightly different from those which have been already adjudicated. The present law was enacted in 1872, and it is not surprising that the statement is often made by those who are poorly informed that the interpretation of the law is now complete, and that no more new questions remain to be fought over and settled. That this statement is not true, and that there is in sight no limit to the number of new questions which may arise for interpretation is known to many, and is illustrated in the case now to be discussed.

Generally speaking, the owner of a 'lode claim' under the Federal mineral-land law is entitled to follow and mine his veins downward upon their dip into the earth from their tops or apices within the said claim even though he passes beneath the surface of land owned by others. This right is, however, subject to certain restrictions and limitations:

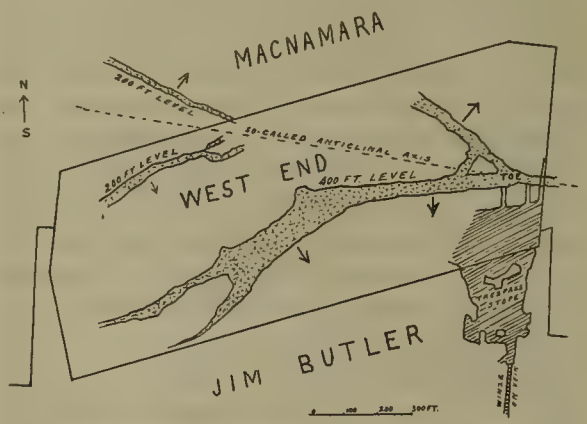
1. Its direction depends upon the relation of the apex of the discovery-vein to the boundaries of the claim.

2. The 'extra-lateral right' can only be enjoyed between the planes of the end-lines of the claim extended in their own direction.

3. If the apex of the discovery-vein crosses both side-lines of the claim as located, these side-lines become end-lines for the purpose of determining the direction and extent of extra-lateral rights, but

4. In either case, in order that there may be any extra-lateral rights, the end-lines (*de facto* or constructionary) must be parallel or at least not diverge in the direction of the dip.

5. Where the apex of the discovery-vein crosses one located end-line and one located side-line of the claim, extra-lateral rights are allowed, as the law has been judicially interpreted, a new theoretical vertical boundary being erected for such rights, parallel with the located end-lines and passed through the vein at the point where it departs from the claim through the side-line.



PLAN OF CLAIM AND OREBODIES.

6. Because they are thus important in fixing the direction of extra-lateral rights the end-lines must be continuous and unbroken.

There are many other principles which may be regarded as now definitely established by court decisions, but there are still many points of uncertainty, and

among them are at least two which have been for the first time passed upon in the Jim Butler-West End case. In the first place, Judge Averill has decided that although a claim was located on a discovery-vein which dips north it may also have extra-lateral rights upon other veins apexing within its boundaries which dip south. In the second place, he has held that, although a claim has a broken end-line, yet, where its discovery-vein crosses a located end-line, and then passes out through one of its side-lines before it reaches the other end-line, the defect in the location is not material, and the claim has extra-lateral rights for the extent which it has apex in the same manner as a claim with parallel end-lines. There is also in the present case a decision that a top or apex exists in the West End claim under the rather unusual conditions hereafter described.

The plaintiff, Jim Butler Tonopah Mining Co., was represented by its chief counsel, Judge Curtis H. Lindley, the author of the standard treatise 'Lindley on Mines,' and his associate, Mr. William E. Colby, and by Mr. Hugh Brown, of Tonopah. As expert witnesses they presented Prof. Andrew C. Lawson, of Berkeley, Prof. John W. Finch, of Denver, Mr. Fred J. Siebert and Mr. Fred Searls, Jr., of Nevada.

Chief counsel for the West End Consolidated Mining Co. was Hon. W. H. Dickson, of Salt Lake City, who was assisted by his partner, Mr. Ellis, and by Messrs. Peck, Bunker & Cole, and Horatio Alling, Jr., of Oakland, Judge S. S. Downer, of Reno, and Mr. Harry Atkinson, of Tonopah. As expert witnesses appeared Messrs. W. H. Wiley, of Los Angeles, E. C. Juessen, of San Francisco, John W. Chandler, of Tonopah, and H. V. Winchell, of Minneapolis.

In the course of its mining operations, the West End company had followed downward upon a vein from beneath its own surface under ground owned by the Jim Butler company. Ore of considerable tonnage and large value had been extracted, and although the West End company, in the desire to avoid expensive litigation, offered to divide the ore and the proceeds already accrued, the offer was rejected and suit was instituted to recover triple damages for wilful trespass. The amount thus sued for was in excess of $3,000,000, and the suit took on serious aspects.

The geology of Tonopah is not simple. There is a series of volcanic rocks which intrude and overlap each other like a pile of batter-cakes unevenly arranged, and of varying thickness. The productive veins are found to a large extent within what is called the Mizpah trachyte formation. This trachyte is believed to be older than the other volcanics, some of which have been intruded into it, and others of which have flowed out upon it, and still others of which are in the nature of overlying tuffs or volcanic breccias. One important rock is the West End rhyolite. It has been intruded into the trachyte in the form of an irregular sheet. Another widely spread eruptive is the Midway andesite. The latter rests upon the trachyte and conceals it from view throughout the area in controversy in this case. The veins do not enter the Midway andesite. They are supposed to have been formed prior to its extrusion; and it is even suggested that there was a time when the veins outcropped on the surface of the ground, and that the andesite flow covered these outcrops. There was a still later volcanic breccia, called the Brougher Mountain or Fraction dacite-breccia, whose relation to the veins and to the other rocks was a matter of some discussion in the case.

The veins of Tonopah do not commonly outcrop on the surface. They generally terminate upward against the Midway andesite, and are thus buried to varying depths, from nothing to 1200 ft., depending on the thickness of this 'cap-rock.' Nor do they all lie in one and the same country-rock. They are found cutting the trachyte, extending downward through it to the West End rhyolite, following along the contact for a distance, then cutting through the rhyolite to another intrusive rock which underlies the rhyolite, and again taking up a position on this 'lower contact.' They thus have the characteristics of fissure-veins which for a considerable distance lie upon or in the planes of contact between eruptive rocks.

As shown by the plan, there appear to be two veins on each level, except in the vicinity of the 'toe.' One of these veins strikes northwesterly and dips northerly. This is the vein which was encountered in the discovery-shaft of the West End claim. The other vein strikes somewhat north of east, and dips southerly, and it was on this south-dipping vein that the alleged "trespass stopes" were made. It will appear from the plan that, on each level, these veins approach each other on strike, coming together along an axis or line of junction which inclines or pitches to the east.

It was shown by the testimony that these two veins had been usually considered as one vein, called the West End-MacNamara vein, and that there were stopes in the mine upon the north-dipping vein which had been carried up to a point where the vein became first flat and then assumed a dip to the south. The vein was therefore termed an 'anticlinal' vein, and the question was raised whether it was all one vein, and whether as a matter of fact being completely buried by andesite, and having no outcrop, it had any "top or apex" within the meaning of the statute.

No plane of cross-section will show precisely the same conditions as to overlying and underlying rocks for any considerable vertical distance. The section shown herewith is, however, substantially one which represents the structure near the eastern end of the West End claim. In this part of the ground, although there is a great amount of quartz beneath the crest of the so-called anticline, the arch is either broken, and one side thrust over the other, or else there is evidence of two different veins, one slightly subsequent to the other, and overlying its present top or terminal edge. That portion of the vein shown on the section between the point marked *A* and the Midway andesite cap-rock was the chief battle-ground of the contest. The Jim Butler witnesses claimed that the quartz in certain rises upon that part of the

vein was not vein-matter in place, and at most nothing more than a part of the "halo" or "stringer zone" of the vein. The West End witnesses maintained that these rises show the full thickness of the north-dipping vein, containing ore with characteristic structure, and that this vein not only overlay the south-dipping vein, but had moved on it so as to be cut by it, as shown in the section.

The West End company claimed to be the legal owner of the stopes in controversy by virtue of its patent from the Government, alleging (1) that it had an apex more than sufficient to cover the area from which ore had been extracted as alleged in the complaint; (2) that although its discovery-vein dipped to the north, while the alleged trespass was on a south-dipping vein, yet that its rights extended also in that direction; (3) that its lode-claim was correctly laid out and patented and that there was no impediment to extra-lateral rights in the shape of its west end-line.

To these claims the Jim Butler company objected on the following grounds:

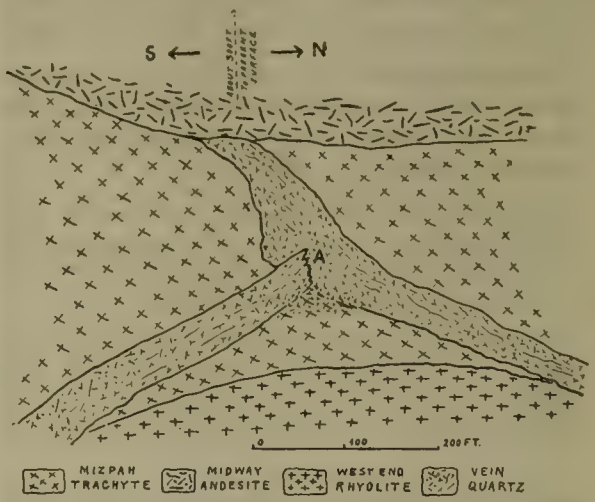
(1) The vein has no "top or apex" such as is contemplated by the statute. That it is a 'blanket' or contact vein, which not only does not reach the surface but which has no terminal edge unless it be one which extends in a general northerly and southerly direction near the west end of the claim, and which crosses both side-lines and thereby constitutes them really end-lines. On this point Judge Averill finds that "this contention is without merit. * * * Its termination, as that now exists in the westerly portion of the West End claim, is the result of the eruption of the volcanic neck known as Mt. Brougher." He finds abundant evidence of apex, showing a diagram of his own making on which there is 600 ft. of apex in one place, 360 ft. in another, and remarks further that "if the halo is to be included in the vein, and geologically it should be, this vein then reaches now and did reach all the surfaces to which apical facts are referable. It has, therefore, along its crest and extending above the anticlinal axis of the united main quartz bodies, a condition of things that may well serve as a terminal edge under the many peculiar circumstances and facts of the case."

(2) That the vein is one of rolling type or habit, and that other similar 'anticlines' are found in it which might likewise be looked upon as having apices. As to this theory, the Judge finds that "the vein is very irregular in size and very much distorted and broken, but it is almost free from rolls, having only two worthy of notice, one easily accounted for as a phenomenon of junction with the Fraction vein, and the other as a result of a number of small faults lying close together."

(3) That the strike of the vein or veins (which the plaintiffs claimed to be but one vein, and in which view they were supported by the findings of the Court) is not easterly and westerly, but northerly and southerly, and hence the true direction of its dip is neither north nor south, but to the east. On this point the Court finds that: "Much time and attention was given to the question of strike. As a matter of common sense rather than technical mathematics the strike of the vein as a whole is easterly and westerly, and the strike of its two slopes, assumed for the purpose to be separate veins, is as claimed by the West End." It is almost incredible that two opposing sets of geologists and engineers could differ so radically as to the direction of strike of such a large and well developed structural feature.

The questions of law which were decided in favor of the West End have already been referred to, and the learned Judge concludes as follows:

"If the conclusion reached herein seems revolutionary, that from the apex or apices of one vein extra-lateral rights flow downward across both of its side-lines, attention should be given to words of former Chief Justice Beatty of Nevada:



CROSS-SECTION OF SO-CALLED ANTICLINE.

"'We are willing to admit that cases may arise to which it will be difficult to apply the law; but this only proves that such cases escaped the foresight of Congress, or that although they foresaw the possibility of such cases occurring, they considered the possibility so remote as not to afford a reason for departing from the simplicity of the plan they chose to adopt.'

"It is easy to realize that the condition described in this opinion is one that escaped the foresight of Congress and is also exceedingly remote from the simplicity of the plan they chose to adopt; yet the law must be applied to it.* * *

"This branch of the case is decided in favor of the defendant corporation. That is to say, the West End Consolidated Mining Company is the owner of the ore-bodies in dispute."

This case, like many others, may be appealed; and the present decision may be only the first of many yet to be rendered over the facts here so briefly sketched. Indeed, it is often many years before the final word is said and all doubts as to the final outcome dispelled. In view of such perplexities, is it any wonder that mining men are clamoring for a more rational and easily solved mineral-land law?

CONCENTRATES

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Silver sulphide only, and no metallic silver, is formed by the reaction between cupric sulphide and silver nitrate, the equation for this reaction being $CuS + 4AgNO_3 = Ag_2S + 2Ag + 2Cu(NO_3)_2$.

Thermo-elements, if they are to yield accurate readings of temperature, must frequently be re-calibrated by determination of their electromotive force at a series of fixed points and subsequent interpolation.

Underground charges at the Franklin mine, Michigan, in 1914, were as follows: sinking, $4.36 per foot; rising, $6.342 per foot; driving, $5.158 per foot; crosscutting, $4.873 per foot; and stoping, $4.866 per fathom.

Antimony is too brittle for use alone, but it is a valuable component of many alloys, more particularly with tin and lead, such as pewter, babbitt, and type-metal. It is employed in the manufacture of cartridge cases and shrapnel shot.

The Stokes method for determining pyrite and marcasite, alone or in mixtures, depends on the estimation of the iron dissolved when the finely ground and purified sulphide is treated with a boiling standard solution of ferric alum.

Reverberatory furnaces at Anaconda have increased in size until the new ones are to have hearths 25 by 144 ft. They will be heated by pulverized coal. In the converter department a 25 by 175-ft. furnace will be built. It will be used in cleaning converter slag.

Analyses of water and sediments from springs at Sulphur Springs, Arkansas, and microscopic study of sediments, indicate that sulphides of iron, zinc, copper, and lead are carried in solution, and that iron sulphides, especially, are being deposited in both amorphous and crystalline states where the waters come to the surface.

Transportation of supplies for the Oriental Consolidated mines in Korea has been nearly paralyzed for a time on account of the foot and mouth disease raging among the Korean bulls. The epidemic is a new one in this country, and the bulls are dying very fast. The authorities are applying quarantine to all infected and suspected localities, and no freight can be moved by bulls or cows. Owing to this the price of rice has gone up 25% in one week, as the rice now has to be brought in on ponies.

Amalgamated plates are not used on dredges, as the violent scouring action to which they would there be subjected would carry away the amalgam. A small amount of quicksilver is generally used in the riffles. The latest method is to re-grind in a Hardinge mill with mercury the black sand caught in Neill jigs or in the riffles to recover the gold which it contains.

The influence of nickel on aluminum bears considerable resemblance to that of copper. It increases the yield point and tensile strength with the simultaneous diminution of elongation and reduction of area. It increases specific gravity, hardness, and rate of corrosion in both fresh and sea-water. And decreases electrical conductivity and resistance to alternating stress.

Nitrogen has four main uses: as an agricultural fertilizer, as nitric acid and derivatives therefrom, as ammonia, and in dyes and various other chemical compounds. Measured in the quantity of contained nitrogen, and in view of the restricted opportunities in the United States for immediately developing the chemical and dye industries on a large scale, bearing decisively on atmospheric nitrogen fixation processes only the three first-mentioned uses need be considered, namely, for crop fertilizer, for nitric acid and its derivatives, and for ammonia as such.

Certain water analyses show peculiar properties, according to the U. S. Geological Survey. A pamphlet containing 203 water analyses has been issued. They were made in the chemical laboratory of the Survey. Most of these analyses have already been published, but many of the original reports are out of print, and the data are therefore obtainable with difficulty. A number of the waters analyzed are commonplace in character, but some are most unusual, if not unique. The Devil's

Inkpot, for example, in Yellowstone park, is essentially a solution of ammonium sulphate; waters of Sulphur Bank, California, are rich in borates; while the Shoal Creek springs, Missouri, contain a remarkable proportion of zinc.

GOLD in the Nickel Plate mine, Hedley, British Columbia, occurs usually with arsenopyrite in brecciated or crushed zones of highly metamorphosed sedimentary rocks, between white basic igneous rocks and contact metamorphic deposits. The richest ore does not occur at the contact, but from 6 to 10 ft. away, in the zone of greatest crushing. The profitable ore-shoots so far developed occur near the white gabbro intrusions only. No large orebodies have been found near the diorite, although it forms 70% of the igneous intrusives in the whole district, and there is no diorite occurring near the Nickel Plate orebodies.

MOLYBDENUM has been detected in two basaltic lavas from Hawaii. Its presence in these basalts reopens the question of its occurrence, since it was thought to be confined entirely to the more silicious rocks. Tests were accordingly made on a trachyte obsidian from Hawaii, on some sodic, and especially on some nephelite-bearing igneous rocks from other localities. From these it would appear that the presence of molybdenum is not correlated with high soda or potash content. Except for its well-known tendency to occur in the more silicious rocks, it therefore seems to be influenced by regional rather than by the general chemical characters.

MORE ACCIDENTS occur on cloudy days than on fair days. More workmen are injured, and more seriously injured, in poorly-lighted work-shops than when working in well-lighted places. It is therefore clear that, all else being equal, the well-lighted work place is the safest work place. It has also proved true that where an adequate supply of natural light is brought into service, men work more safely and cheerfully than where the best artificial light is employed. It should therefore always be the aim, both through proper building construction and through continuous cleanliness, to admit ample daylight into the workshop during the working period.

WHEN CERTAIN GRADES OF CYANAMID are melted with common salt, the free graphite in the original material is combined with the calcium cyanamid forming cyanide. A transformation of over 90% nitrogen efficiency is obtained. The resulting product contains approximately 25% KCN equivalent. This material, which can be prepared so as to deliver it into the hands of the consumer at about two-thirds the present price of high-grade cyanides, requires solution in water and filtration. Both operations are easy. The filtrate can be used in the place of cyanide for the extraction of precious metals. Large-scale experiments have been tried in various cyanide works throughout the world. In every case it has proved to be identical in behavior with regular cyanide, showing the same extraction efficiencies. The lower price at which this material can be delivered to the consumer more than takes care of the simple extra dissolving and filtering operations incident to its use. There should be, therefore, a large field for this material supplanting the more expensive, high-grade cyanides.

STANDARD TERMS used in air-lift pumping are as follows: (1) Static head: normal water-level when not pumping, measured from surface or top of well casing. (2) Drop: point to which the water-level drops below the static head while being pumped. (3) Pumping head: level of water when pumping as compared to ground surface or top of well-casing. Static head + drop = pumping head. (4) Elevation: point above the ground surface or top of well-casing to which water is raised. (5) Total lift: distance water is elevated, from level when pumping, to point of discharge, at an elevation, and includes: elevation + static head + drop = total lift. (6) Lift: distance the water is elevated from level when pumping to point of discharge at surface, and includes: static head + drop = lift (or pumping head). (7) Submergence: distance below the pumping head at which the air picks up the water. (8) 100 per cent: the vertical distance the air travels with the water from point introduced to point discharged, and includes: total lift or lift + submergence = 100 per cent. (9) Starting submergence: distance below static head at which the air picks up the water and includes: drop + submergence = starting submergence.

GRAPHITIC OR CARBONACEOUS SCHIST of the West African mines precipitates gold from cyanide solutions. This has been determined by numerous experiments, according to W. R. Feldtmann. The maximum amount which the schist will precipitate is roughly proportional to the percentage of carbon which the sample of schist contains. The finishing or 'load point' is fairly sharply defined. In general, where a maximum load point was aimed at, it amounted to from 4 to 7 oz. gold per ton of schist. That the cessation of precipitation represents a load point of the schist, and not a change in the action of the solution due to contact with the schist, is shown by experiments which proved that the precipitation is limited only by the amount of the precipitating agent contained in the schist on which the auriferous cyanide solution is allowed to act. He summarized his conclusions as follows: (1) It has been demonstrated that the graphitic schists of West Africa precipitate gold from auriferous cyanide solution in a manner that is, in all important respects, analogous to the action of charcoal under like conditions. (2) The gold is precipitated on the charcoal (and on the schist) not as metal but as a compound, possibly a carbonyl aurocyanide. (3) The gold compound is decomposed and the gold dissolved to a considerable extent by alkaline-sulphide solutions (judging by the results of a large number of tests, the re-solution is effected rather more easily from the schist than from charcoal).

Idaho Minerals at the Exposition

In an area of 49 by 61 ft., the state of Idaho has displayed about 250 samples of ores in the Palace of Mines and Metallurgy at the Exposition. A large piece of dressed sandstone stands at the main entrance to the booth. At the back is a reproduction of the Sawtooth mountains. This is 15 ft. high, 16 ft. deep, and 60 ft. long. At the base of this is a series of cross-sections showing the veins, fault systems, and geological features of the principal mines of the Coeur d'Alene region. Benches, tables, and small stands are placed to show the specimens.

In 1914 over 350 producers in Idaho yielded $1,286,459 gold, 13,621,123 oz. silver, 5,178,000 lb. copper, 345,334,106 lb. lead, and 49,230,000 lb. zinc, valued at $24,976,906, from about 2,500,000 tons of ore. In 1913 the Coeur d'Alene returned 2,039,030 tons, worth $17,670,083. Net profits totaled $4,773,287. The state's total to date is $342,000,000.

It is impossible to mention all the exhibits, but the following list is well distributed over the various counties and the metals produced:

Lead-Silver. A bench 60 ft. long and 4 ft. wide contains Shoshone County ores. The Bunker Hill, Hecla, Hercules, Hunter, Success, and Tamarack companies have specimens of country rock, outcrops, ores, and mill products. Among the latter are the mill feed, jig, Wilfley table, and vanner products, oil flotation, and Wyman acid flotation concentrate of the Federal company. The Stewart also has a complete display from its mill. On the small stands mentioned are pieces of ore weighing from 350 to 1100 lb. each. These are from the large properties. In the 'Mine' near the Idaho booth, the Bunker Hill & Sullivan company has a reproduction of part of its mine. In it is a good deal of ore, an electric locomotive, ore-cars, and the 'safety-first' sign at the portal of the Kellogg tunnel.

Zinc. Several mines sent zinc ores. The ore that attracts most attention is that from the Interstate-Callahan. Besides various level ores, there is one piece weighing 3860 lb. This is from a depth of 1200 ft. Mill products are also shown.

Copper. These ores were sent by mines in several counties. One bench contains samples from prospects and productive properties. Shoshone county produced ore from the Snowstorm at Larson; malachite, azurite, black and red oxide, and sulphide from the Empire at Mackay, copper-gold from the Clearwater; 3.3% chalcopyrite from the Bullion; and chalcopyrite, glance, and native copper from the Castle Rock in the Placer Center district. Lemhi county sent copper-nickel from the Gray Eagle in the Black Bird district; also copper-nickel-cobalt from the Uncle Sam. In Custer county is the well known Lost Packer mine. On account of its situation on Lone creek it can only be worked for a few weeks in the summer. Supplies and coke are taken in, and a vigorous smelting campaign takes place. Rich ore is treated. The matte is sent to smelters in Utah. The specimens shown contain 15% copper, 1¾ oz. gold, and 5 oz. silver per ton. From the Leopard and Parallel mines in Copper Basin, and the Silver Bell at Bayhorse are copper-gold ores. Malachite, bornite, and chalcopyrite are mined from the Mountain Queen in the Seven Devils district of Adams county.

Lead. Among these ores are the following: a large block of lead carbonate from the Hercules. It contains iron, cerussite, sulphide, and native silver. The Pittsburgh-Idaho at Gilmore shows lead carbonate assaying 37% lead and 15 oz. silver. That from the Latest Out contains 34% lead, 18 oz. silver, and 10% iron. The Wilbert company, operating in the Dome district of Blaine county, exhibits dense, fine, steel galena containing 38% lead and 9 oz. silver; also mill products.

Gold. Three large and one small table are loaded with country-rock, and low and high-grade ores. The Queen of the Hills sent ore and mill products from the Wood River district, Blaine county. From Quartzburg, Boise county, the Gold Hill & Iowa Mines Co. shows ore and Lane mill products. On a separate stand is a 62-lb. specimen from the Martha vein of the Gilmore Mining Co.'s Allie mine, Lemhi county. The gold is in an ore containing 49% iron oxide, and 5% silica, and occurs as flakes on the iron. Several rich shipments have been sent to Salt Lake City. A miscellaneous lot includes gold ore from the Liberty Bell, at Buffalo Hump, McKinley at Lucile, Buckhorn and Independence at Golden, Franklin and Coeur d'Alene at Ten-Mile, all in Idaho county, and Musgrove and Edmund in Lemhi county.

Rare Minerals. An interesting display of these is made. It includes antimony, nickel, cobalt, molybdenite, wolfram, and hübnerite.

There is also coal, mica, gypsum, limestone, shale, volcanic ash, cement, sand-lime brick, phosphates, and iron ore. The last is from a new deposit at Iron Mountain, Washington county. It contains 56.64 to 64.3% iron, and 6.6 to 17.93% of silica. It is estimated that 3,000,000 tons is available.

The report of the Bunker Hill & Sullivan Mining & Concentrating Co. for 1914 is just to hand, and as this great property is mentioned in the above notes, an abstract of the report should be of interest.

In his brief remarks, the manager, Stanly A. Easton, states that production was well maintained, and development of new ore was highly satisfactory throughout the year. Ore reserves blocked out are as follows; Stemwinder, 27,782 tons; Sullivan, 775,499 tons; and Bunker Hill, 2,904,990 tons, a total of 3,708,271 tons. The Kellogg shaft was completed to No. 14 level, 1000 ft. vertically below the Kellogg (mill adit) tunnel. Station and ore-pockets were finished. Electric pumping equipment was installed. Cross-cutting to the orebodies in two directions is under way. These shoots should be opened on this level early in the spring. Development on No. 13 level was continued, and resulted in disclosing plenty of good ore. In the suit with the Stewart company the court upheld the previous decision in favor of the Bunker Hill company. The value of the ore wrongfully extracted has yet to be recovered. The Sierra Nevada and Caledonia companies paid substantial dividends to the Bunker Hill company. Experimental work resulted in further benefits in the mill. Certain electro-chemical processes promise to increase the recovery of lead, silver, and zinc from mill residue. Prices received for lead and silver were the lowest in 16 years, and below the average of 30 years. The earned surplus available for dividends was $1,017,829, out of which $981,000 was distributed.

The balance of the report is best shown in the following table:

Mine development, feet	2,754
Cost per foot ($8.849 in 1913)	$10.768
Ore mined, tons	440,819
Cost per ton ($2.225 in 1913)	$1.98
Electric haulage of men, ore, and supplies, per ton	0.56
Hoisting 350,651 tons, per ton	0.049
Pumping charges, per ton	0.045
General mine expense, per ton	0.405
Underground improvements, per ton	0.041
Ore crushed and concentrated, tons	440,819
Cost per ton	$0.39
Concentrate shipped, tons	56,731
Lead production, pounds	70,663,236
Silver production, ounces	1,161,324
Value of metals	$3,362,499
Operating profit	949,987
Dividends paid	981,000

The balance at the end of 1913 was $2,880,203, and $3,245,475 at the end of 1914. Dividends from other companies and increased book valuations accounted for the increase.

The output to date is as follows: ore mined, 6,462,867 tons; gross value, $60,231,542; net smelter returns, $35,820,939; operating profit, $19,817,614; and dividends paid, $15,710,250.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

HOUGHTON, MICHIGAN

Optimism in the Copper Country.—Construction.—Development of Small Properties.—College of Mines.—Mayflower, Quincy, and Ahmeek in 1914.

There is nothing but good news to report from the Michigan copper district. When we read that the mines and mills at Butte and other Western copper centres are returning to nearly normal production, we are glad of it. We also realize and appreciate more fully how much better off Michigan has been during the last six months than the Western districts. For several months the mines at Keweenaw point have been operating at full capacity. At present all the large producers are operating above normal. Nearly 15,000 men are now employed here. Beginning May 1, all the surface and underground men of the Calumet & Hecla and subsidiary companies will receive a wage increase of 10%. Over 7000 employees will receive the increase, which means a return to the high wages paid before the curtailment of last fall. Several weeks ago the Quincy Mining Co. advanced wages. On May 1 another raise will become effective. This second increase will place the wage schedule where it was last August.

The resumption of construction work, which was interrupted last fall, is noticeable. At the Victoria a shaft will be sunk close to the present working shaft to increase production and lower hoisting costs. A new steel ore-house will be erected at No. 5 shaft of the Mohawk. No. 3 shaft of the Osceola will soon be ready for resumption of mining. No. 3 shaft of the North Kearsarge will probably start during May. No. 3 and 4 shafts at the Ahmeek are being overhauled for regular work.

According to the superintendent of the Mayflower company, G. S. Goodale, all work during the year ended February 12, 1915, was confined to further exploration of the property by diamond-drilling. Two machines worked in holes 35 to 41, inclusive, drilling a total of 10,304 ft. No. 39 reached a depth of 2087 ft. No. 34 and 37 make up a transverse vertical section across the formations, and in the restricted area investigated indicate a disorganized condition of the strata due to faulting and crushing. Other holes showed similar disturbance. No. 41, down 1747 ft., is in uniformly firm and undisturbed ground, but not deep enough to prove the mineralized formation. Expenditure on prospecting amounted to $26,483. Including assessment No. 2 of $74,379, the revenue was $91,406. Cash at the end of 1914 amounted to $62,985.

While the present high price of copper means large profits to the large producers and increased wages to the employees, it also means a great deal to the smaller exploration companies and prospects. Anxious to take advantage of the present market, these will accelerate development as much as possible. The Hancock mine is gradually increasing its shipments to the Franklin mill. More men are being employed underground. The Houghton Copper Co. is building a railroad spur to permit shipment of ore from its stockpile of several thousand tons. At the Lake mine preparations are being made to unwater the shafts, to resume exploratory and mining work. Franklin and New Arcadian will probably commence shipments to the Franklin mill early in May. Algomah will probably resume underground work in a week or so. Wyandot will resume mining as soon as the mine is pumped out. Exploration will be resumed at the Onondaga property directly. The recently discovered New Arcadian lode continues across the New Baltic property. Since it has been found that this lode improves in character as it approaches the New Baltic, the latter company will expose the lode at different points by pits and cross-trenches.

Regular work of the Quincy company in 1914 was hampered by the effects of the miners' strike of 1913, heavy airblasts around No. 2 and 6 shafts, and the copper market. Results were as follows:

	1914.	1913.
Copper sold, pounds	22,612,460	18,161,575
Revenue from copper	$2,041,992	$1,900,365
Revenue from silver	12,630	20,832
Net profit after paying operation, construction, accident account, etc.	205,505	76,161
Dividends	55,000	412,500
Surplus at end of year	897,533	746,938

The people of the copper country are much pleased with the announcement of Governor Ferris that he will reappoint

MOHAWK No. 1 SHAFT-HOUSE.

to the Michigan College of Mines board of control William Kelley, of Vulcan, president of the board, and James MacNaughton, of Calumet. The good of the institution, rather than politics, influenced the appointments.

The Ahmeek Mining company reports as follows for 1914: At No. 1 shaft all development shows 'rock' of average value. Mules are used for tramming on No. 8, 12, and 14 levels, with satisfactory results. No. 2 shaft area has proved of average quality. New equipment at No. 3 and 4 was started on June 1.

	1914.	1913.	1912.
'Rock' stamped, tons	590,519	383,689	652,260
Copper sold, pounds	13,634,605	9,044,166	15,950,492
Average price, cents per lb.	13.08	15.42	16.61
Cost, cents per lb	9.71	13.30	7.85
Total revenue	$1,787,436	$1,433,695	$2,757,576
Profit	462,644	176,919	1,465,396
Dividends	200,000	850,000	1,100,000
Surplus at end of year	968,771	706,128	1,379,209

At the stamp-mill the low-pressure steam-turbine is in place and nearly connected. All floors and foundations are finished for two stamps, also 46 Wilfley tables and 12 Hardinge mills have been installed.

The Calumet & Hecla company will pay $15 per share on June 18. On March 18, $5 was distributed. Total to date, $1294 per share.

CRIPPLE CREEK, COLORADO

Gold Output.—Milling Suit.—Trail Mine.—Bull Hill Air-Compressor.—Mary McKinney and Sitting Bull.

The following is the output of the Cripple Creek district for the month of May, as reported by the various mill and smelter managers:

	Tons.	Average value.	Total value.
Golden Cycle	28,000	$23.00	$644,000
Portland (Colorado City mill)	11,300	19.50	220,350
Smelters	5,500	55.00	302,500
Portland (Cripple Creek mill)	18,900	3.00	55,900
Independence	9,680	3.08	29,814
Ajax	1,225	6.12	7,497
Neville	2,100	3.20	6,720
Dante	900	2.50	2,250
Wild Horse	550	3.50	1,925
Total	78,155	$16.26	$1,270,956

The new Golden Cycle Mining & Reduction Co. has been threatened with suit by the old United States Reduction & Refining Co. This revives some interesting milling history. The latter company owned and operated the Standard plant at Colorado City at the time the Golden Cycle mill started in 1907. It had in addition, two idle plants, the Philadelphia at Colorado City, and the Union at Florence. Later an agreement was made with the Golden Cycle; in consequence the Standard plant was closed in 1912. The present suit is really between different factions of the United States company to prevent the sale of the properties, and the Golden Cycle is interested only in so far as its agreement with the United States company is concerned. A. E. Carlton, president of the Golden Cycle is quoted as follows in a recent interview: "Under the arrangement made by John T. Milliken, the controlling factor in the Golden Cycle until a few weeks ago the latter agreed to take care of the interest on the bonds of the United States company in return for the turning over to him of the ore contracts it held. That agreement terminated last December, but was renewed, and will continue until the same date next year. The Golden Cycle, independently of most of these contracts, has the sole right to treat the ores from the greater number of the mines of the Cripple Creek district. In addition to having contracts, many of the properties are interested in the Cycle mill, such as the Vindicator, Elkton, Cresson, and the United Gold Mines, and naturally would wish to participate in the profits of the milling as well as the mining of their ores. We are prepared to pay enough in addition to the contract obligation to let the owners of the United States company have the junk value of the three mills, plus the amount of the contract. In other words, we will be willing to buy these plants up to a cost to us of $350,000 at a receiver's sale. We can realize, perhaps $125,000 on them as junk, but we will have fulfilled our obligations. If the stockholders and the bondholders cannot agree, or if either of them believe that their interests are not protected, they can fight it out and we will carry out the promises made by Mr. Milliken. There is no hope at present for anyone to get into the milling business on a profitable scale, in view of our ore-contracts, so that ends the situation so far as the mills are concerned. We will not raise the prices nor attempt in any way to gouge the miners. Such a step would be adverse to the mines which feed us their products." To the casual observer it would seem as though the extravagant promises made in various prospectuses sent broadcast by those having the Golden Cycle stock to sell have killed the 'golden goose,' and that those mines which do not participate in the profits from the Golden Cycle mill may demand lower rates rather than allow their more favored neighbors to make 2% per month from treating their ores. Indeed, rather than having things as tightly sewed up as Mr. Carlton seems to think, we may yet see another mill war such as made earlier days so interesting. Indeed, to many of us, the time seems ripe for a local custom-mill to treat ores under $10 per ton in the district itself, thereby saving $1 per ton for a 40-mile down-hill haul to the valley.

The new development by Eby & Co. at the Trail continues to open well. A two-car shipment returned a settlement of $40 per ton. More men are employed and a good future is promised for this lease.

The large air-compressor at the Logan shaft, which has supplied air to many of the smaller mines on Bull hill and vicinity, was stopped on May 1. This plant, together with its extensive pipe-lines, was first operated by the Woods Investment Co. of the early days. It enabled many a small prospect to be operated in the easiest and cheapest manner by means of air-drills. It was profitable for the Woods people, and later for the Western Investment Co. Recently the plant was taken over by a local syndicate which has found that the expense of operating by steam is prohibitive. They have made arrangements to substitute electric power. This change is the probable reason for the closing down of the plant. It also means the loss of at least 200 tons per day in the production of the district.

The Maryana Leasing Co., controlling ground on the No. 8 level down in the Mary McKinney, has men at development. A drift is being driven to connect with a winze sunk from the old Anaconda adit. As soon as connection is made the company will have a large block of ground ready for active work. New electrically-driven machinery is being placed on the Mary McKinney to enable the company to extend work to a greater depth.

The Hondo Mining Co. operating the Sitting Bull claims situated in the gulch between the Portland and the Golden Cycle, has recently found good ore at 200 ft. Some shipments have been made. This is good ground which has been idle since the early days when $150,000 was taken from a single shoot at the 100-ft. level. We expect to hear great things from this property now that systematic development has been undertaken.

PLATTEVILLE, WISCONSIN

Zinc, Lead, and Pyrite Markets in April.—District Outputs.

In April the Wisconsin zinc-lead districts developed many extraordinary features. These tended to bring about higher metal prices. Zinc ore was higher than ever before. The beginning of the month saw recessions in both the quotations for metal and ore, the latter coming in for more pronounced cuts. What was lost by metal was quickly recovered. By the end of the month the highest prices ever recorded were attained.

Diligent inquiry among leading representatives of smelter interests brought out conflicting statements regarding stocks of metal and ore at smelters. All agreed that metal stocks were low. On the question of ore, some contended that stocks were large, others that this was not so. One large zinc-ore producer admitted that buyers were solicitous in securing contract arrangements whereby they might obtain the output of mines on flat-rate agreements. Mining men were as one in expressing dissatisfaction with quotations prevailing for zinc ore during April. In this dissatisfaction is already discovered one of the greatest disturbing factors in the status of markets on both metal and ore in the immediate future. It requires no discriminating intelligence to observe that the production of zinc ore is below the theoretical maximum output expected by smelters, who have already oversold on the current production, and later when it becomes imperative to secure the necessary supplies to meet contracts based upon future delivery, there will be a scramble for ore with more attractive offerings. Miners are not at all anxious to become parties to the execution of contract agreements. While every

possible expedient is being met to secure a largely enhanced output of zinc ore, none reveal any desire to go beyond a normal output at present. The district is actually making lighter deliveries than were reported during the long period of depression that existed in the zinc-ore markets prior to the first advances recorded in August 1914. Zinc ore prices opened strong at the beginning of April at from $60 to $70 per ton of 60% metal content. This gradually declined to as low as $54. At the end of the month prices recovered to $65 to $75, with premium separator product going as high as $78 per ton. The bulk of the shipments for the month came from smelter-controlled properties. There was little open-market offering. The zinc-ore reserve at all points in the district on the last day of the month was in excess of 5000 tons.

Lead ore showed little improvement. Fair gains were made in the price of pig lead, but the demand for lead ore showed apathy on the part of buyers. Ore that was cleared sold at about $54 per ton, 80% metal content.

Producers of iron pyrite faced an indifferent market. Scarcely any demand came until the last week, when the demand improved. Prices, especially on fines, became better, and by-product cleared from all of the separating plants.

Carbonate of zinc-ore producers received treatment from buying interests noted for its 'refined cruelty,' ore going to the highest figures ever published, yet not a pound of product was sampled and no deliveries were made, although thousands of tons were ready for sale and shipment.

The following ore deliveries were reported by districts:

Districts.	Zinc, pounds.	Lead, pounds.	Pyrite, pounds.
Benton	12,016,000	825,140	1,282,000
Galena	5,252,000	90,000	.....
Hazel Green	4,326,000	.....	.....
Livingston	3,928,000	.....	.....
Cuba	2,680,000	.....	854,000
Platteville	1,718,000	.....	.....
Linden	1,930,000	146,040	878,000
Mifflin	970,000	296,090	.....
Mineral Point	114,000	.....	.....
Highland	56,000	.....	.....
Total	32,990,000	1,357,270	3,014,000

Sales were made to the following buying concerns: Mineral Point Zinc Works, 8085 tons; National Separating Works, Cuba, 1609 tons; Matthiesen & Hegeler Zinc Works, 1534 tons; Illinois Zinc Co., 1013 tons; Campbell Magnetic Separating Co., Cuba, 739 tons; Grasselli Chemical Co., 636 tons; Empire Roasters, Platteville, 1881 tons; Linden Separating Works, 413 tons; and American Metals Co., 317 tons.

Shipments of lead ore were the best for any single month shown in years. About 1000 tons more are held in reserve. Pyrite was secured at the electro-static separating plants.

MIAMI, ARIZONA

MAGMA MINE DEVELOPMENT.—SUPERIOR & BOSTON, IRON CAP, ARIZONA COMMERCIAL, COLD-GOODWIN.

The Magma company, which operates the richest copper mine of its size in Arizona, has almost finished construction that has been underway for several months. A narrow-gauge railroad 30.20 miles long has been built between the Magma (town of Superior) and Webster station on the Southern Pacific, nine miles northwest of Florence. Another shaft from the 1200-ft. level to the surface is almost completed. An electric hoist of 2000-ft. capacity has been ordered. Development has shown that the formation or the quartz-porphyry dike that carries the ore-shoots has changed its dip twice below the 800-ft. level. For 800 ft. it followed an inclination of about 65 or 70° to the north. From 800 to 1000 ft. it is vertical. Diamond-drilling shows its dip from the latter level to 1200 ft. to be about 65° to the south, or just the reverse of its dip nearer the surface. A notable change in mineralization is apparent at 1000 ft. While the copper content of the shoots is the same, the gold value has quadrupled, being $1.60 per ton on the lower level, compared with 40c. per ton nearer the surface. On the lower level zinc also occurs in large quantity, it being in separate shoots from the copper. Neither the copper nor zinc ores contains the slightest amount of the other metal. The zinc ore contains about 20 oz. silver. At present the Magma mill is handling about 150 tons of ore daily. The crude (hand-sorted) averages about 2% copper, concentrate the same. The apparent low copper percentage of the concentrate is due to the unusually high iron content of the latter, fully 15%. The manner of mining the Magma during the past few months has resulted in a high saving in cost of timber, as well as increased efficiency. The general manager, Mr. Browning, was able to improve on the usual method of back filling in the stopes by the vertical position of the vein between the 800 and 1000-ft. levels to such an extent that all handling of the ore in the stope after breaking has been obviated. This has been accomplished by laying planks on the floor of the stopes at a steep inclination from each side toward the centre of the stope, thus forcing the ore when broken to run by gravity into the chute connecting with the drift below. The Magma mine and mill now employ between 150 and 175 men. Because of the number of men now employed in development nearing completion it is not probable that the advent of railroad transportation will mean any immediate increase of the working force at the property. Thirty men are employed on shaft work alone. The shaft has been cut mainly by a series of rises and winzes and is completed to within about 30 ft. of the surface. It is being cut with two compartments, but will be widened immediately to three when the present rise is through to the surface, some time in the latter part of May. The new hoist will be a Nordberg electric with rope pull of 10,500 lb., lifting speed of 750 ft. per minute, and 2000-ft. capacity balance drums. It will be equipped with automatic contact-control, insuring increase of power by regular cycle precluding any danger of sudden rush of current. In the beginning the hoist will be operated with a skip on one side and cage on the other, but two skips will eventually be used. The hoist will be 25 by 12 ft. over all. The hoist room is 17 by 40 ft. in the clear. The railroad will be turned over to the Magma company as soon as cessation of wet weather permits of thorough surfacing, probably the last week in May.

About 100 men are now employed at the Superior & Boston mine. Shipments of copper ore go to the El Paso smelter.

The Iron Cap is shipping four cars of ore per week to the El Paso smelter. It averages 10% copper. High-grade ore, containing between 25 and 30% copper, is being stored, about 200 tons already being in the stock-pile. In January and February the mine and its equipment were thoroughly overhauled. The collar of the shaft was concreted to a depth of 18 ft. and the shaft was re-timbered 200 ft. below the concrete.

The Arizona Commercial's future improves with development. Three stopes in sulphide ore on the 1300-ft. and one on the 1200-ft. level are being worked, and 175 tons of ore is being shipped daily to the Old Dominion smelter. The pumping plant is lifting about 450,000 gal. of water per day from the 1400-ft. level to 1200-ft., whence it flows to the Old Dominion shaft. The connecting drift at the 1200-ft. level between the Old Dominion and Arizona Commercial shafts is 8000 ft. long. It was finished last October by the latter. It is used solely for draining the Arizona Commercial and for ventilation.

The Cold-Goodwin, one of the best of the Miami district's prospects, has resumed development as the result of the increased price of copper. In the bottom of the shaft (500 ft.), the chalcopyrite ore that has been found from the surface is changing to chalcocite, a change which almost invariably results in increase of the sulphide zone throughout this district.

KALGOORLIE, WESTERN AUSTRALIA

ZINC-SHEET AND STEEL MANUFACTURE.—MOUNTAIN QUEEN AND QUEEN OF THE HILLS.—YUANMI COMPANY.—SONS OF GWALIA.—HORSE-SHOE.—GREAT BOULDER.—EDNA MAY.

Every country has had to accommodate itself to new conditions resulting from the War. Australia is no exception. One instance is the zinc-shaving supply for cyanide plants. The Broken Hill Proprietary Co.'s spelter contains only 1.2% lead and 0.06% iron. It is suitable for rolling into sheets. Arrangements have been made with Hoskins and Co., of Lithgow, New South Wales, to roll this spelter into sheets. From these shaving is cut. In normal times imported zinc-shaving in Australia costs $30 per ton more than is charged for spelter. The cost of Australian shaving is considerably more. The War has also caused the Broken Hill Proprietary to combine with the North and South companies in increasing the Port Pirie smelting works. The first-named company has also made a start at Newcastle, in making steel rails. The Commonwealth government has already contracted with it for the supply of 12,500 tons. The total is approximately $550,000, or $44 per ton. Delivery will commence in July. It will be the first delivery of steel rails actually made in Australia. The New South Wales, Victorian, and South Australian governments are said to have also ordered rails from the company. Other proposed lines will help the new works.

The plant of the Mountain Queen at Southern Cross is being dismantled; it is to be transferred to the Queen of the Hills mine at Meekatharra. The latter is owned by the Lake View & Aroya Exploration Co., which also holds two-thirds of the Mountain Queen shares. The ore-shoot in the latter mine became so poor and refractory in the sulphide zone as to be unprofitable. The Mountain Queen is equipped with a double No. 1 Holman pneumatic stamp-mill, a 4 by 16-ft. tube-mill, and vacuum-filter. These were driven by a 224-hp. Kynock gas-engine, and Commonwealth down-draught wood-gas generators burning ordinary 5 to 6-ft. wood. This mill has, during the last year, been treating 3000 tons monthly, yielding $30,000, with a profit of $10,000. This is more than sufficient to pay the annual dividend of 12c. per share or $90,000 per year on the Lake View & Oroya Exploration Co.'s shares. As the plant on the Mountain Queen is a duplicate of the Queen of the Hills plant, its installation at the latter will about double the revenue and profit. Probably, the dividend also, if last year's average can be maintained.

In December 1914 G. C. Klug, manager for Bewick, Moreing & Co., acquired for the Yuanmi company 401 acres at Wardanrie in the Yalgoo district on the Murchison. At that time the prospectors had a shaft down 100 ft. and a winze 30 ft. below that level. At the bottom of this winze a drift 31 ft. long was in ore 65 in. wide for a distance of 31 ft. It assayed $17.52 per ton. Cross-cuts show the full width of the lode to be 102 in., assaying $12.72 per ton. The lode is opening so well that it is proposed thoroughly to develop the mine. The plant at the worked-out Black Range mine will be moved to the new property.

The announcement that a winze below the No. 20 level of the Sons of Gwalia mine, sunk to 23 ft. at a point 930 ft. south, has averaged $20 per ton over a width of 72 in. is good so far as it goes. However, in the drift at the same level, the ore-shoot from 915 ft. to 991 ft. was also in ore averaging $20 per ton. The winze was put down in a rich part, and proves its continuity at depth.

The cutting of No. 4 lode in the Golden Horse-Shoe at 2480 ft., 300 ft. south of the main shaft, and 700 ft. south of the Ivanhoe boundary, is hopeful. This is the most southerly point that this ore-shoot has been located in the deeper levels of the Horse-Shoe since it returned from Great Boulder ground. This ore, which averages $8.16 per ton over a width of 96 in., is 800 ft. from the Chaffers boundary. As it is cut out in the Great Boulder long before reaching the Main Reef, now owned by Chaffers, the outlook does not look promising for the latter. Before being absorbed by Chaffers the Main Reef company drove on this lode at a depth of 2261 ft. It was only worth $3.34 per ton for the width of the drive and a length of 102 feet.

In addition to trenching on the surface, Richard Hamilton, manager of the Great Boulder mine, has had a diamond-drill hole put in from the 1100, 1250, 1450, 1650, and 2200-ft. levels of the Boulder Perseverance mine to test the two lodes on the eastern boundary of the claim. In various trenches on the surface the ore assayed as follows: $2.04 for 24 in., $10 for 60 in., $12.24 for 60 in., and $53.04 for 30 in. In the boreholes the assays varied a good deal, but ore assaying $18.36 for 12 in., $10.20 for 84 in., $24.48 for 30 in., and $8.64 for 72 in. was cut at various points. As all these discoveries were made well within 200 ft. of the Perseverance boundary, and 500 ft. east of the Great Boulder's main drifts, cross-cutting from the Perseverance would soon prove whether the new lodes are worth serious attention.

The boom in the Edna May group shares continues in Melbourne, Victoria. Any mine with the prefix of Edna May in its title 'goes off like hot cakes,' if put on the market. The Battler and Battler Extended with the Edna May prefix, situated 4½ miles northwest of the Edna May, only containing 'leaders' 9 to 12 in. wide, were put on the market at $1.25. They immediately moved to $1.75. The Empress, which is on the Murchison 300 miles north, is included in the group. As it was sponsored by the same people, it is quoted at $6, and has touched $7.20 for a $2.40 share, on which $1.75 only is paid up. This mine is depleted down to 250 ft. A shaft has to be sunk below that level before any ore can be obtained, far less tested. The Edna May directors are evidently afraid to sink. The shaft, from July to the end of January, was left at a depth of 240 ft. It reached 268 ft. by the end of February; no sinking has been done since. Ore reserves on November 1, 1911, were only 52,000 tons, or 18 months' supply.

PETROGRAD, RUSSIA

MONGOLIA PRACTICALLY WITHDRAWN AS A FIELD FOR MINING.

A statement has just been issued dealing with Mongolian gold mining that will be a surprise to Russians and foreigners. It will be remembered that on the strength of Russia's political interference with China's protectorate over Mongolia, resulting in the emancipation and practically the independence of the latter, great hopes were raised of Mongolia becoming not only a large source of supply in respect to corn and cattle, but also a fine field for industrial enterprise, particularly gold mining. The statement refers to the great interest in gold that existed about the time of the emancipation. It is well known that high hopes were raised at Petrograd at the time on the strength of the alleged gold deposits of that country. It will be also remembered, for what reason was never clearly expressed, that not long ago the Russian government issued a warning to all whom it might concern, that anyone committing himself to mining operations in Mongolia must do so entirely at his own risk, the relations between that country and China were such as to make it inconvenient for Russia to grant such protection as the preceding political events might have made industrialists think she was competent to afford. Whether it was the issue of this Government warning that constituted the cold douche on mining in Mongolian gold, and certainly it was well calculated to discourage the foreigner from going too deep into it, or whether for some other reason, it would appear that the Mongolian gold industry as a field for outside enterprise has been relegated to a more or less distant future.

Two large deposits of copper pyrite have been found 18 miles from Elisavetpol, according to a recent consular report. Sulphur content is from 48 to 53 per cent.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press.

ALASKA

The U. S. Geological Survey is dispatching 12 parties to Alaska to continue the systematic surveys and investigations that have been in progress for the past 18 years. Of these parties three will be sent to southeastern Alaska, including Juneau and Ketchikan, one into upper Chitina region, one to Port Valdez, two will work in the Turnagain Arm-Knik region, one will make investigations in the Yukon-Tanana region, and two in the Ruby-Kuskokwim region, and another will traverse the little-known area lying between the Ruby district and the Tanana river. One party will be engaged in general investigations in different parts of the Territory. These parties will sail from Seattle during May so as to take full advantage of the field season. All the men needed for the work have been engaged, and the purchase of horses, supplies, and equipment is well under way.

The second session of the Territorial Legislature is finished. Among the laws passed are the following relating to mining: workman's compensation act, general mining law, law providing for the assessment of unpatented claims, an 8-hour law for placers, and new mine inspection act.

Chisana

It is reported in Cordova that A. McGuire has discovered rich ground in Dry gulch, near Johnson creek. He has bonded the claims to F. Hoffman and J. J. Finnigan. A shaft cut bedrock at 142 feet.

Fairbanks

Three claim-owners started sluicing on Ester creek on April 11. Others on Cleary, Chatanika, and Fairbanks creeks were then preparing for the season.

Juneau

According to P. R. Bradley, superintendent of the Alaska Juneau company, an 8000-ton mill will be erected near the present small plant. It will be designed by George Bradley, who planned the Gastineau mill. A large wharf is to be built. A hydro-electric plant will also be constructed. In the suit of the Alaska Juneau *v.* Ebner company, involving water-rights on Gold creek, the verdict was in favor of the defendant, upholding its claim of prior rights.

ARIZONA

Cochise County

At the Douglas smelter of the Copper Queen company 16 roasting furnaces are working. Six are treating sulphide ore from Bisbee. Large shipments of concentrate from the Moctezuma mill at Nacozari, Sonora, will keep the plant busy for some time.

Mohave County

(Special Correspondence.)—Bullion shipments from the Tom Reed-Gold Road district during April were valued at $165,000, against $160,000 in March. Ore treated in April totaled 14,500 tons, compared with 14,000 tons in the previous month. Rich ore from the winze down 125 ft. below the Tom Reed 950-ft. level helped to swell the returns.——The cross-cut at 565 ft. in the United Eastern has cut the vein. It is similar to the shoot at 460 feet.

Oatman, May 4.

At 1075 ft. in the Tom Reed mine the vein is 18 ft. wide, several feet more than where opened last week.——After a heavy flow of water had subsided at 300 ft. in the Pittsburgh, it was found that a good vein was exposed in the face of the drift.——It is reported that the Arizona Southwestern Copper Co. has been financed. The mine will be unwatered. The new shaft is to be sunk to 500 ft. Good lead ore has been opened at 200 feet.

Yavapai County

Encouraging developments are reported from the Black Chief Copper Co.'s property in the Black Hills district. Some new machinery was recently bought in Prescott by the manager, J. M. Sullivan.——Good progress is being made in erecting the Grey Eagle Reduction Co.'s plant. It will have a capacity of 50 tons per day.

CALIFORNIA

Amador County

Eighty stamps continue to crush ore at the South Eureka mine near Sutter Creek.——An assessment of 5c. per share has been levied by the Treasure Mining Co. Its property is between the Bunker Hill and Fremont mines at Amador City. ——Some good ore has been opened at 1200 ft. in the Keystone. C. R. Dow is superintendent.——Suit has been started by the Original Amador company to quiet title to several claims within the limits of Amador City. Residents have erected houses on them.——It is reported that by means of an assessment of 50c. per share, E. Green has secured a controlling interest in the old Eureka Consolidated.

Calaveras County

About 24 in. of rich ore has been cut at 100 ft. in the Ford mine near San Andreas. J. C. Benson is in charge.

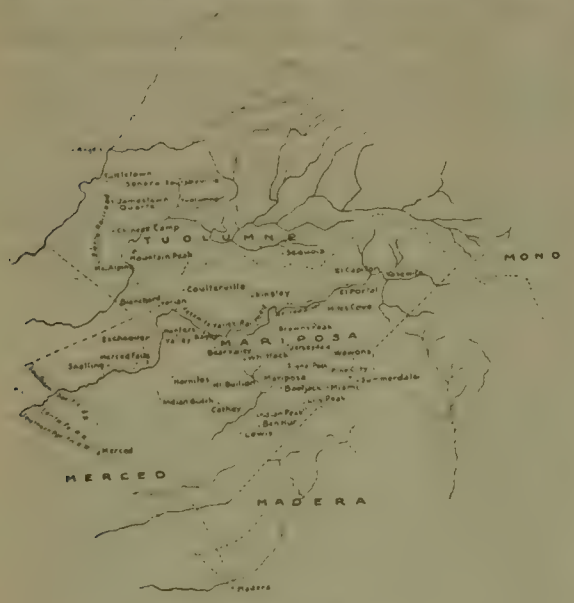
Eldorado County

A rotary gravel mill has been installed at the Rising Hope mine near Placerville. It will treat up to 125 tons per day.

Mariposa County

(Special Correspondence.)—Morison, Flagel, and Quinn, lessees at the Pine Tree mine, owned by the Mariposa Commercial Mining Co., crushed 22 tons last week for $127 per ton.——The Mountain Queen company has been incorporated by San Francisco and Oakland people. They acquired the Sunshine claims. This property is fairly well opened and equipped. Three hundred tons milled returned $12.50 per ton by amalgamation. Concentrate assayed $300 per ton.——The Colorado Mining Co., controlled by Judkins, Weston, and Dearborn, on Sacton creek, crushed 80 tons, yielding $21 per ton. The shaft is down 250 ft. The vein averages 4½ ft. wide. Ten stamps are worked.——Teal, Oleson, and associates have purchased the old Washington claims of 300-acres of patented ground.——Carroll Bros. and others are erecting a 5-stamp mill on the Stud Horse Flat property, on the Merced river, two miles below Bagby.——The Little Wonder claims have been re-bonded to Los Angeles people, miners are driving an adit to cut the vein.——The Rival and Sweetwater property is being developed with 30 men. A mill test of 62 tons from a 4-ft. vein on the Rival mine is said to have been satisfactory. A hoist and steam pump are to be installed.——Worthington, Skelton & Co., of Jerseydale, are developing the Gevil Gulch claim. Machinery is to be purchased soon.——The Clearing House mine on Merced river is being operated in charge of George Egenhoff.——The Red Banks mine, two miles below Bagby, is being developed. The compressor will be moved from the Crown Lead mine. Machine-drills are to be installed. ——The Virginia mine near Bagby has resumed operations under direction of Mr. Pounding, of Oakland. A 10-stamp mill

is crushing good ore.——Charles E. Paine, of Mariposa, has discovered a deposit of molybdenite on the Summit.——L. P. Helmer had 60 tons of ore treated at the Austin mill. It yielded $14 per ton by amalgamation. This ore is from the old Persia mine on Sacton creek.——Mrs. Jennie E. Diven, of



MAP OF MARIPOSA COUNTY.

Oakland, has secured 62½% interest in the Buckingham Mountain claims. About 2000-ft. of development has been done. Prospects are good. A large mill is one of the possibilities.

Mariposa, May 3.

Nevada County

The Golden Center company has issued its authorized capital of 25,000 shares at $2 each. Mining is being carried on under part of the residential district of Grass Valley.——The Major mine near Nevada City is being re-opened.

The H. B. Nichols property of 60 acres, west of Grass Valley, has been sold to J. B. Preble, of Seattle. A shaft is down 150 ft. Both quartz and gravel occur.

Placer County

Work has been resumed at the old Black Oak mine near Wermar. Buildings and machinery are to be erected.——Improvements at the Eureka and Banner mines near Auburn consist of a large pump, compressor, and roller mill.——The Marigold Gold Mining Co. is to purchase five claims of the Hines Gilbert-Gold Mining Co. The price is said to be $140,000, paid in installments.

Sierra County

Work is to be resumed at the Oriental mine below Alleghany. The main adit is over 4000 ft. long. The property has been closed for 10 years. W. B. Pearson, of the Plumbago mine, will also take charge of the Oriental.——The Alhambra and Extension have been bonded. Good ore has been developed in them.

COLORADO

San Juan County

The Silver Lake mill is being re-modeled. Oil-flotation machines are being installed.——The Gold King mill is busy. The Louis Bastian flotation machine is doing good work.——The North Star mine is to be sampled and developed.——Mining has been resumed at the Mayflower.——The Shenandoah and Trilby have been leased.

IDAHO

Blaine County

In March the Wilbert company in the Dome district, 25 miles east of Arco, mined 209 tons of ore. Of this, 159 tons, averaging 6.56 oz. silver and 57.14% lead, was shipped to Utah. The profit was $1279. High-grade ore is coming from the 500-ft. level. When the mill starts it will produce 1500 tons of concentrate per month.

Lemhi County

(Special Correspondence.)—A two years' lease on the Italian mine has been secured by M. H. Phillips and John M. South. Work has been started. A 30-stamp mill driven by water-power is ready for crushing ore.——The concentrating plant at the Copper Queen mine is to be started on low-grade dump ore. T. E. Lynch is owner. Gas-engines are used for power.

Leesburg, May 3.

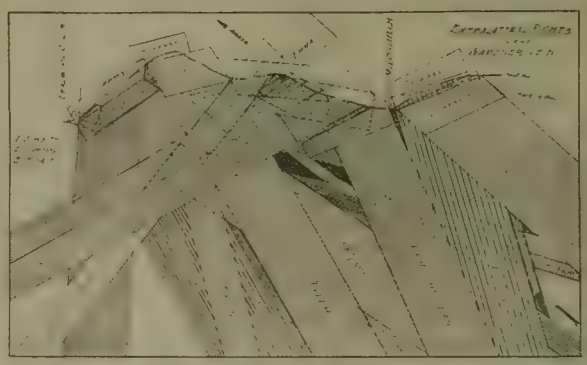
Shoshone County

On May 5 the Caledonia company distributed 2c. per share, equal to $52,100. The total for the current year is $260,500. In March the mine produced 3164 tons of ore. Of this, 529 tons was shipped. The mill treated 2517 tons. Mining cost $1.84 per ton, milling, 81.2c. The ore and concentrate contained 47,664 lb. copper, 1,080,240 lb. lead, and 97,484 oz. silver, valued at $100,599.

The Stewart mine is producing 500 tons of ore daily. Owing to the Hypotheek ore being not suitable for treatment in the Stewart mill, the proposed milling contract has been abandoned.

The Idora Mining Co.'s mill on Beaver creek is to be remodeled to treat 150 to 200 tons per day. It has been leased to Gus Ehrenberg, of Spokane, for 30 months. The Tuscumbia mine will supply ore for the plant.

The application of the apex law at Wardner is discussed by Fred T. Greene, of Butte, Montana, in a paper to be presented at the September meeting of the A. I. M. E. at San Francisco. He states that there are many storm-centres of



apex litigation in the Rocky Mountains. Not the least of them is the Wardner camp, where such litigation has been almost continuous since 1892, and the end is not yet. In their decisions, the Courts have accepted the claims of the litigants that the 'Wardner vein' is a broad zone varying from 250 to 500 ft. in width at the surface. This is the simplest theory which could have been advanced, and probably decreased, rather than augmented, the number of contests; in fact, every one of the claim-owners seemed to feel that the greatest advantage would accrue to him if this theory were adhered to. The dominant structural feature of the Wardner vein is a persistent fault, striking north 40° west, dipping about 40° to the southwest, and called the 'Wardner footwall.' Twenty years of litigation established the rights of the following claims as shown in the accompanying plan: Lackawanna, Sullivan, Bunker Hill, Stemwinder, Emma, Last Chance, Tyler, King Fraction, Viola, San Carlos. Rights of

the Phil Sheridan, Republican Fraction, Cheyenne, Lincoln, Sims Fraction, and Overlap remained to be determined.

MICHIGAN

The U. S. Bureau of Mines rescue-car which has its headquarters at Ironwood, is at Houghton for instruction. Miners and College of Mines students will see proper demonstrations of first-aid work.

HOUGHTON COUNTY (THE COPPER COUNTRY)

(Special Correspondence.)—The stamp-mill at the White Pine mine commenced regular work with two shifts on May 3. 'Rock' is being taken chiefly from stock-piles. Nothing is known yet as to the amount of copper extracted. Plans are now under way for the erection of collar-houses, a supply-house, change-houses, and shops.

Houghton, May 7.

So much copper is being sent by water to the East that the Mutual Transport line has put on another boat. The *Rhoades* last week took on 2700 tons of metal at Lake Linden.

Large numbers of mostly unskilled men are crowding the copper district, and the unemployed situation is causing some alarm. The local papers are warning men not to come to the region.

Mining and milling is to be resumed at the Winona. This will give employment to about 400 men. Lessees' time is up on June 1.

The report of the Winona Copper Co. for 1914 shows that in August the mine was closed, but in October a tributing arrangement was made with 35 of the best of the former employees to work certain stopes on No. 3, 4, and 5 levels from No. 3 shaft. This has resulted satisfactorily for all concerned. The last three years compare as follows:

	1914.	1913.	1912.
'Rock' stamped, tons	123,339	120,806	181,148
Copper produced, pounds	1,352,085	1,448,737	2,307,237
Revenue from copper	$109,797	$223,299	$376,219
Total revenue, including balance from 1913 and assessment	368,069	419,235	541,128
Total expenditure	275,421	344,727	479,094
Balance	92,648	74,508	62,034

On June 12 the Calumet & Hecla company and subsidiaries will distribute a bonus of over $500,000 among nearly 10,000 employees.

MISSOURI-KANSAS-OKLAHOMA

On May 4 the H. L. & S. concentrating mill at Lawton, Kansas, disappeared. This was due to a cave-in of some ground. The loss is about $10,000.——The Carmean & Squires company has resumed work at the No. 4 mine, near Webb City, Missouri. Ore occurs at 180 feet. The mill has a capacity of 250 tons.——The Gennessee company is prospecting at Duenweg. One drill has found ore at 180 to 192 ft. It assays 11.36% blende.——Development at the Wilson property at Duenweg is satisfactory.

MONTANA

FERGUS COUNTY

(Special Correspondence.)—Development in the North Moccasin mine of the Barnes-King Development Co. in the past few months has disclosed a large body of rich ore, apparently extending under the townsite of Kendall. This shoot was found at a depth of 700 ft. This is deeper than any work that has been done in this district. The Barnes-King output in March was $56,000. The outlook is bright. One hundred men are at present employed by the Barnes-King company at Kendall.

The old Kendall mine adjoins the North Moccasin property. It was closed in November 1912, when the known orebodies were worked out. Its shaft, however, was only 500 ft. deep. The orebody now being developed by the Barnes-King has been opened as far as the Kendall property line on the 700-ft. level. Among the possibilities of the future is that the Kendall will be reopened, and the shaft sunk 200 ft. deeper to mine this orebody. The Kendall has produced a total of several million dollars in gold. It has distributed $1,505,000 in dividends, paying $30,000 out of surplus as late as July 1914. It has a well equipped power-plant and cyanide mill. It is to be hoped that the owners will soon re-open their mine and carry on exploration at depth.

The Fergus Oil & Gas Co. has been reorganized. J. H. P. Gauss is the new president, Louis Blodgett, secretary, and Mr. Murray, treasurer. Active exploration will start soon.

Another oil company has been incorporated by Moore capitalists for $100,000, of which $80,000 has been issued. They will prospect for oil near Moore.

Lewistown, April 28.

SILVERBOW COUNTY

Work is to be resumed at the Mountain View mine of the Anaconda company. About 750 men will be employed. The normal output of ore is between 1200 and 1500 tons per day. On account of the court decision on the Alice mine, mentioned in the *Press* last week, work has been suspended.

The report of the North Butte company for the first quarter of 1915 states that from the treatment of 54,570 tons of dry ore and 15½ tons of precipitate the yield was 3,358,325 lb. copper, 179,569 oz. silver, and 181 oz. gold. The mine was worked at from 50 to 60% normal capacity. Good developments resulted from work on the Edith May and Snowball veins. The Granite Mountain shaft is ready for work.

NEVADA

ESMERALDA COUNTY

The U. S. District Court at Seattle has appointed Carl Johnson, of Seattle, permanent receiver for the Goldfield Merger Mines Co. Suits are to be commenced against directors for alleged abandonment and loss of property, especially the Velvet claims sold to the Jumbo Extension.

HUMBOLDT COUNTY

According to Frank Margrave, superintendent of the Nevada Packard Mines Co., preliminary arrangements have been made for construction of a 75 to 100-ton mill. A pipe-line is being laid. Electric power will be secured from the line supplying the other mill at Rochester.

LINCOLN COUNTY

Tests on Amalgamated Pioche ore, by the General Engineering Co. of Salt Lake City, show that water concentration and flotation will make a good recovery. When treatment is started this system will be used.

NYE COUNTY

Seven mines at Tonopah produced 9871 tons of ore worth $203,638 during the first week of May.——The Extension company has declared a dividend of 10c. per share.——There are 13 sets of lessees working in the old workings of the Midway. Forty dollar ore is being broken between the 1070 and 1170-ft. levels of the Merger. It is stated that the company may acquire one of the mills at Tonopah. The report of the Tonopah Extension Mining Co. for the year ended March 31, 1915, has been issued. Development amounted to 12,651 ft., making 84,421 ft. to date. Cross-cutting will soon be started at 1350 ft. No estimate of ore reserves is possible, but the increase in treatment capacity from 150 to 250 tons per day was justified. All underground costs were $5.191 per ton. The mill treated 71,882 tons averaging 28.13 oz. silver and 0.264 oz. gold per ton. From the sale of 1,790,032 oz. silver and 17,585 oz. gold was received $1,285,508. Treatment cost $3.753 per ton. Marketing charges were 45c. per ton. The net profit was $590,165. New equipment consisted of a Nordberg hoist, Chicago pneumatic air-compressor, electric-haulage plant in the mine, 10 stamps, two tube-mills, Dorr apparatus, Rockwell furnaces, and a high-pressure water system.

UTAH

Beaver County

A hoist and compressor are to be installed at the Lenora mine. The superintendent, A. C. Nebeker, has been in Salt Lake City for this purpose.

Juab County

Ore shipments from the Tintic district last week totaled 149 cars.——Nothing but high-grade zinc ore, 36 to 40%, will be received by smelters, hence there is considerable dissatisfaction among producers. A good deal of the zinc ore sent out this year contains under 30% metal. The quantity of the higher grade is limited.——The Mammoth and A. S. & R. companies have arranged a new smelting contract.

Salt Lake County

(Special Correspondence.)—The Alta and Big Cottonwood districts continue to hold the interest recently aroused. The stocks are all strong on the Exchange, and there is great activity in the mining-claim market. The Wasatch Mines Co. has furnished the latest excitement by finding the continuation of the old No. 5 orebody on the other side of a fault. This shoot is on the Braine fissure and the Cardiff contact. So far as developed, it is 7 ft. wide, and averages $40 per ton. They are about to commence shipments. The company had started a drainage adit some time ago, but abandoned the project. This is now to be resumed.——The Alta Con. has so far blocked out an orebody 440 ft. long, 2 ft. wide, and 100 ft. high, at a depth of 500 ft. The average value of the ore is $40 per ton.——The Emma Copper Co., whose claims adjoin the old Emma mine of international reputation and historic interest, is prospecting for the continuation of the Emma orebody, which has yielded about $11,000,000.

Salt Lake City, May 7.

A couple of days later than the above was written, 5 ft. of ore was cut in a rise in the Flagstaff ground of the Wasatch company, 4000 ft. from the portal of the Tom Moore or Flagstaff adit. As soon as the roads are in good condition teams will start hauling ore.——The Michigan-Utah company will resume work in June.

The report of the Utah Copper Co. for 1914 contains the following information:

The area of mining claims is now 738 acres. Other land covers 6031 acres. Development in the Boston claims totaled 9030 ft. Drilling amounted to 8920 ft. The totals of development and drilling to the end of the year were 448,533 and 46,391 ft., respectively. Underground development cost 0.88c. per ton of ore mined. Adding drill work, the total was 1.7c. per ton, against 2.34c. in 1913. This was charged to operation. The ore area is now 226.3 acres. The average thickness is 465 ft. Reserves are estimated at 342,500,000 tons averaging 1.45% copper. An additional quantity probably lies under these reserves. The average thickness of capping is 115 ft. During the year 5,708,836 cu. yd. of overburden was removed. To date the total is 27,834,043 cu. yd. Of the ore mined, 98.27% was by steam-shovels, the balance from underground. Cost of shovel work was 30.96c. per ton. Underground work cost 78.45c. The combined average cost was 32.32c. per ton.

The Magna plant treated 4,461,461 tons of ore. The Arthur did not work after August 6. It handled 2,008,705 tons. The year's tonnage was 1,049,226 tons less than in 1913. The metal market was responsible for the curtailment. The average grade was 1.425%. Average extraction was 66.04%, an increase of 2.09%. The cost of milling was 35.36c. per ton, a reduction of 1.3 cents.

The Bingham & Garfield railway carried 5,902,196 tons of freight. Of this, 4,829,877 tons was ore, 100,466 tons coming from other mines at Bingham. Transport cost 27.82c. per ton.

The smelter produced 121,779,401 lb. copper, compared with 119,939,809 lb. in 1913.

Financial results were as follows: Total operating costs were 95.5c. per ton, a decrease of 2.1c. The revenue from 115,690,445 lb. copper, 34,729 oz. gold, and 325,352 oz. silver, etc., was $16,222,456. The operating profit was $5,992,163. Income from dividends, interest, etc., less other interest, made available $8,678,491. Dividends totaled $4,827,885. Depreciation amounted to $523,851. The surplus at the end of 1913 was $9,708,653, and at the end of 1914, $13,035,409.

Summit County

The Big Four Exploration Co. is to erect a 250-ton plant to treat a dump of 800,000 tons of tailing at Atkinson, seven miles north of Park City. Kirk and Leavell designed the plant. The tailing contains gold, silver, lead, and zinc, and averages $5 per ton. It is an accumulation from the various mills at Park City.

The Park City Mills Co.'s plant has resumed work. It has a capacity of 35 tons per day. Recent experiments by Messrs. Holt and Dern have shown that over 85% recovery can be guaranteed.

Tooele County

(Special Correspondence.)—The Tooele smelter of the International company is now treating 1000 tons of lead ore and 600 tons of copper ore per day. There are five lead furnaces in operation. There have been several changes made in the staff positions, all in the nature of promotions.

Salt Lake City, May 7.

CANADA

Alberta

It is just a year since the oil boom commenced at Calgary. Oil was found in the Dingman well, 40 miles southwest of the town. About 450 companies were organized with a capital of $500,000,000. At the present time about 50 companies are drilling for oil. Five wells have given promising results. The oil-bearing area is estimated at two by three and a half miles.

A party of miners, in charge of J. C. Vanlicke, who represents United States and Canadian capital, has gone to examine the Fond du Lac district. This area is at the east end of Lake Athabasca, about 600 miles north of Calgary. Reports of a silver discovery were made last year, but nothing has been heard of the place lately.

MEXICO

Hidalgo

In March the Santa Gertrudis mine made a profit of $32,600 from 13,917 tons of ore treated.

San Luis Potosi

An antimony smelter is being erected in the city of San Luis Potosi, according to a consular report of April 2. It will be ready to start when mining and transportation conditions permit the ore-supply to be shipped and the product exported. The machinery, which is American, is now ready for installation. It is expected that the plant will employ 150 men. The capacity is to be 3000 tons per annum of refined star antimony. The product will be shipped to the United States. This will be the first and only smelter in Mexico producing refined antimony for the market. It is owned by American capital. Ores will come from its own properties in San Luis Potosi and Queretaro.

The only antimony smelter heretofore operating in Mexico is situated at Wadley, a small station on the National Railway, 102 miles north of San Luis Potosi. The Wadley smelter is not equipped for finishing the product. It has exported its product to England for further refining. The Wadley plant was erected about 14 years ago. A large part of its ore came from the Catorce district. Antimony has been found in many places in Mexico, especially in Durango, Sonora, and Oaxaca. Relatively small quantities of ore have been shipped to the United States for smelting. The Catorce deposits have been the best producers for the last 20 years. The ores are rich. Antimony appears in many ores treated at the lead smelter at San Luis Potosi. Its presence is deleterious.

PERSONAL

W. C. Maisch is at Petrograd.

Albert Burch is at Goldfield.

R. T. Tustin, of Chicago, is in Idaho.

T. H. Oxnam was at El Paso during the week.

Mark L. Requa has returned from New York.

Oscar H. Hershey is returning from Kellogg, Idaho.

J. V. N. Dorr will be in Denver during the month of May.

Philip L. Foster and A. F. Main have been at Telluride, Colorado.

Charles Butters has moved his New York office to 120 Broadway.

W. J. Loring left San Francisco on May 9 for New York, on his way to Chile.

E. H. Leslie was married on April 10 at Pittsburgh to Miss Mathilda G. Shrom.

H. W. Hardinge has left New York for an extended trip to the West and Alaska.

A. M. Yonge has returned to Costa Rica as superintendent of the Mina La Union.

E. M. Hamilton sailed on May 8 from Liverpool to New York, on his way to California.

Henry S. Munroe, professor of mining in the Columbia School of Mines, retires on June 30.

William Wraith is general manager for the International Smelting & Refining Co., at Tooele, Utah.

Charles P. Beresford, manager of the Prestea mine, West Africa, has been visiting Cobalt, Ontario.

R. Gilman Brown is leaving London on a visit of inspection to the Kyshtim and Ridder mines in Siberia.

F. L. Bosqui is returning from Johannesburg to London, where he will open an office as metallurgical engineer.

H. D. McCaskey succeeds Edward W. Parker as chief of the Division of Mineral Resources in the Geological Survey.

Lloyd B. Smith, of the Associated Geological Engineers, has returned to Pittsburgh from the oil-fields of Mexico and Central America.

Arthur Bennetts of the Quincy mine has been appointed head mining captain of the Mass, to succeed the late W. J. Ninness.

Will H. Coghill has removed his laboratory from Chicago to El Paso, Texas, where he will continue the testing of ores at 3705 Hueco street.

Edward W. Parker has resigned from the U. S. Geological Survey to accept an appointment as the head of a bureau to be formed by the anthracite mining companies.

Edgar H. Gould, for several years efficiency engineer at the North and South Kearsarge mines of the Osceola Consolidated, has been appointed underground superintendent at the White Pine.

William R. Appleby, David T. Day, Bradley Stoughton, Harry H. Stoek, George S. Rice, and Joseph W. Richards are in attendance at the Panama-Pacific Exposition as jurors in the Mining Department.

Frederic Keffer, for 17 years connected as manager and consulting engineer, with the British Columbia Copper Co., has formed a partnership with Henry Johns, for 15 years superintendent of the same company's mines. Their office is at Spokane.

Scott Turner is a survivor from the *Lusitania* disaster. C. T. Brodrick is among those lost; a graduate of Harvard, he had done excellent work lately as a mining geologist in Siberia and more recently he had given his services to the Belgian Relief Commission. Another victim of the disaster is Lindon Bates, Jr., a Yale graduate, a promising young man, and the son of the chairman of the Belgian Relief Commission at New York.

Lead Production in 1914

By C. E. Siebenthal.

(Advance statement, U. S. Geological Survey.)

Production of refined primary metal available for consumption, and production of secondary lead.

	1912	1913	1914
Desilverized lead	309,857	301,160	340,397
Soft lead	141,248	131,867	158,219
Desilverized soft lead	29,789	29,433	43,506
Total production of refined primary lead	480,894	462,460	542,122
Production of antimonial lead	13,552	14,667	16,668
Supply:			
Stock in bonded warehouses Jan. 1.	4,481	10,492	5,310
Imports—			
For consumption	14,146	11,980	7,386
For warehouse	69,414	45,165	20,952
Production from domestic ores	392,517	411,878	512,794
Total supply	480,558	479,515	546,442
Withdrawn:			
Exports of foreign lead—			
From warehouse	64,906	44,544	21,545
In manufactures, with benefit of drawback	11,320	9,757	9,399
Exports of domestic lead	.....	.....	58,722
Decrease by liquidation	5,692	419	56
Stock in bonded warehouses Dec. 31.	10,492	5,310	7,668
Total withdrawn	92,410	60,030	97,390
Available for consumption	388,148	419,485	449,052

Exports of domestic lead, in tons.

	By months.		By destination.		
	Short tons.	Value.	To—	March-June, 1914.	July-December, 1914.
1914					
March	5,838	$439,246	Great Britain	7,153	16,995
April	5,931	427,551	Germany	5,141	2,241
May	2,045	148,563	Netherlands	4,720	2,010
June	6,348	496,440	Belgium	2,101	560
July	10,894	854,137	Russia	448	6,263
August	5,486	443,879	Canada	.....	4,082
September	2,793	231,393	Japan	.....	2,247
October	7,829	594,554	Other countries	599	4,153
November	8,417	618,531			
December	3,141	247,390	Total	20,102	38,560
Total	58,722	4,501,684			
1915.					
January	6,460	491,929			
February	3,920	308,766			

Imports of lead, in ore, base bullion, and refined, by countries, 1908–1914, in pounds.

Country.	1912	1913	1914
United Kingdom	279,546	404,594	245,548
Germany	494,237	262,132	4,529,919
Other European countries	55,356	143,293	123,085
Total from Europe	829,139	810,019	4,898,552
British North America	319,497	338,569	384,007
Mexico	159,455,564	95,693,439	46,282,207
South America	3,207,936	8,766,327	2,417,744
Other countries	3,309,356	8,686,612	2,694,293
Total imports	167,121,592	114,293,966	56,676,803

Imports of lead, by classes, 1907–1914, in pounds.

	Lead in ore (lead content).	Base bullion.		Pigs, bars, sheets, and old.	Total lead content.[1]
		Gross weight.	Lead content.[1]		
1907	64,815,254	76,259,828	74,594,313	18,554,899	157,964,466
1908	64,708,204	153,921,829	150,560,176	5,518,621	220,787,001
1909	71,357,858	149,852,579	146,579,779	7,152,665	225,090,312
1910	94,751,054	118,061,415	115,483,542	6,970,170	217,204,766
1911	35,586,180	141,481,852	138,952,372	5,264,800	179,903,352
1912	19,577,499	152,420,624	146,999,168	544,925	167,121,592
1913	19,883,313	96,908,170	94,327,654	82,999	114,293,966
1914	23,649,637	33,444,503	32,730,320	296,846	56,676,803

[1] Lead content of bullion for 1907–1909 estimated on the basis of average lead content of imports of base bullion in 1910.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, May 12.

Antimony	35 —35¾
Electrolytic copper	19¼—19½
Pig lead	4.45—5.45
Quicksilver (flask)	$75.00
Spelter	13¾—14
Tin	45 —46½
Zinc-dust, 100-kg. zinc-lined cases	20

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, May 13.—Copper is quiet but strong; lead is dull but firmer in the West; zinc is scarce for immediate delivery.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
May	6	Mch 31	15.37
"	7	Apr. 7	15.75
"	8	" 14	16.03
"	9 Sunday	" 21	16.85
"	10	" 28	17.93
"	11	May 5	18.63
"	12	" 12	18.75

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	....
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.61	Oct.	11.10	....
May	13.97	....	Nov.	11.75	....
June	13.60	....	Dec.	12.75	....

Exports from the United States during the week ended April 24 totaled 14,585,358 lb., valued at $2,158,807. Of this, 4,936,972 lb. went to England, 4,543,639 lb. to France, 3,899,930 lb. to Italy, 583,384 lb to Norway, 391,277 lb. to Scotland, and 105,024 lb. to Spain. Imports amounted to 7,008,085 lb. of all kinds, worth $820,700.

The American Smelting & Refining Co. will pay a dividend of 1¾% on preferred and 1% on common stock on June 1. Copper Range is producing at the rate of 35,000,000 lb. per year.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending	
May	6	Mch. 31	50.14
"	7	Apr. 7	50.04
"	8	" 14	50.06
"	9 Sunday	" 21	50.18
"	10	" 28	50.60
"	11	May 5	50.33
"	12	" 12	50.06

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.38	48.85	July	54.90	....
Feb.	57.33	48.45	Aug.	54.35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	50.25	Oct.	51.12	....
May	58.21	....	Nov.	49.12	....
June	56.43	....	Dec.	49.27	....

The above quotations indicate a steady market. London advises a good undertone. American sellers have been shy. The upward movement last week was due to a better enquiry from Indian Bazaars. China exchanges have not reflected the firmness of the silver market so much as might have been expected, but there is nothing to suggest that the higher quotation would attract selling from that quarter. European purchases have been small. Up to April 22 exports from London to the East totaled £1,684,000, against £2,346,500 in that period of 1915. The decrease is equal to about 6,650,000 ounces.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Apr.	14	Apr. 28	70.00
"	21	May 6	70.00
		" 13	75.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60.00	Aug.	80.00	....
Mch.	39.00	78.00	Sept.	76.25	....
Apr.	38.20	77.50	Oct.	53.00	....
May	39.00	....	Nov.	55.00	....
June	38.60	....	Dec.	53.10	....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.			Average week ending	
May	6	4.20	Mch. 31	4.15
"	7	4.20	Apr. 7	4.23
"	8	4.20	" 14	4.20
"	9 Sunday		" 21	4.20
"	10	4.20	" 28	4.23
"	11	4.20	May 5	4.20
"	12	4.20	" 12	4.20

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	....
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	....	Nov.	3.68	....
June	3.90	....	Dec.	3.80	....

Tables covering production and consumption of lead last year are on the previous page of this issue.

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.			Average week ending	
May	6	14.50	Mch. 31	8.50
"	7	14.50	Apr. 7	8.75
"	8	14.50	" 14	9.12
"	9 Sunday		" 21	9.37
"	10	14.25	" 28	11.04
"	11	14.25	May 5	12.21
"	12	14.00	" 12	14.33

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	5.22	9.05	Aug.	4.45	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9.78	Oct.	4.75	....
May	4.91	....	Nov.	5.01	....
June	4.84	....	Dec.	5.40	....

The Butte & Superior company may increase its quarterly dividend from 75c. to $1.50 per share.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	....
Feb.	39.76	37.23	Aug.	50.20	....
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	....	Nov.	33.51	....
June	30.72	....	Dec.	33.60	....

The tin market is quiet at 41c. per pound. A Consular report from Chile states that the Campañia Estañifera de Llallaqua has been organized at Santiago with a capital of $243,325, to erect a tin smelter at Arica or Mejillones.

In 1914 the value of the secondary metals, exclusive of gold, silver, platinum, iron, and steel, recovered in the United States was $57,039,706, according to J. P. Dunlop, of the U. S. Geological Survey. This is a decrease from 1913 of $15,746,321, the secondary metals recovered in that year being valued at $72,786,027.

The term 'secondary' does not imply that these metals, which are recovered from scrap metal, sweepings, skimmings, drosses, etc., are of inferior quality, but is used to distinguish them from 'primary metals,' which are derived from ore. Secondary metal included 127,882 tons copper, 61,062 tons lead, 71,642 tons zinc, 12,447 tons tin, and 4522 tons aluminum. These are equal to 22, 11, and 20% of the first three primary metals produced, and 26% of the tin imported.

Eastern Metal Market

New York, May 7

The demand for copper has eased off but prices are well maintained. Tin has been dull and quotations have declined under the influence of cheap Banca tin. Spot spelter is scarce, and prices show a tendency to go higher, although future metal has been more freely offered. Chinese antimony is quoted at 34 to 35c. Fears are entertained for the future supply from China and Japan because of the unsettled conditions in those countries.

COPPER

The demand has been quieter in the past week, but London is strong. Prices here are fully maintained. Electrolytic advanced £1 in London, May 5. The tone here is steady. Most producers are holding to 19c., full terms, equal to 18.87½c., cash, New York, but second hands quote 18.62½c., cash, New York. There is talk of renewed inquiry from abroad for large quantities, but nothing definitely is known. Over 1,000,000 lb. of high-grade Lake sold during the week at 23c. Good grades, for which the claim is made that they will answer every purpose, can be had at 21c. This is considered a fair quotation. Exports in April totaled 16,822 tons, 6147 tons of which went to the United Kingdom and 4499 tons to France. Italy took 2539 tons and Sweden 3318 tons. The contracts for shells and ammunition which have been placed in this country are the cause of feverish activity to erect new plants and extensions to existing ones to house the thousands of machine-tools which have been purchased to turn out the material required in quick time. Thousands of tons of steel rounds have been bought, and as much is being negotiated. As previously pointed out, all this activity has a direct bearing on the metals.

LEAD

The domestic demand continues light. Some weakness has been imparted to the market by the action of a few consumers in offering at concessions metal which they previously had purchased. Small quantities have been sold on a basis of 4.05c. f.o.b. St. Louis. Foreign buying appears to be a little less active. The figures of production of refined primary lead in the United States, as given by the U. S. Geological Survey, show that unprecedented as were the exports of 1914, they were not great enough to offset the increased production of 1914 as compared with 1913. The increase was 79,622 tons or 17.2%. The trade generally regards the figures as showing the cause why lead has not advanced under the war demand proportionately to copper and spelter. New York quotation yesterday was 4.20c. and that at St. Louis 4.07½ cents.

SPELTER

Spot metal is quoted at 14.25 to 14.50c. At the latter price a couple of cars of prime Western were sold May 5, and a car of higher grade went at 15.50c., New York. On May 4, offerings were made on the floor of the New York Metal Exchange of 12.75c. for May delivery, 12.50c. for June, and 12c. for July. No sales resulted. The broker making the offers had 100 tons for each month, and would have disposed of the quantity in lots of 25 tons. He was commissioned to make the offerings, and did not solicit bids. Western makers of galvanized sheets are investigating the market in futures carefully before entering commitments for their product.

TIN

The chief features of the week are the lower price following a freer offering of Banca tin, and the modification of Great Britain's restrictions on trading in the metal. Business has not been active at any time and to this, also, was due the decline in price to 38.50c quoted May 6. England's concession did not do much to help the wholesale dealers, as both they and their customers must continue to file agreements which will satisfy the British consul as to the ultimate destination of the tin they handle. A third form of agreement was adopted which will permit the retailers to do business. The change was brought about by the tin committee of the New York Metal Exchange. The April tin statistics showed that deliveries into consumption in that month were good, amounting to 3200 tons. The total for four months showed a decrease of 3575 tons, as compared with the same period of last year. The arrivals at Atlantic ports totaled 4236 tons and those at Pacific ports, destined for the East, amounted to 1100 tons. It is notable that shipments from the Straits in April were 302 tons larger than in the same month last year. There was afloat yesterday 5140 tons, 725 tons of which was Banca.

ANTIMONY

Hallett's and Cookson's are practically unquotable, although a sale of two casks of Cookson's has been heard of at 40c. Chinese has jumped to 34 and 35c., prices which have been paid. In the week England is reported to have purchased 250 tons in this market. Not only England, but other countries which ordinarily are sellers are now buyers. The political complications in Japan and China are causing fears that that source of supply may be cut off. Stocks of the metal were large up to a few months ago and it has been their absorption by manufacturers providing for the future, coupled with the smaller flow of metal to this country, which has sent prices up. A smelter to produce refined antimony will be started at San Luis Potosi, Mexico, as soon as mining and transportation conditions permit. It is an American-owned company. Notes on this appear in 'The Mining Summary' of this issue of the *Press*.

Exports of metals, April 30 to May 1: copper, 5679 tons; lead, 2992 tons; and spelter, 1219 tons.

Schools and Societies

The UNIVERSITY OF CALIFORNIA held its 52nd commencement on May 12. There were 968 degrees of all classes conferred on graduates. The ceremony took place in the Greek theatre. The total enrollment during the past school year was 8699 students.

The AUSTRALASIAN INSTITUTE OF MINING ENGINEERS spent the second week in March visiting the west coast mining districts of Tasmania. There were 70 members in the party. Mt. Lyell (copper), Zeehan (lead), Mt. Read (zinc-lead), and Mt. Bischoff (tin), were among the places visited. At Queenstown, where the Mt. Lyell mine and smelter is, an interesting four days were spent. Robert C. Sticht is president.

The alumni of the MICHIGAN COLLEGE OF MINES will hold their Panama-Pacific Exposition re-union on September 20 and 21. These dates immediately follow those of the meeting of the A. I. M. E. The college alumni register, an elaborate pigskin-bound, gold-inlaid volume presented by the Chicago M. C. M. Club, has been placed in the Bureau of Mines exhibit in the Palace of Mines and Metallurgy. Wilbur H. Grant, consulting engineer in San Francisco, was the first to register. Milton B. Huston, of Philadelphia, was second. The Board of Control of the college has asked for the cooperation of the faculty and alumni association in arranging for a celebration of the thirtieth anniversay of the college in 1916.

BOOK REVIEWS

STAMP MILLING AND CYANIDING. By Francis Andrew Thomson. P. 285. Ill., charts, index. McGraw-Hill Book Co., Inc., New York, 1915. For sale by the *Mining and Scientific Press*. Price, $3.

This is an excellent little work on a subject which has been covered many times by other writers. One would think that unless something new had been developed there would be hardly any scope for another book. The concise manner in which it has been arranged gives the volume its chance. Strictly speaking it is a compilation. The author, who is at the State College at Pullman, Washington, admits this. He has drawn freely from the leading journals in the United States, and one in England, which devote most of their space to ore treatment. Manufacturers of machinery for this purpose helped illustrate the book by supplying photographs of their products. These combinations resulted in a variety of opinions on processes.

The 15 chapters include the following discussions: characteristics of gold and silver; principles of amalgamation; the stamp-mill and its accessories (a good review); stamp-mill amalgamation; modifications and applications of the stamp-mill (from Gilpin county, Colorado, to the Rand); modified gravity-stamps, steam-stamps, arrastras and pans, centrifugal and edge-runner mills, and tube-mills and ball-mills; comparisons of various mills, that is, work done; history and chemistry of cyaniding; preparations of ores for treatment, from crushing to agitators; dissolving gold and silver; separating solution and pulp; all filters described; precipitation methods; and clean-up and smelting.

Following each chapter is a complete bibliography of the subject, a feature in several recent works, including 'Rand Metallurgical Practice.' A table gives the characteristics of slime-filters in convenient form. The two last chapters deal with the relations and functions of apparatus in gold and silver mills, so here are found flow-sheets of 18 types of mills.

ELECTRIC MINE SIGNALLING INSTALLATIONS. By G. W. Lummis Paterson. P. 196. Ill., index. D. Van Nostrand Co., New York, 1914. For sale by the *Mining and Scientific Press*. Price, $1.50.

This is a practical treatise on the fitting-up and maintenance of electrical-signalling apparatus in mines. The writer is the author of a well known work, 'Management of Dynamos' and others. Save occasional articles in the technical press, little has been published on this subject. The use of electricity for signalling has been more or less used in mines for over 50 years. In recent years it has been a feature, in fact, at large and deep mines, the outputs could hardly be maintained with the old methods of signals. The author illustrates and describes apparatus which experience has shown to give the best results, and shows by plans the best methods of installation and maintenance. Electricians at various mines often devise their own signal systems, resulting in interesting comparisons of efficiency. Turning to the volume under review, we find discussed ringing keys and tappers, bells, alarms, relays, and indicators, generators and primary batteries for mine-signal installations, shaft wiring and signals, and electric engine plane wiring and signals. Most of the diagrams given, especially the shaft arrangements, are of practical use to mine electricians. An appendix contains an abstract of electricity rules enforced in English coal mines. Also U. S. Bureau of Mines regulations. A useful lot of symbols for motors, generators, converters, transformers, switches, signals, and ground connections is given.

RECENT PUBLICATIONS

U. S. Geological Survey publications, Washington, D. C., 1915:

PRODUCTION OF SPELTER IN THE UNITED STATES IN 1914. By C. E. Siebenthal. P. 8. Chart. The output was 353,049 tons, against 346,676 tons in 1913.

RESULTS OF SPIRIT-LEVELING IN MICHIGAN IN 1911 AND 1913. *Bulletin* 559. P. 79. Ill., index.

Water-Supply Papers, prepared under direction of M. O. Leighton:

NORTH PACIFIC COAST BASINS. By F. F. Henshaw, G. C. Baldwin, G. C. Stevens, and E. S. Fuller. No. 312. Prepared in co-operation with the states of Montana, Idaho, Washington, and Oregon. P. 706. Ill., maps, index.

PACIFIC COAST BASINS IN CALIFORNIA. By H. D. McGlashan and G. C. Stevens. No. 331. P. 442. Ill., index.

SPRINGS OF CALIFORNIA. By Gerald A. Waring. No. 338. P. 410. Ill., maps, index. This is an interesting report, especially for Californians.

MISSOURI RIVER BASIN. Compiled by B. D. Wood. No. 340-F. P. 22.

LOWER MISSISSIPPI RIVER BASIN. Compiled by B. D. Wood. No. 340-G. P. 22.

GEOLOGY AND WATER RESOURCES OF TULAROSA BASIN, NEW MEXICO. By O. E. Meinzer and R. F. Hare. No. 343. Prepared in co-operation with the New Mexico Agricultural Experiment Station. P. 317. Ill., chart, maps, index.

PROFILE SURVEYS IN WILLAMETTE RIVER BASIN, OREGON. No. 349. Prepared in co-operation with the state of Oregon. J. H. Lewis, state engineer. P. 8, and 16 large maps.

PROFILE SURVEY IN BEAR RIVER BASIN, IDAHO. No. 350. P. 7, and 6 charts.

PROFILE SURVEYS OF MISSOURI RIVER FROM GREAT FALLS TO THREE FORKS, MONTANA. No. 367. P. 8, and 13 maps.

PROFILE SURVEYS IN WENATCHEE RIVER BASIN, WASHINGTON. No. 368. Prepared in co-operation with the state of Washington. P. 7, and 8 maps.

The following indexes have been published by the Survey:

SHORTER CONTRIBUTIONS TO GENERAL GEOLOGY.

MINERAL RESOURCES OF THE UNITED STATES, 1913. Metals and non-metals.

PUBLICATIONS BY SURVEY AUTHORS ON METALS AND NON-METALS EXCEPT FUELS. Compiled by Isabel P. Evans. *Bulletin* 580-P. P. 43.

Professional Papers:

THE STRATIGRAPHY OF THE MONTANA GROUP. With special reference to the position and age of the Judith River formation in north-central Montana. By C. F. Bowen. No. 90-I. P. 59. Map.

THE CRETACEOUS-EOCENE CONTACT IN THE ATLANTIC AND GULF COASTAL PLAIN. By Lloyd William Stephenson. No. 90-J. P. 28. Maps.

THE HISTORY OF A PORTION OF YAMPA RIVER, COLORADO, AND ITS POSSIBLE BEARING ON THAT OF GREEN RIVER. By E. T. Hancock. No. 90-K. P. 7. Illustrated.

THE INORGANIC CONSTITUENTS OF ECHINODERMS. By F. W. Clarke and W. C. Wheeler. No. 90-L. P. 6.

COAL-MINE FATALITIES IN THE UNITED STATES IN 1914. Compiled by Albert H. Fay. P. 31. U. S. Bureau of Mines publication. Washington, D. C., 1915.

COAL RESOURCES OF DISTRICT I (Longwall). By Gilbert H. Cady. Field-work by G. H. Cady, K. D. White, and others. In co-operation with the U. S. Geological Survey. *Bulletin* 10. P. 149. Ill., maps, charts, index. State Geological Survey. University of Illinois, Urbana, 1915.

COMPANY REPORTS

ALASKA GOLD MINES COMPANY

For some years the preparatory work of this company's subsidiary, the Alaska Gastineau Mining Co., has attracted considerable attention. It is now a gold producer, the first unit of the mill is crushing ore.

The area of claims and land owned, and controlled under option, in the vicinity of Juneau, is approximately 2489 acres. Development in the mine in 1914 amounted to 28,523 ft. Diamond-drilling totaled 6203 ft. To the end of 1914 the total was 53,703 ft. of ordinary work, and 7545 ft. of drilling. Adding the work done previous to that of this company, the openings are over 13 miles. Little was done last year to prove additional ore. Work was mainly to prepare ore for extraction. For the first time it is possible to make a statement regarding ore reserves. The block lying substantially west of No. 2 incline shaft, and above No. 10 level, contains about 21,000,000 tons, fully developed. It averages slightly less than $2 per ton. This estimate does not include ore between No. 1 and 2 shafts, between No. 8 and 5 levels, or any below No. 10 level. But taking all into consideration, there is not less than from 75,000,000 to 100,000,000 tons of a recoverable value of $1.50 per ton. If lower yet profitable ore is included, this quantity would be greatly increased. The accompanying plan shows the condition of the mine at the beginning of 1915. The mill is now crushing about 2000 tons per day. Its ultimate output should be 10,000 tons per day.

The Salmon Creek power scheme is practically finished. When it is, the cost of 6000 hp. per month should not exceed $1000. Another source of power from three creeks is to be developed, work having started. It is valuable for summer power.

The new mill started in February. In March it treated about 40,000 tons. The tailing assayed a trifle over 30c. per ton. This will be reduced later. The heads averaged $1.85 per ton. In June the second unit will be started, the third and fourth about a month later. Concentrate is receiving treatment in a temporary plant. The mill was described in the *Press* of April 17. The report is an excellent one in many ways. All necessary information is given to the shareholders. The large panoramas of the mine, mill, and power-plant give an idea of the large size of the undertaking.

ANACONDA COPPER MINING COMPANY

The extensive ramifications of this company are always a source of interest. Recent financial arrangements have been fully discussed in the *Press*. During 1914 the mines and works operated at 50% capacity from August 1 to the end of the year. Many of the mines were entirely closed. At the present time they are nearly all working full time.

Underground development last year totaled 33.15 miles. The total amount of shaft-sinking was 3460 ft. Shafts at the Mountain Con., Diamond, Steward, and Mountain View were extensively repaired. Development was generally satisfactory, especially in the Leonard, West Colusa, Steward, Original, Tramway, Anaconda, Badger State, and West Gray Rock mines. A tonnage of ore slightly greater than the quantity extracted (3,898,100 tons) was added to the reserves. Eleven main and nine auxiliary hoists were operated by compressed air. Electric locomotives reduced costs underground. Safety-first departments were kept busy. Metal production was as follows:

	Anaconda.	Great Falls.
Ore, etc., treated, including custom ore, tons	3,748,726	488,244
Copper, pounds	188,664,551	35,055,741
Gold, ounces	78,815	20,836
Silver, ounces	7,555,915	758,201

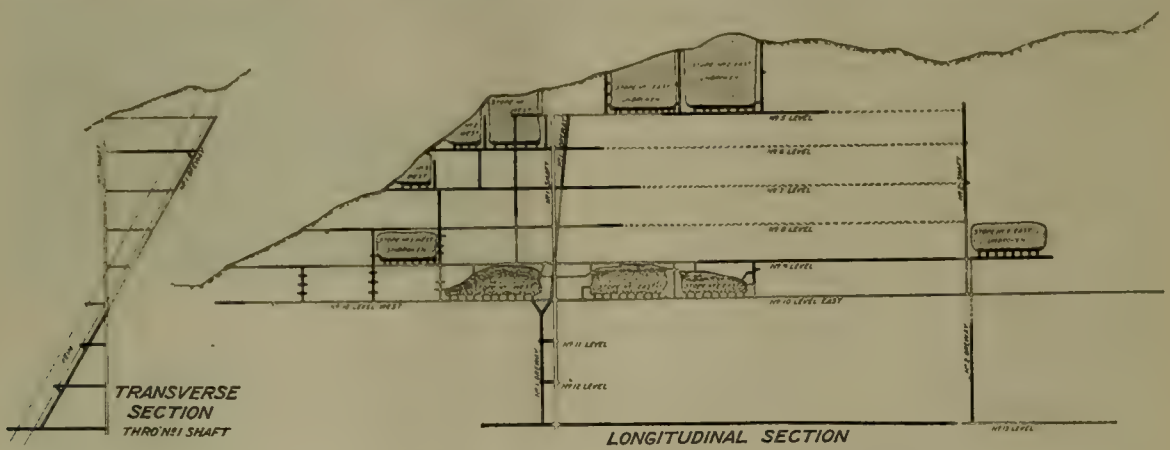
The company's mines contributed 3,768,640 tons of ore, etc., and 205,298,531 lb. copper, 99,651 oz. gold, and 7,221,815 oz. silver.

Financial results were as follows:

Sale of metals	$36,745,559
Royalties, rents, etc.	457,129
Metals on hand at end of 1914	14,330,972
Total income	$51,533,660
Operating expenses	$28,149,316
Metals on hand at beginning of 1914	16,173,788
Balance to profit	7,200,556
Revenue from investments and subsidiaries	2,843,491
Total profit	10,044,047
Dividends paid	9,077,500

The year commenced with a balance of $7,968,971, and ended with $7,681,059. The excess of dividends was therefore drawn from the surplus.

Improvements to cost $6,000,000 are now being made to the plants. These have been mentioned in the *Press*. The April output of 21,800,000 lb. is nearly the normal production.



PERSEVERANCE MINE, JUNEAU. DARK LINES SHOW WORK DONE IN 1914.

New Machines and Devices

Information based on letters and catalogues from manufacturers.

Wood Tank and Pipe at the Exposition

Tanks and pipes made of wood are used extensively in mining operations. Pipes are increasing in favor for power, corrosive and other waters, and other purposes. In the Palace of Mines and Metallurgy at the Panama-Pacific Exposition, the Pacific Tank & Pipe Co., of San Francisco, has an exhibit of unique design. It covers an area of 32 by 36 ft. The booth is built up entirely of wood water-pipes. The two sides and back consist of both 2 to 32-in. machine-banded and 24 to 48-in. individually-banded California redwood and Douglas fir pipe. The pipe is completely formed and ready for actual use.

The ceiling of the booth is covered with filter-cloth, burlap, and cocoa-matting. This material is the same as is used in the bottom of leaching vats in cyaniding.

Near the back is a section of 10-ft. diameter pressure pipe constructed from 4 by 6-in. redwood staves heavily banded with ¾-in. pipe bands and pipe shoes. This pipe rests in two standard saddles similar to those used in regular field work.

Directly in front of the 10-ft. pipe and in the front of the booth is placed a model cyanide leaching plant complete in every detail, with clean-up and refining house, even to the pipes necessary.

On either side of the model plant are the two entrance gates. At the side of each are two 50-ft. model towers with 20,000-gal. tanks, walk-ways, and conical covers; one a model 12-post wood tower with wood deck, wood tank and cover, and the other a 4-post model steel tower, wood deck, wood tank, and wood cover.

Within the booth are shown samples of the different pipe couplings, such as mortise and tenon, wood collars, riveted-steel collars and cast-iron collars for joining the ends of the pipe together. Also a large number of different model patent and plain tanks to be used either for settling, or for Pachuca agitators, and rectangular tanks. All the different iron and brass-pipe fittings used in connection with service connections for municipal water-works or irrigation. Different samples of round and flat hoops, lugs, and shoes, iron-pipe fittings and wood-pipe fittings for acid waters, bottom-discharge doors, zinc lathes, and a complete line of goods manufactured and carried by the firm, fully covering both the tank and pipe work in every field.

Drag-Line Cable-Way Excavator

The drag-line cable-way excavator, while having found a wide application in industries other than mining, is not as well known a device to mining men as it should be.

Sauerman Bros. of Chicago are at the present time introducing their drag-line excavator to the mining world. The excavator is designed for digging sand and gravel, and many other kinds of excavation and stripping work. It can be operated successfully either in wet or dry ground. The machine consists primarily of a bucket and carriage mounted on a slack track-cable. The carriage runs out to the loading point by gravity. The track-cable is slackened to permit the bucket to dig into the material. The machine is operated by a double friction-drum hoist.

Owing to the simplicity of construction and operation, the drag-line excavator will excavate, elevate, convey, and dump the material in one operation. Actual operation shows that material may be handled at a cost of about 3 to 6c. per ton, depending on local conditions. In mining operations the field for this machine would include certain placer deposits, stripping, and open-cuts. The device is not only applicable to pits,

A DRAG-LINE CABLE-WAY EXCAVATOR AT WORK.

but also to hillsides. The accompanying photograph shows the excavator at work. An interesting catalogue is ready for distribution.

Commercial Paragraphs

In 1914 the GENERAL ELECTRIC Co's sales totaled $90,467,691, compared with $106,477,439 in 1913. Like most other concerns in the country there was a decrease in business.

Alberger 'Spirofio' surface condensers (dry vacuum system), and tubular heaters for boiler feed and general service are the subjects of *Bulletin* 12 and 13 of the C. F. BRAUN & Co., of San Francisco. Sectional plans are shown, accompanied by data useful for this apparatus.

A 5 by 12-ft. adjustable quick-discharge tube-mill was recently sold by CHALMERS & WILLIAMS, of Chicago Heights, Illinois, for shipment to India. Catalogues on this firm's modern crushing machinery and the Symons disc-crusher have been received. Several advantages are claimed for the latter. A 5 by 10-ft. mill has also been sold to the Marsh company, Wallace, Idaho.

Leather belting is well exhibited at the Panama-Pacific Exposition by the CHARLES A. SCHIEREN Co., of 37 Ferry street, New York. This firm has a number of vertical, horizontal, and quarter-turn drives, the power being transmitted through shafting, friction-clutches, tight and loose pulleys, countershafts, and Lenix drives from a single electric motor to a variety of machines. The head of this concern, C. A. Schieren, died in April.

In the *Press* of April 17 appeared an illustrated description of the large NORDBERG hoist installed at the Inspiration mine, Arizona. One photograph showed the hoist-house, another a side view of the twin hoists, but the drawing consisting of three different views should not have been used in connection with this hoist, a mistake having been made. However, the description and other pictures are correct and illustrate this new system of hoisting.

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Edited by T. A. RICKARD

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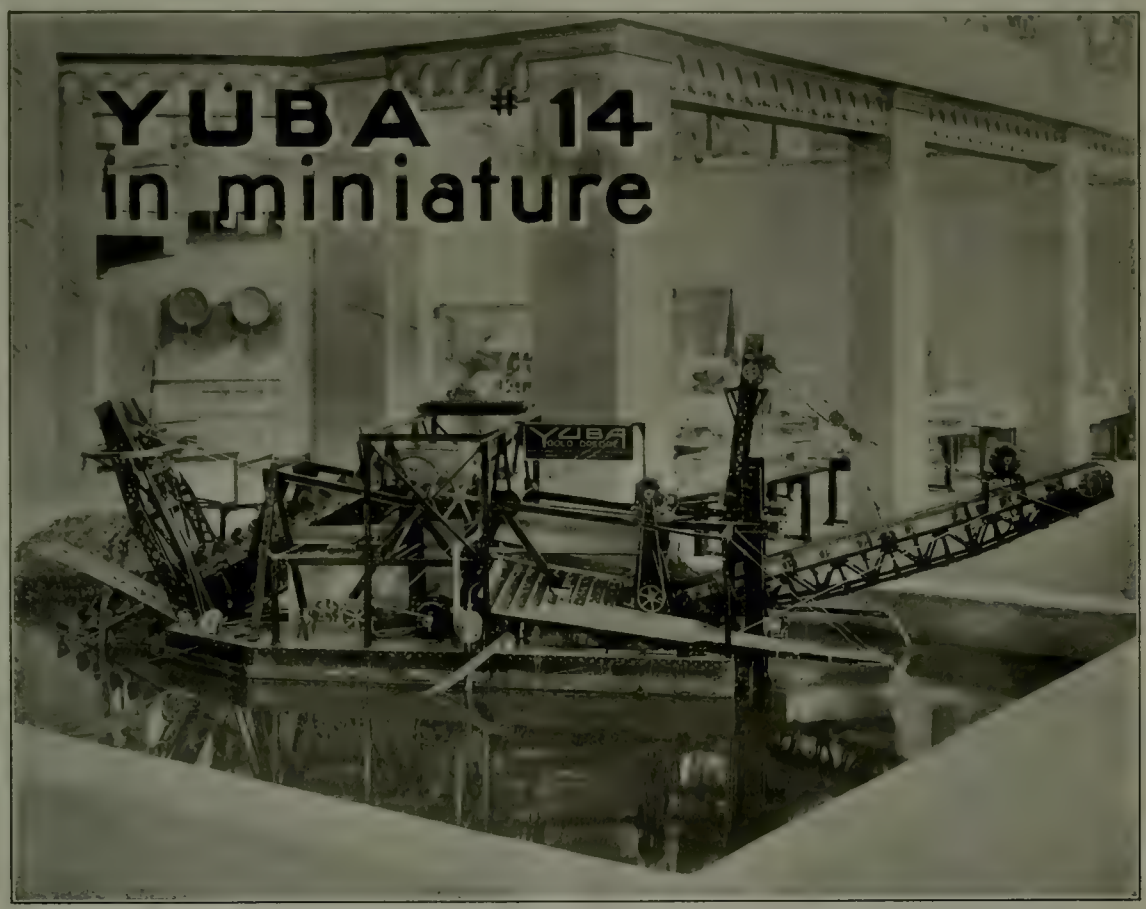

TWO working models—complete in every detail—of Yuba No. 14 are at the Exposition, one in the Palace of Mines and one in the California Building. Every mining man will be interested in them. A booklet describing these models will be sent on request.

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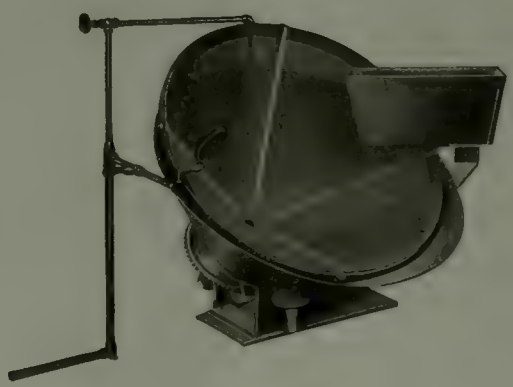

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Buyers Directory—Page 28
Advertisers Index—Last Page

TABLE OF CONTENTS

EDITORIAL Page.

Notes 783
Carbon and cyanidation 784
More research is needed.
The Mining Game 784
The Editor comments on the views of operators as to the relation of speculators to legitimate mining.
Copper and Aluminum 786
Aluminum has become a competitor of copper in industry; their relative advantages are reviewed.

DISCUSSION

FINANCING MINING OPERATIONS.
By Charles L. Paige 787
One who does mining with drill and shovel demurs to our views upon the speculative side of mining and the function of the engineer in appraising mines.
THE OUTLOOK FOR ENGINEERS.
By T. H. Oxnam, Jr. 789
A metallurgist of experience contributes thoughtful observations on this topic.
JAPAN AND CHINA.
By W. S. Kent 789
Commendation of our editorial views, tempered by a disagreement on a minor point.

ARTICLES

THE EFFICIENCY OF TAMPING.
By Edgar A. Collins 790
Excessive use of explosives may be justified in tunnel-driving, where speed of advance is the first consideration, but is incompatible with economical mining. Investigation at an Arizona mine demonstrates that careful tamping permits a saving of 25% in the consumption of explosives without interfering with the speed of work.
PRECIPITATING ACTION OF CARBON IN CYANIDE SOLUTIONS.
By W. R. Feldtmann 791
Carbon is found in many rocks and some ores, its presence has produced difficulties in the recovery of gold by cyanidation. Careful experiment on West African ore containing graphitic carbon has shown that the gold is precipitated by the carbon as a compound, and that alkaline sulphide solution will re-dissolve this. Experiments are in progress to devise a process based on this discovery.
GOLDFIELD RE-VISITED—I.
By T. A. Rickard 797
Goldfield has suffered a decline from its early prosperity, but prospects are again improving. Unfortunately progress is threatened by litigation which eventually may involve nearly all the companies because of conflicting extra-lateral rights. The Editor explains the situation thus created in the first of a series of articles on this interesting district.
THE SAPPHIRE MINES OF YOGO, MONTANA.
By O. W. Freeman 800
The only place where sapphire is mined from the rock in which it occurs is in southwestern Fergus county, Montana. The sapphire found here is of the deep-blue color which is most prized, and over $200,000 worth of the rough stones is produced yearly. After being cut their value is many times increased.
COSTS AT THE SOUTH KALGURLI 802
LEAD AND ZINC SMELTING IN AUSTRALIA 802
The Port Pirie lead-smelting works has been taken over by a company which is jointly controlled by the principal mining companies.
COPPER EXPORTS FROM JAPAN 802
The War caused a decline of 50% in the copper exports of Japan in the second half of 1914.
COSTS AT THE COMMONWEALTH MINE 803
OIL REFINERIES AT KUROKAWA, AKITA-KEN 803
One company is building a plant of Russian design and another a plant of the American type; comparative results are awaited with interest.
EXPERIMENTS ON COPPER ORES BY THE PHELPS-DODGE GROUP OF COMPANIES 803
Research is in progress to determine the best process for treating low-grade ore recently developed in the Copper Queen. Flotation has been found to add 12% to the recovery by ore-dressing methods. At Moctezuma flotation gives less encouraging results.
COSTS AT THE PORCUPINE-CROWN MINE, ONTARIO 804
ALTERNATING CURRENT IN ELECTROLYSIS 804
An alternating current superimposed on a direct current diminishes the back electromotive force of polarization and increases the current strength, if the cell is irreversible.
CHANGING COMPRESSOR INTO STEAM-ENGINE 804
SUPPLIES USED AT THE GOLDFIELD CONSOLIDATED MILL 804
MISSOURI MINERALS AT THE EXPOSITION 807

DEPARTMENTS

CONCENTRATES 805
REVIEW OF MINING 808
Special correspondence from Cripple Creek, Colorado; Toronto, Ontario; Victoria, British Columbia; Fairbanks, Alaska.
THE MINING SUMMARY 811
PERSONAL 815
SCHOOLS AND SOCIETIES 817
THE MARKET PLACE:
Metal Prices 816
Eastern Metal Market 817
COMPANY REPORTS 818
Phelps, Dodge & Company and subsidiaries: Copper Queen Consolidated Mining Company; Detroit Copper Mining Co. of Arizona; Moctezuma Copper Company; Burro Mountain Copper Company; Stag Cañon Fuel Company; Phelps-Dodge Mercantile Company. Canadian Mining & Exploration Co., Ltd. Allouez Mining Company.
MINING DECISIONS 819
NEW MACHINES AND DEVICES:
Disc-crushers 820
Dredges at the Exposition 820
Portable Electric Drill 820

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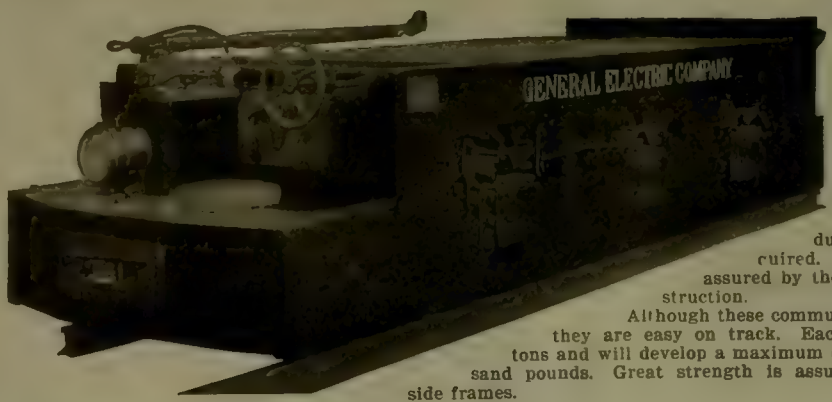

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5460

EDITORIAL

T. A. RICKARD - - - - Editor THOMAS T. READ - Associate Editor

THE useful article on the 'Assay of Cyanide Solutions' in our last issue was written by Mr. O. E. (not C. E.) Roodhouse. Signatures are not always easy to decipher.

BUSINESS continues to expand. The Government forecast of crops is excellent. The volume of domestic transactions is increasing. Idle railroad-cars are less numerous. If the Stock Exchanges have abated their impetuosity, that also is desirable; if the cart precedes the horse, a tangle ensues.

OUR metal-market report from New York indicates the continued strength of copper. Absorption of output keeps pace with the resumption of productive activity. The belligerent nations require copper regardless of cost; there is also a broadening domestic demand for industrial purposes. With peace there should be an immediate need of copper and other metals, for the work of reconstruction.

A JAPANESE recently in Mexico writes to *The Japan Times* to explain that the disturbances in Mexico are a good thing for the native population; the fighting is not serious and casualties are insignificant, he says. If the Mexicans serve as soldiers they earn "1.50 *yen* to 2.50 per day, while they cannot get more than half that amount if engaged in peaceful labor." This Japanese observer concludes that "war is a blessing to them." The point of view is new, and unwelcome.

ZINC continues to advance. It is stated that the Butte & Superior mine has sold 2,500,000 pounds of spelter at 13 cents, delivery to be made at the rate of 500,000 pounds per month for 5 months. The American Zinc, Lead & Smelting Company has sold 3,500,000 pounds on forward delivery, the prices being astonishing, namely, 900,000 pounds ordinary brass spelter at 16¼ cents, 2,100,000 pounds intermediate spelter at 19 cents, and 500,000 pounds of highest grade at 20 cents per pound.

USE of coke is being encouraged in Germany in order that the output of desirable by-products may be increased. Benzol is needed for use in automobiles, sulphate of ammonia is equally essential in fertilizer manufacture, in order to maintain the domestic food-supply. Government buildings and railways have therefore been instructed to use coke as fuel, mixing it with coal when necessary, experience having shown that in firing locomotives, for example, a mixture of one-third coke and two-thirds coal gives satisfactory results.

PRACTICAL details of mining do not lend themselves to lengthy description, as a rule; hence they escape the printed record. Yet they are among the items of knowledge most required and they furnish just the information we are most anxious to give to our readers. Therefore we are particularly grateful to Mr. Edgar A. Collins for his interesting note on the use of 'tamping' at the Commonwealth mine, in Arizona. The experiment made under his direction is also a deserved compliment to the Bureau of Mines, for the test was prompted by a suggestion emanating from that useful department.

TONOPAH is to be congratulated on the consolidation, announced on May 15, of the Tonopah Extension, Tonopah Merger, and Tonopah Victor mining companies. As is generally known, the controlling factor in the Tonopah Extension is Mr. Charles M. Schwab, recently identified with the success of the Bethlehem Steel Company, but formerly president of the United States Steel Corporation—a man of enormous initiative and energy. Under the terms arranged, the Extension will purchase all the Merger and Victor ground, and assume the debts of both the subordinate companies. The Merger will receive one share of Extension stock for every 7 of its stock issued; similarly the Victor will receive one share of Extension for every 8½ shares of its stock issued. The agreement is to be ratified by the several companies at general meetings to be held at an early date. This consolidation obviates the danger of internecine litigation based on supposed apex-rights. While this is the prime motive, we understand, it is also apparent that the unification of property will diminish overhead expenses and give the two minor companies the benefit of.

the excellent technical administration of the Extension staff. In every way the event is of good promise to Tonopah.

IN a sensible little article in the latest bulletin of the Canadian Mining Institute, Mr. Norman R. Fisher discusses the check in the growth of the mining industry of Ontario. He concludes that the explanation is to be found largely in the granting of titles to claims without the obligation to work them. Thus large tracts of promising ground near existing mining centres are closed to the prospector and to others willing to take the chances of exploratory work. We agree with Mr. Fisher that this factor is becoming increasingly operative both in the United States and Canada. No unearned increment is so objectionable as that accruing to the man who alienates a portion of the public domain in order to hold it unproductive while his neighbors develop the ground in its vicinity. Mining regulations should be such as to give the maximum reward to the developer, while taxing the dog in the manger to the point of ejection.

RECENTLY we commented on the Calumet & Hecla's relations with its employees and contradicted the ignorant slander of a local contemporary. Now comes the announcement that the company has set aside $500,000 to be distributed on June 12 among its employees, on the basis of time actually worked. The bonus is to compensate for the wages forfeited by the men, and officers of the staff, through the reduction that was made, in consequence of the effect of the War on the price of copper, on September 1, 1914, and continued until May 1, 1915. Thus not only has the company restored its former wage-scale, but it has re-imbursed its workers for the reduction necessitated during a time of stress. This act came as an agreeable surprise not only to the beneficiaries themselves, but to the entire mining community of the Keweenaw peninsula. It affects 10,000 men, and follows a 10% increase in wages. Yet in the current issue of the paper published by the Western Federation of Miners we read about "the copper heel" in Michigan and we note a violent attack by an insurgent Finn on the company's management, only equalled in ignorance by the San Francisco paper that discussed the same subject. Indeed, the Calumet & Hecla, from the days of Agassiz to those associated with the resident manager, Mr. James MacNaughton, has been identified with square dealing and humane methods. We record the latest evidence of the fact with keen pleasure. Concurrently it is proper to refer to the restoration of maximum wages at Butte, where the sliding scale, based on copper prices, has brought day's pay to the $4 level once again. From the Southwest similar increase of pay is announced; in one case a company had to put another story on the structure of its sliding scale in anticipation of copper rising to 25 cents. Idle men from other districts are flocking to the copper and zinc mines. 'Tis a poor sort of prosperity that does not benefit employer and employee alike. We rejoice in the growing sense of fairness characterizing the administration of mining affairs.

Carbon and Cyanidation

We publish a valuable article by Mr. W. R. Feldtmann on the precipitating action of carbon in contact with cyanide solutions containing gold. This was presented as a paper before the Institution of Mining and Metallurgy, in London, and as not many of our readers see the bulletins of that technical society, we are glad to reprint the article in full. Both the reputation of the author and the interest of the subject warrant the space we give. To those engaged in mining on the Mother Lode, in California, the experiments made by Mr. Feldtmann will be of immediate value, because the precipitating action of carbon has been as much a metallurgical nuisance to them as to the technical men in West Africa, black shale encasing the veins of gold-bearing quartz in both regions. It is generally recognized now that it is not graphite but other forms of carbon that do the mischief. Graphite is a form of carbon that has been completely altered by heat and pressure; it is too dense to act as a precipitating medium. The action is due to occluded gases of the hydro-carbon type emanating from organic matter while in process of coal formation. The gold is precipitated by adsorption through the agency of these occluded gases. This constitutes one of the main hindrances to cyanidation on the Mother Lode, for it diminishes extraction while also increasing the consumption of cyanide. The former can be mitigated by the use, as shown by Mr. Feldtmann, of sodium sulphide, which is a solvent for the precipitated gold, although the cyanide is not; but the alkaline sulphide does not remedy the high consumption of cyanide. However, the experiments recorded by Mr. Feldtmann point the way to further research.

The Mining Game

If a Cornishman of the old-fashioned kind were to visit Nevada he would find that 'mining' does not signify the same kind of thing at Goldfield and at Camborne. In the heyday of the Cornish tin industry it was the custom for a number of men to start a mining enterprise on the basis of joint liability and assessment, the working capital being called-up as required. This was known as the cost-book system, which has now been discarded for limited liability and the joint-stock company. The operators were called 'adventurers' and they constituted a sort of private syndicate for the exploitation of a mine. In the early days of the Comstock, a subdivision of interest was effected by dividing the property into shares equal in number to the feet measuring the length along the lode. Dealings took place in 'feet,' not shares. Later it became convenient to sub-divide the holdings still further, so the 'share' idea was developed, until the ownership was spread among a million or more units. That facilitated gambling, by decreasing the value of the counters in the game until policemen and servant-girls could participate freely. Thus the 'mining game' was evolved. At first crude and clumsy, it has

been developed into complicated activities involving the exchanges and the press in a business of far-reaching magnitude. Of course, the whole system is alien to the ideas of the mining profession or of the real exploiters of mineral deposits, not of other people's pockets. It is a condition and not a theory; as such it should be recognized and studied. During a recent visit to Nevada we discussed the question with sundry persons engaged in the business, from tipsters on the train to managers of big mines. For instance, an intelligent young man complained that the management of the Nevada Wonder mine was "too conservative"; the Philadelphia controllers of this successful property "never let anything out"; there was "nothing doing in the speculative way." To our informant it seemed desirable "to create interest." Another company, the Tonopah, "did the right thing," so he said, because "they gave out a good deal about the mine." Finally, he sat back and concluded with the assertion: "What is wanted is publicity." On cross-examination we ascertained that he felt aggrieved because his Nevada Wonder shares ranged in quotation from $1.75 to $2.50 only. That afforded a dull market. He had no reason to believe that good news concerning the mine was withheld by the management or that any attempt at a 'freeze out' was being made. No, he simply objected to the lack of "speculative interest" in the stock. In short, he thought himself entitled to expect that the management would publish information calculated to excite active dealings, resulting in a wild inflation of the quotations. That was his kick. He had not bought a participation in an industrial enterprise; he had bought a counter in a game; and the game was too slow to suit him. He liked the sort of publicity that makes a market for low-priced shares among the gullible public. That brought up the mention of George Graham Rice, *alias* Herzig, *alias* Shefftels, who, under various guise, developed 'the game' to the point where the Government found it necessary to afford him the restricted hospitality of one of its official residences. He is the great protagonist of the mining 'game' and of those press activities that beguile the public by means of piffle plentifully printed. At Goldfield his paper, *The Mining Age*, circulates freely; in the hotel a notice-board gives it special prominence. We shall be absolved of journalistic jealousy if we mention these facts as a pitiful commentary on this phase of mining in Nevada. A basic industry is prostituted. The fact is recognized by reputable citizens, who yet will assert that the scribes and parasites create "speculative possibilities" and "bring money to the mining camps." As one of them said: "I've got a claim near a rich mine, but you can't sell a proximity to a capitalist represented by an engineer." The inference being that you can capitalize a 'proximity' by peddling shares to the public. And you can. It is done daily with great success. From a few cents the shares of a puling wild-cat can be hoisted to dollars on the strength of the flapdoodle published in utterly irresponsible publications. Indeed, it is claimed that mining operators of some repute will use Rice to boost their stocks, employing him as a tool for unloading the scrip of unhappy enterprises. One of these gentlemen told us that "you can't raise capital for legitimate mining, leastways not so as to make any money." Further he claimed that publicity *à la* Rice was not needed for legitimate business, but it was essential to "the stock game." We quote these views in no frivolous spirit. They represent a current notion that must be examined carefully by those having the true interest of mining at heart.

How does it work? In the first place, the mining communities of southern Nevada are nearly bankrupt because the residents have been beaten at their own game. Men that know the trickiness of the share-peddler and are aware of the facts concerning a particular hole in the ground will buy shares when a publicity campaign is started, expecting to climb upon the band-wagon before it upsets, but often, by reason of their own greed or an unexpected turn of a trick, they are caught. It is not easy to forecast which way a wild-cat will jump. Of the multitude of simpletons that buy 10-cent shares on the strength of disreputable tricksters, we have nothing to say. It is doubtful whether even a paternal Government can keep them from parting with their savings. But of the miners that participate we must say something. Theirs is a pathetic part to play in this farce. The men employed on the mines have caught the fever of speculation and deal in shares. Some of them are employed to act as informers or "do gum-shoe work" for brokers, who 'carry' them on their books for a block of shares. The real miner is a poor hand at the game because he is a bad seller; once he buys he becomes "married to his stock." One miner in the Jumbo Extension is said to have made $10,000, but such gains are like a lottery winning: one hears much of it, and very little about the thousands that drop their savings into the maw of deceitfulness. Few miners have any idea of the proportion existing between a 'strike' of rich ore and the intrinsic value of shares in an over-capitalized company; as soon as a discovery was made in the Jumbo Extension, for example, the share-valuation of the mine doubled, at once, before time had been given for any systematic development to prove the extent of the ore-body. From the miners the share-dealing extends to some superintendents, which is even more dangerous, because it tends to vitiate reliable sources of official information. One superintendent—and a capable one too—formerly in Nevada wrote recently from Arizona to ask for an appointment at Tonopah and expressed his willingness to take lower pay because there was "no chance to play stock in Arizona." He thought there was more money to be made in the game of spoof and chicane than in digging ore out of the ground. We believe this to be not only poor morality but a pathetic illusion. Most of those that play 'the game' are beaten by their confederates, known or unknown. All of them try to "catch a sucker" bigger than themselves and most of them fail to find him. It is a miserable interplay of greed and knavery, and bears but little relation to genuine indus-

try. What the tout is to the race-track the tipster is to the share-market; and the race-track is related to horse-breeding as the share-market to the industry of mining. We shall discuss other phases of the subject in later issues of this periodical.

Copper and Aluminum

During October of 1914, electrolytic copper sold for an average of 11.1 cents per pound; the average price for April of this year was 16.64 cents and the average quotation for last week was 18.75 cents. This week will undoubtedly show a continued rise. On the face of these facts the copper producers might be expected to exhibit great jubilation, and the absence of such a demonstration is due to the general recognition that this phenomenal rise is caused by abnormal conditions created by the War, which first served to depress the price of copper and later to raise it. Copper is used, in a variety of ways, in making munitions of war. Ammunition is now being manufactured for the belligerent countries, not by the millions of dollars worth, but by hundreds of millions, and an excessive demand for copper has thereby been created. The producers are not neglecting to make hay while the sun shines, but they are not blinded to the fact that so favorable a condition cannot be expected to persist indefinitely. No one can know when the War will come to an end, still less to foresee whether the conclusion of peace will merely cut off the war demand without restoring normal consumption, or will give rise to increased industrial consumption in repairing the ravages of war. The most probable effect will be a sharp slump in demand on the conclusion of the War, followed by a gradual increase, stimulated by reconstruction in the regions laid waste by the War.

Meanwhile a number of other considerations have to be taken into account. We have already referred to the possibility that the Germans, having been forced by military necessity to diminish their ordinary consumption of copper, may so successfully overcome the difficulty that they will not only be able to get along permanently with a less supply but will teach the rest of the world to do the same. The copper industry of the world has been developing on the basis that the rapid growth of consumption, which has averaged 9% per annum for the past 15 years, will continue. If this proves not to be the case an over-supply of copper and correspondingly low prices for the metal seem likely to characterize the period immediately following the War. Some hint of the progress being made in devising substitutes for copper can be gleaned from the reports from Germany that a special soft iron is being used instead of copper for the manufacture of ammunition. But the most serious competitor of copper is aluminum. A little over one-half of the world's production of copper is used in the electrical industry. As pointed out in the editorial review of aluminum appearing in our issue of January 3, 1914, the two metals are on a par from the standpoint of cost when aluminum sells for 20 cents per pound and copper for 13 cents. The quotation for aluminum week before last, for prompt delivery, was 19.25 cents per pound. The competition from aluminum has not been serious as yet, especially in this country, since the output has been small, being confined to one company. As pointed out in the editorial mentioned, this situation has entirely changed, for the production has greatly increased and a rival company plans to enter the field, so that aluminum is likely to sell at lower prices than have ruled during recent years. The copper industry heretofore has been on the basis of being able to concentrate its attention to the making of a metal that the world had to obtain: now it must adjust itself to the finding of a market for its product. In other words, the copper industry has been in the position of a manufacturer whose goods sold themselves; now it bids fair to be in the position of a manufacturer who must devote a large part of the energy of his organization to the selling of his goods.

In general industry the competition of aluminum with copper seems to be more serious even than in the electrical. There are some fields in which it seems improbable that copper can be displaced; in others it certainly can be. Aluminum has been handicapped in this country by the business policy of the principal company, which not only produced the metal, but also manufactured it into finished products. Probably this was necessary in order to convince manufacturers that aluminum could be thus used, but it also served to deter manufacturers from embarking in the business, since it is obvious that a manufacturing company controlling the price of the raw material can, as soon as it feels competition from other manufacturers, put them out of business by raising the price of the raw material. The company would certainly make money, either on the raw material or the manufactured product; the rival manufacturers would have no chance at all to make money. If manufacturers can buy aluminum in a competitive market they have more chance to make money through efficient methods of fabrication and marketing, and the use of aluminum has a corresponding opportunity to expand. Another serious feature of the position is that in most miscellanous industries the size, rather than the weight, of the object is the controlling factor. Because of its light weight, 100 pounds of aluminum is thus able to displace 250 or 300 pounds of copper or brass. Any gains made by aluminum in competition with copper are thus seen to be attended by a much greater loss by the latter metal. The rôle of a pessimist is an unpleasant one, and we trust that accusation may not be laid at our door. What we hope is that the copper industry will not fail to read the signs of the times, and prepare to meet the probable developments of trade. Next to the iron and steel industry, copper is the most important of the metallic mineral products of this country. It is so intertwined with the general prosperity of the nation that not the producer alone, but the whole nation, is concerned in its prosperity. We hope that, through foresight and ingenuity, this prosperity may not be endangered. Copper at over 20 cents is abnormal and unhealthy.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

Financing Mining Operations

The Editor:

Sir—Mark Twain, in his book 'Roughing It' tells about a mining associate of his named Ballou. Mr. Ballou was an old miner, a geologist, and a chemist, for he had some knowledge of rocks, and he managed to brew coffee with alkali water in the desert. The party found the coffee a failure; even Ballou, after drinking a portion of it, was forced to announce that it was too technical for him.

The appositeness of this story is perhaps vague, but it has often recurred to me when I have tried to glean the wisdom offered by technical or professional writers and speakers. If we laymen turn to theology we find a language in which spiritual allusions and similes leave us depressed and humiliated; if we try a law-book we are bewildered by strange phrases: if we take up a medical work, and do not lay it down quickly, we become the prey of some doctor who will treat us for brain-fever, and all because of the razzle-dazzle of the barbarous lingo. And so it goes through scientific literature, which is presumed to embalm knowledge for general distribution, but buries it like a bug under a brickbat.

I have sometimes wanted to contribute to your journal my opinions or experience on subjects discussed, but usually there is a halo of professional sublimity over them, or a maze of arbitrary or technical terms too profound and dangerous for me. Some writers seem to have copyrighted all admissable knowledge upon their subjects, and they file it in condensed formulae. They fight, or write, by the book of arithmetic, one, two—and the third is in your esophagus.

Of course the *Mining and Scientific Press* is broad-gauge and admits articles in the ordinary vernacular, but over many of the topics hovers some professor with his hammer, ready to flatten us like a lead button and then cupel us to nothing. We admit that professors are protected by law and are admitted socially, in some circles; and that some of them have a following. Some of them are mellow; some of the older practitioners are not so gay with scarfs and bannerets as the lighter vessels, emerging later along. You may now and then also meet technical graduates, even from colleges, who speak wisely without flourish and who write rationally, perhaps instructively, outside the rules of arbitrary technology—or whatever it is that they practise. Generally it is the new young technician whose college accent bewilders us.

With the foregoing apology for my diffidence, together with the explanation that I am not a speculative miner but delve with pick, shovel, drills, and dynamite, your readers will know that I do not live chiefly to fill the world with words. But when such a topic as 'Financing Mining Operations,' introduced by Robert H. Todd in the issue of April 17, and somewhat modified by the Editor in his article 'Speculation in Mines,' arises, almost any of us can get busy. In fact, some of us can delve 'one yard below your mines and blow them at the moon.' The last sentence shows that Shakespeare was no slouch in mining matters.

Mr. Todd makes some true statements and draws sensible conclusions as to what may be termed the financial indisposition that retards digestion in mining particularly gold mining—most notably in California, specifically northern California, and especially in this immediate region—in fact, in my own vicinity.

The Editor's concentration of the topic into two basic ideas (1) that mining is essentially speculative, and (2) that the only appraiser of a mine worthy of confidence is the properly qualified engineer, contains too much sand and slime to assay very high by ordinary blowpipe analysis. My gorge arises when it is thus asserted, as a basic idea, that mining is speculative! This by an apostle of the 'precision of thought' doctrine so lately advanced in these columns! Any old dictionary defines speculation (in its commercial sense and application) to mean buying and selling, that is to say, dickering in a commodity; but I cannot find that mining is speculative, speculation, or that it is done by dickering. It is clear to nearly all of us, in our calm moments, that speculation has done more to prevent mining than anything you could mention. The Editor's view of mining is deflected. Did speculation develop the Comstock, or did the Comstock develop speculation? Did speculation discover or develop Cripple Creek? Did it Guggenheim Alaska? Permit me to assert, as affably as I can, that mining is an exact science, if there is such a thing. Mining is digging. If we do not dig we do not mine, though we speculate until doomsday. Speculators are a kind of parasite—barnacles or snails—not miners. Mining may be hazardous, like other ventures, in fact, all excepting death and taxation, the only sure things. Speculators risk nothing; they only buy paper, or something else, and get it; if they can or cannot sell it they are not affected by mining operations, but operations may be sadly affected by speculators.

The small speculator is more valuable to industry and progress than the 3 or 4% capitalist, who is more conservative; but it is most pitiful to separate the former from

his money, which is often borrowed money, and so is gone twice over. The small speculator who is unable to sell his paper is the fellow who fills the magazines with accounts of mine swindles, largely mergerizing his accounts; and all the while mining, to him, is an unknown process. Probably he never looked for, or saw, a mine. But he will condemn mining, just as men a thousand miles from a race-track condemn a horse that loses a 100 to 1 bet for them. All this is mere iteration, stale, flat, and unprofitable, but let it go as cumulative testimony *Stet*.

A higher, at least a more powerful, order of speculative mining is followed by the fellows who buy, annex, or acquire real ores and mines. They or their agents actually visit and examine mines, sometimes at a distance from good hotels and pullman coaches. Their specialty is ore on the dump, but as next best they sometimes stope out and remove it from a well-opened mine. This order of speculative operators is often strong enough to build great reduction works and smelting-plants; primarily, they do not mine. They only annex, acquire, remove, and exploit; incidentally often devastating wide areas of public domain to enrich a small group of far-away capitalists and non-resident share-owners. We do not hear of their grub-staking a prospector or making any effort at outside development, discovery, or conservation.

The Editor's second basic idea, (2) that the only appraiser of a mine worthy of confidence is the properly qualified engineer, is more pepper in my eye. It reads so nicely that it appears as good and safe as cyanide bullion. It should be sound counsel for speculative process of mining. When they have decided upon the properly qualified engineer, conceding his honesty, his judgment, his industry in examination; when they have read and digested a competent report and have perused the proved assays; then they may concede he has made a better guess than they could have done, as to the safety of investing, particularly if the report is unfavorable to the mine. But if they expect the best engineer to be infallible they overtax human nature, if not the profession itself. Engineers, like mines, may sometimes be salted; or, like mines, misleading. The best judgment may be warped by circumstance. The most careful sampler may be misled by his own samples. The assays upon which his report rests may be a little erroneous. Again, the engineer may not know of, or have facilities for, reduction tests of the particular ore examined. Any one of these, and many other details, may be determining factors between profit and loss.

It appears that Mr. Todd's basic idea, too, is the welfare of investors in corporation shares, and he recommends the general assessment of such investments. Most assuredly it is the most essential and equitable process, for it is seldom that a mine, or any business, continues without difficulty or reverses. Why should investors, who associate themselves for the purpose of mining, want to evade paying their share of losses, any more than partners in any other business? It is a singular expectation for people to buy an interest in a business with the proviso or hope to share nothing but profit, a guaranteed dividend all the time. When they expect this they deserve that their selfishness be rebuked. It is as though partners contribute to a mining venture and send one of the members down the shaft to explore; if he finds treasure, they agree to hoist away and divide the product; if he finds nothing, they expect to leave him in the hole and abandon the partnership; and then, if he calls in outsiders and makes a discovery and gets out treasure, the deserters often expect to share what, by business rules and moral equity, they have forfeited. Such faint-hearted financiers are not rare. They should not invest in mining, nor in any other industry. Let those who fear their fate too much, and whose deserts are small, rather invest in sound securities such as town-lots, not assessable. When the town-trustees vote improvements or development they merely condemn and confiscate small investments.

In this region capitalists looking for mines are scarcer than volcanoes, as there is one of the latter in sight part of the time. Here is a region richly mineralized, that has yielded many millions in gold, silver, and copper, and where mining has been done for 66 years. A hundred veins yielding gold outcrop on every square mile of it, but it does not show an average of one shaft 50 ft. deep per square mile, and not more than a dozen mines equipped for even limited exploration. Mining for gold and silver in northern California languishes for lack of men affluent enough to buy a gasoline touring car, and give us 'the once over.' Prospectors and promotors alike have neither credit nor encouragement and are degenerating into 'pocket-hunters' and 'snipers.' Hundreds of them have abandoned claims and locations where they could not get food or equipment to continue or remain.

"Ill fares the land, to hastening ills a prey,
Where wealth is mergerized and men decay."

CHARLES L. PAIGE.

Shasta, California, May 8.

[We are glad to give space to the expression of views unlike, or even opposed to, our own. Mr. Paige's ruminations are decidedly interesting. He and his comrades need not hesitate to contribute their opinions to our columns if they write thoughtfully, as in this case. We stand between them and the 'high-brows.' The academic person does not always understand the practical. We find ourselves in sympathy with both. Both are necessary in the scheme of life. We deprecate a sneering attitude on the part of either. The professor of mining might be a useless person if the man with the drill did not make mines, but the gentleman behind the drill would be lacking in much necessary information if the professor did not collect it and systematize it. Mr. Paige's objection to the use of 'speculative' in connection with mining is interesting to us, as anybody who disagrees with our view is necessarily more interesting to us than one who is of exactly the same mind. We advise Mr. Paige to exchange his "old dictionary" for a new

one. Speculation is the risky use of money or time in the hope of gain. The prospector who swings his pick to earth is a speculator; he is spending his strength and time on the chance of finding more than enough ore to compensate him. It is true the excess of speculation, especially in paper transactions, is injurious to legitimate mining. Insane gambling is an exaggeration of sane speculation. Without speculation mining would cease; without speculation in thought mankind would vegetate. No, Mr. Paige, mining is not "an exact science," it is an art to which science is applied with varying success. We are sorry if our insistence on the idea that the only appraiser of a mine worthy of confidence is the properly qualified engineer should cause our correspondent to sneeze violently. The idea is one to which we cling with great tenacity, and we expect to advocate it with iterative effect. No, we do not claim infallibility even for the best engineer. None of us is infallible, not even the youngest. But efficiency in any work is only possible to those who have had the proper training and experience. We have no more confidence in the boy wonder than in the ancient mariner. Efficiency is the result of scientific teaching and wide experience.—EDITOR.]

The Outlook for Engineers

The Editor:

Sir—The article by 'KCN Engineer' on this subject is indeed an interesting one, especially what is said about the graduates who drop out within four years of graduation, and also married men *versus* single men.

It has impressed me more strongly each succeeding year that perhaps the trouble lies more with the men who take up mining as a profession than with the profession itself. Possibly the foregoing statement should be qualified to specify those who drop out. Is it not true that a large number of the men entering our mining schools know practically nothing of the life and work of the profession, and within two or three years after entering the field drop out because they are in no way suited to it? If such is the case, we then have a surplus of college-trained men looking for positions such as they are supposed to be capable of filling. Owing to competition, which as a result follows this surplus, they take the positions open at lower salaries than would be the case if fewer men were available. If, in place of a collegiate degree now required by some of our technical schools for entrance, one or two years' field-work was required, would not a large proportion of those who fall by the way be eliminated at the start, thus reducing the surplus and bettering conditions for those who do persist?

Another reason, I think, why salaries are low, is the consolidation of a number of properties under one management, thus reducing the number of men needed for technical work; in other words, reducing the overhead. This reducing of overhead expense is without a doubt necessary, but it does reduce the number of positions open to the young engineer.

Is it not true that married men will stay with a job longer than a single one? If so, from an economical standpoint, would it not be cheaper to provide the accommodations for the married man? I have always heard it said, and experience has taught me its truth, that a changing crew or staff is never an efficient one. Like your correspondent, I am an optimist and do not write this because I have reached the point where every other business looks good in comparison to mining.

Los Angeles, May 5. T. H. OXNAM, JR.

Japan and China

The Editor:

Sir—The leaders that you publish from time to time on questions quite irrelevant, for the moment, at any rate, to the title of your magazine must come as refreshing showers after drought to miners and prospectors in remote corners of the world, who have not the opportunities of libraries and reading rooms, and are largely dependent, for their information about such subjects, on the blatant braying of the daily press and on magazine articles—too often purchased by interested parties—the columns of which are intercalated by advertisements.

'Japan and China,' in your recent issue, is such a leader, and while I fully endorse the greater portion of it there is one point about which I am far from being in accord with you. With regard to the marching of Japanese troops through Chinese territory to accomplish the investment of Kiaochou, you say: "As a gross violation of neutrality the action of Japan was on all fours with the invasion of Belgium." Hardly on all fours. While I do not wish for one moment even to appear to condone the Japanese offence, which is greatly to be deplored, I can hardly consider it on a parallel with the German invasion of Belgium, for, it must be remembered, Japan had not guaranteed the neutrality of China, as Germany had of Belgium.

W. S. KENT.

San Francisco, May 10.

THE WASP NO. 2 MILL IN 1914. This mill in South Dakota treated 176,140 tons of $2.302 ore last year, and theoretical and actual recoveries of gold and silver were as follows:

	Gold		Silver	
	Fine oz.	Value.	Fine oz.	Value.
Called for by assay of heads	17,178	$355,073	50,600	$27,248*
Called for by assay of tailing	4,498	92,977	31,217	16,811*
Apparent extraction, difference	12,680	$262,096	19,383	$10,437*
Apparent extraction, per cent	73.81		38.30	
Actual recovery, mill ore	12,402	$256,380	14,533	$ 7,952
Actual recovery, slag	206	4,126	3,057	1,520
Total recovery	12,608	$260,506	17,590	$ 9,472
Actual recovery, per cent	73.31		34.77	

*Calculated at 53.85c. per fine ounce.

The ore that goes to this mill is mined by steam-shovel. A few feet of overburden lies above the deposit. Treatment consists of coarse crushing and cyanidation.

The Efficiency of Tamping

By EDGAR A. COLLINS

Probably most mining engineers and superintendents incline to the belief that by 'stemming' or 'tamping' a hole loaded with explosives, the breaking efficiency of the explosive will be increased. The word 'stemming' is used by the U. S. Bureau of Mines to denote the action of packing clay, or other material, into the mouth of a hole to make it air-tight; while the word 'tamping' is used to denote the material used.

But, while stemming is generally recognized as good practice in mining operations, it is seldom systematically employed in the metal mines of this country. The reason for this is probably due, indirectly, to the almost universal use of machines to break the ore, and to the fact that with their use on a large scale, the breaking effect of individual holes is lost sight of in the general result.

Fifteen or twenty years ago, when hand-work was the general method employed for drilling ground, and holes were drilled with very much more effort and expense than at present, the young miner was taught how to load and stem his holes so as to obtain the maximum effect. With the advent of the machine-drill, however, the entire face of a heading was drilled and blasted simultaneously, so that the failure of one hole to break affected the results of the whole round, and consequently, an excess of powder was frequently used in order to be 'on the safe side.' At the same time stemming became rather the exception, especially with the younger miner, who frequently became a full-fledged machine-man within a few weeks without having had any previous training in the economical use of explosives.

With development work in which speed is the main requisite there is some excuse for using more explosive than necessary. Unfortunately, however, the same tendency naturally follows in the stopes, and it is here that the greatest waste is liable to occur.

The thoughtful mine-manager or superintendent naturally views a decrease in his powder bill with enthusiasm, and, as I have, he may have considered the possible advantages of a more general use of tamping. Until recently, no conclusive data covering reliable tests have been available, and not unnaturally, he may have shrunk from carrying out an elaborate series of tests.

It was under these circumstances that I ran across Technical Paper No. 17, by W. O. Snelling and Clarence Hall, recently published by the U. S. Bureau of Mines on this subject. In it complete data are given showing the increase in explosive force gained by using varying amounts of different material for tamping. These tests showed such a remarkable increase in the explosive efficiency, by using even a small quantity of almost any tamping material, that all doubts were at once dispelled. The pamphlet was given to the mine-foreman and shift-bosses to study, and as a result it was decided to test the theory on a large scale.

At the Commonwealth mine the shrinkage-stope system is employed to win the ore. Holes are drilled with Waugh stopers about 4 ft. deep, and from 3 to 4 ft. apart. The ground is medium hard and makes 'mean drilling,' but it breaks well. The regular charge of explosive heretofore had been three sticks of 1 in. 35% ammonia gelatin. Instructions were given to issue only two sticks of powder per hole, and to give each man a large ball of clay. The men were notified that six inches or so of the clay was to be tamped in each hole on top of the powder, and that if this was done the holes would break as before. They were particularly warned not to drill the holes closer together, and were informed that they would not be blamed in case the holes did not break, provided that they could show that tamping had been used as per instructions. At the same time they were given to understand that the failure to break would be considered as evidence that tamping has not been used.

The result of a three months' test in the stopes has justified our faith, and has shown an apparent saving in the consumption of explosives amounting to almost 25%. The word 'apparent' is used advisedly, as with our system of mining, it is impossible to state the exact quantity of ore broken in any month, and the only guide is the amount of powder used per hole drilled. The following figures show the comparative consumption of powder for the last three months, during which the test has been in operation, and for the preceeding three months.

	Average number of machines.	Holes per machine.	Total holes.	Total powder, lb	Powder per hole, lb.
January-March	23.1	10.8	21,385	21,323	0.997
Previous 3 months	19.5	8.5	15,126	19,915	1.316

In explanation of the much greater number of holes drilled during the last three months, it should be stated that more time was spent in drilling, and less in 'barring down.' This was due to the stopes being narrower.

There is, of course, the possibility that in some cases holes have been drilled closer together, since the change was made. This point has received careful attention, however, and it is believed that there is no appreciable offset from this cause. In the opinion of the foreman and shift-bosses, the holes are being drilled practically as before, and the saving in explosives therefore is a real one. Following up these results, instructions have been given to cut down the amount of powder issued to the development points from 10 to 20%, and the experiment will be carefully watched.

The full benefit of 'stemming' will only be obtained if systematically enforced throughout a mine. It is necessary to provide plenty of suitable material at some convenient point, so that there is no excuse for not using it. This, however, is not all; intelligent and interested supervision is necessary to insure its general use, and to overcome the passive resistance that many men offer to all innovations. At the Commonwealth, the clay is obtained from the more slimy portions of the tailing-dam, after it is partly dried by the sun. It takes a man about half a shift to gather enough mud for the day's supply, and to work it into a stiff clay. It is then sent underground, to the various magazines, and is issued with the explosives.

Precipitating Action of Carbon in Cyanide Solutions

By W. R. FELDTMANN

*The question of how charcoal and, in some cases, graphitic carbon precipitate gold from cyanide solutions is an interesting problem which has only recently begun to attract attention. There is a considerable amount of literature on the subject of the precipitation on charcoal of gold from gold chloride solution,[1] and much has also been written on absorption and adsorption by charcoal[2] of gases, salts, etc. A number of letters and articles have appeared in the technical press dealing with 're-precipitation' of gold from cyanide solutions, but these, as a rule, have merely been in the nature of a relation of difficulties in extraction due, or assumed to be due, to presence of carbon in the ore treated. In October 1913 a paper was read before the Institution of Mining and Metallurgy[3] in which the first serious attempt was made to trace the rationale of the precipitating action of charcoal in auriferous cyanide solutions.

The present writer, who has had occasion to investigate rather closely the precipitating action of some 'graphitic' ores, and has incidentally collated some data on charcoal precipitation, will endeavor in the following paper to present such of the results obtained as appear to be relevant to a better understanding of a perplexing subject.

The quartz veins being worked by several of the West African gold mining companies are intimately associated with a carbonaceous schist. This schist, graphitic in appearance and frequently referred to locally as 'graphite,' causes considerable trouble in the cyanide treatment of tailings and slimes. It has been assumed, and rightly assumed, that poor extractions are, in part at least, due to gold dissolved from the ore becoming 're-precipitated' on the carbonaceous schist mixed with it. But it should be understood that the term 're-precipitation' does not imply anything in the nature of a reversed action of the solution at any stage of treatment, but merely that a process of precipitation accompanies, and is contemporaneous with, the dissolving of the gold from the ore—the final effect being to transfer part of the gold from one constituent of the ore to another—from the quartz to the schist. The trouble, it is true, can be and has been evaded by cutting out wet crushing, amalgamation, concentration, etc., and substituting dry crushing, roasting, and cyanidation of the whole of the ore as one product. The dry-crushing and roasting treatment gives satisfactory extractions and presents other convenient features, but it is, naturally, a costly process, suitable only for the richer ores.

That the graphitic or carbonaceous schist of the West African mines precipitates gold from cyanide solutions has been determined by numerous experiments. The maximum amount that the schist will precipitate is roughly proportional to the percentage of carbon in the schist, and the finishing or load point is fairly sharply defined. In general, where a maximum load-point was aimed at, it amounted to from 4 to 7 oz. of gold per ton of schist. That the cessation of precipitation represents a 'load-point' of the schist, and not a change in the action of the solution due to contact with the schist, is shown by the following experiment:

Five beds of the schist, previously crushed to —10 and +30-mesh and each weighing 300 gm., were placed on filters. Five cyanide solutions each 1200 c.c. and all carrying 0.13% KCN and 36.9 dwt. gold per ton were passed through these beds as follows:

No. 1	solution	through	beds	1	to	5	in	series	in	30	hours.
No. 2	"	"	"	1	"	4	"	"	"	24	"
No. 3	"	"	"	1	"	3	"	"	"	18	"
No. 4	"	"	"	1	and	2	"	"	"	12	"
No. 5	"	"	bed	1	in			"	"	6	"

A portion of each solution was then assayed with the following results:

No. 1	solution	after	passing	5	beds	in	30	hours	assayed	Trace.
No. 2	"	"	"	4	"		24	"	"	0.33 dwt.
No. 3	"	"	"	3	"		18	"	"	19.80 "
No. 4	"	"	"	2	"		12	"	"	35.50 "
No. 5	"	"	"	1	"		6	"	"	37.70 "

From the foregoing example it is clear that the precipitation is limited only by the amount of the precipitating agent contained in the schist on which the auriferous cyanide solution is allowed to act. No. 1 solution, after passing through 5 beds of fresh 'graphite,' is completely precipitated. No. 2, after passing through only 4 beds, already partly charged with gold, is also precitated fairly completely. Solution No. 4, passing through two beds of nearly fully charged 'graphite' was hardly precipitated at all. Before No. 5 solution was applied to No. 1 bed the latter was completely charged and no more was precipitated. That No. 5 solution came off actually slightly higher in gold than it went on to No. 1 bed is probably due to the fact that the gold precipitated does not remain absolutely, although nearly, insoluble in cyanide solution. The full load for the sample of graphitic schist used in the above experiment appears, from the solution-assays, to be about 7½ oz. per ton. The actual assay of No. 1 bed, after water-washing, was 7 oz. per ton.

Obviously, as long as any of this graphitic schist is mixed with the ore, it is bound to be an important factor

*A paper read before the Institution of Mining & Metallurgy, London, on April 15, 1915.

[1]S. Brussow, *Zeitsch. f. Chemie u. Ind. d. Kolloide*, 1909, No. 5, p. 137, and D. Avery, *Jour. Soc. Chem. Ind.*, 1908, No. 27, p. 255.

[2]Homfreys, *Zeitsch. Phys. Chemie*, Leipzig, 1910, Vol. 74; Freundlich and Neumann, *ibid.*, 1909, Vol. 67.

[3]Morris Green, Trans., Vol. XXIII, p. 65.

in—if, indeed, it does not constitute the root of—extraction difficulties. To some extent the cyanide treatment is bound to bring about a transfer of the gold contained in the quartz or ore proper, in a form in which it is soluble in cyanide, to a state of gold precipitated on the 'graphite,' in which condition it is nearly insoluble in cyanide solution. Unfortunately a considerable admixture of the schist with the ore is inevitable, as it not only occurs as a friable selvage on the walls but is actually sandwiched in streaks through the veins, especially where these are richest.

At first it seemed to me that to assume, without further investigation, that the precipitation was due to the action of carbonaceous matter in the same sense that charcoal acts, would be merely to substitute one mystery for another. Moreover, it appeared that in the case of the somewhat complex 'graphitic' schist quite other causes might be at work, whether in the shape of some relatively uncommon element or of some unusual combination of common elements. I set myself, therefore, in the first instance, to endeavor to find out what the actual precipitant might be—which is clearly present in limited quantity only—or, alternatively, to eliminate it by way of pre-treatment or to satisfy it by 'loading' it with some metal or substance other than gold.

A typical analysis of the 'graphitic' schist is as follows:

Silica	45.75 (in part quartz)
Alumina	22.57
Ferrous oxide	7.98
Manganous oxide	0.28
Lime	2.25
Magnesia	3.51
Carbon dioxide	1.36
Combined water	5.50
Graphite, etc. (by difference)	10.80
	100.00

It can probably be regarded as a highly metamorphosed carbonaceous modification of the phyllite common to the country.

A special examination for elements that might be included in the 'undetermined constituents' in the above analysis (which term covers a small amount of arsenical pyrite) gave traces of lead and copper, no zinc, bismuth, molybdenum or chromium, 0.02% nickel, and 0.53% arsenic, as well as a trace (doubtful) of antimony. The heavy mineral constituents present—the sulphides—are clearly not responsible for re-precipitation phenomena, as is proved by the fact that concentrate from the ore, although difficult to treat by cyanide, does not re-precipitate gold from cyanide solutions.

The silica is, in part, easily soluble in solutions of alkali and alkaline carbonates. It was noticeable that, although cyanide solution filtered through the schist beds came off perfectly clear, the subsequent water-washes brought away a turbidity which, when settled out, appeared as a voluminous gelatinous precipitate consisting of silica 47.3%, alumina 35.1%, lime 10.5%, and magnesia 5.2%. The schist contains a small amount of magnesium sulphate, which can be extracted by water.

The carbon, which varies in quantity in different samples—running from 4% to as high as 10%—is distinctly graphitoid. It can be separated from the schist by fusing the latter repeatedly with caustic potash and treating with acid until the residual product is approximately pure carbon. This, when dried and pressed or rubbed, shows a true graphitic lustre.

This residual carbon can be easily and quickly (in a few hours) oxidized by treatment with chlorate of potash and concentrated nitric acid to a quasi-colloidal substance which differs from the products (humic acids) obtained by the oxidation of ordinary amorphous carbon in that it is of a light yellow color and is only soluble to a limited extent in water. The presumption therefore is that the carbon in the schist is of a graphitoid nature, probably a colloidal form of graphite. That it can be comparatively easily removed by roasting, in spite of its graphitoid nature, is probably due to its colloidal condition. It seems worth mentioning at this point that, when the ore is treated by roasting, the test to determine whether it is sufficiently well roasted to yield a good extraction is directed towards determining whether all the *carbon* has been got rid of. The presence or absence of carbon in the roasted ore is a conclusive indication of the quality of the roast from an extraction point of view.

Several hundreds of experiments were carried out with a view to finding some means of stopping the precipitating action of the graphitic schist. They were mostly of an empirical nature and were started primarily with the object of seeing whether the precipitating agent in the schist could be satisfied or 'pre-loaded' with some metal other than gold, or whether it could economically be destroyed by chemical means, or whether its action could be weakened by the presence of other substances in the cyanide solutions. These tests were applied:

1. By pre-treating beds of the schist with various reagents such as solutions of metallic salts, oxidizing agents, and other substances, and subsequently passing auriferous cyanide solutions through the pre-treated beds.

2. By adding to auriferous cyanide solutions various oxidizing and other reagents, and making comparative precipitation trials on the schist.

Among the reagents applied for pre-treatment were solutions of copper, silver, lead, mercury, platinum, tin and various iron salts, dilute nitric acid, varying strengths of alcohol, alkaline carbonate, cyanide and ferricyanide, barium peroxide, ammonium nitrate and nitrite, alkaline sulphite and bisulphite, alkaline sulphide, etc.

Some of the metals, notably silver and copper, were precipitated by the graphitic schist, the former, certainly in part, by replacing the manganese present. But both silver and copper were immediately dissolved on applying the auriferous cyanide solution and did not at all subsequently affect the amount or rate of precipitation of gold.

Among additions to the auriferous cyanide solution (without pre-treatment of the graphite) were copper, silver, lead, mercury, platinum, iron and cadmium salts, barium peroxide, potassium ferricyanide, cyanogen bromide, etc.

None of these substances was of the least avail in checking the rate of amount of precipitation of gold by the graphite: oxidizers such as cyanogen bromide seem rather to promote it.

A series of temperature tests over a fairly wide range of temperatures (from 7 to 30 C.) showed that the rate of precipitation is not affected by any variation in temperature within the limits stated.

The failure to detect, in the graphitic schist, any element likely to cause precipitation of the gold and the long list of negative results in pre-treatment and other experiments seemed then to necessitate a re-consideration of the possibility of an analogous action of the schist—considered simply as a carbonaceous substance—and of charcoal. There are undoubtedly remarkably few substances known, other than nascent hydrogen, or metals capable of producing nascent hydrogen, that will precipitate gold from cyanide solution without first destroying the free alkaline cyanide present. One of these few is charcoal, and it precipitates gold in quantities approximately of the same order of magnitude as the amount of gold precipitated by the carbon in the graphitic schist. For instance, in the example given at the beginning of this paper the gold precipitated represents about 0.22% of the amount of carbon present in the schist. Freshly ignited samples of charcoal give a precipitation of 22 to 24 mg. gold on 10 gm. of the charcoal under like conditions as to strength of solution and time of contact. So that a certain amount of analogy between the precipitating action of charcoal and of the graphitic schist is ready at hand.

Having regard to this possible analogy and as a preliminary to a further investigation of the action of the schist, it was thought worth while to study the effect of charcoal on auriferous cyanide solutions and, with a view to fixing a number of data relating to the precipitation of gold by charcoal, several series of tests were carried out, which will be dealt with below.

In every case the charcoal, crushed through a 10-mesh sieve, was immersed in the solution, without agitation, for the stated length of time.

(A). Precipitation with graduated cyanide strength. No free alkali.

10 gm. charcoal standing in contact with 200 c.c. KCN solution containing 21.6 mg. gold. Time about 16 hours.

The results are tabulated below:

Free NaCN in 200 c.c. solution, Gm.	Gold precipitated, Mg.	Gold adsorbed, Mg.
Nil ($NaAuCN_2$ only)	16.6	0.6
0.14	14.0	0.4
0.28	13.3	0.5
0.42	12.9	0.7
0.56	12.1	0.9

It will be seen that the precipitation is greatest where the cyanide strength is at a minimum, and with increased cyanide, from about 0.07% upward, decreases steadily.

The third column of figures in the same table represents adsorbed (as distinct from precipitated) gold. The figures for the adsorbed gold were arrived at as follows: Of the 200 c.c. solution applied to the charcoal in each test, exactly one-half was filtered off and the gold in it determined. The remainder of the solution was then passed through the same filter and the charcoal washed with a copious supply of water. The second half of the solution (plus washes) was then also assayed.

The second half of the partly precipitated solution in each case contained slightly more gold than the first half, showing that, by virtue of surface action, there is a small but distinct concentration of the soluble (and therefore presumably unchanged) gold salt on the charcoal. This concentration of salts in solution is an effect which, as will be noted from above series of tests, is different in nature and of a different order from permanent precipitation. The precipitation results are based on the amount of gold originally in the 200 c.c. of solution *minus* the amount contained in the whole of the solution and washes after precipitation.

(B). Precipitation with graduated alkalinity.

10 gm. charcoal standing about 15 hours in contact with 200 c.c. 0.28% KCN solution carrying 21.6 mg. gold.

Free NaOH in 200 c.c. solution, Gm.	Gold precipitated, Mg.
Nil	12.0
0.17	12.2
0.34	12.4
0.51	12.8
0.68	13.35

The estimation of precipitation with graduated alkalinity is based on the assay of the first half of the partly precipitated solution only and therefore includes adsorption. Probably the apparent slight differences in precipitation are merely due to different degrees of adsorption. It would appear probable also that the adsorption shown in the figures tabulated under *(A)* is an effect of the alkalinity of the cyanide solution and not of the cyanide *qua* cyanide.

(C). Precipitation with graduated gold content.

10 gm. charcoal standing in contact with 200 c.c. of solution containing 0.28% KCN and graduated amounts of gold, for about 15 hours:

Gold in 200 c.c. solution, Mg.	Gold precipitated, Mg.	Gold adsorbed, Mg.
2.16	2.08	0.08
5.4	4.28	0.02
10.8	7.4	0.20
16.2	9.75	0.45
21.6	11.29	0.9

In these tests the partly precipitated solutions were again assayed in two halves in order to arrive at a measure of the adsorption.

The precipitation figures in this table indicate that, as was to be expected, the absolute amount of gold precipitated increases with the increase of gold contained in the

applied solution, but that these increases are not proportional. The more gold there is in the solution the smaller the percentage of it which is precipitated in a given time.

(D). Precipitation with varying time of contact.

In this series a number of 10-gm. lots of charcoal were treated for varying lengths of time up to 48 hours with 200 c.c. 0.28% KCN containing 43.2 mg. gold (twice as much as in the previous tests), in the expectation that with this grade of solution the load-point would be reached within a couple of days.

It was found that the extreme time given was insufficient to exhaust the precipitating power of the charcoal, but the figures obtained are interesting:

Contact, hours.	Gold precipitated, Mg.	Contact, hours.	Gold precipitated, Mg.
3	14.0	18	20.6
6	16.2	24	20.8
9	18.0	36	22.0
12	19.6	48	24.2

It will be noticed that at from 18 to 24 hours the load-point appeared to have been reached, but at 24 hours and beyond, precipitation appeared to be resumed, much as if some secondary reaction had commenced. This interesting feature was not followed up, as, at the time the experiments were made, the object of the charcoal precipitation tests was merely to obtain a general idea of the factors affecting the action of the charcoal. The results of the experiments tend to show that, however the precipitating action of the charcoal may be accounted for, it is different in nature and degree from mere adsorption and that the amount of it is influenced by the proportion of gold present, the time of contact, and the strength of the cyanide solution. The amount of excess alkali present has little or no effect on the amount of precipitation. It has also been found a matter of indifference whether the gold in the solution has been dissolved from ore, or has been added as aurous cyanide or as auric chloride.

From a gold chloride solution, on which carbon acts chemically as a precipitant:

$$4AuCl_3 + 6H_2O + 3C = 4Au + 12HCl + 3CO_2*$$

the gold is quickly precipitated in visible metallic form on charcoal. The gold thus precipitated is readily soluble in alkaline cyanide.

The precipitation on charcoal from an auriferous cyanide solution is clearly of a different nature. For, in the first place, it is inconceivable that charcoal, *qua* carbon, can similarly act chemically upon a weak alkaline auro-cyanide solution. Secondly, the gold precipitated remains almost completely insoluble in fresh alkaline cyanide solution. And, thirdly, the most careful examination of the charcoal on which gold has been precipitated from cyanide solution fails to reveal the presence of any visible coating of gold.† These considerations suggested the idea that gold precipitated on charcoal from cyanide solution might be soluble in some practicable reagent other than cyanide, and a number of possible solvents were tried, keeping this contingency in view. After several fruitless endeavors the interesting discovery was made that a considerable proportion of the gold could be dissolved in solutions of alkaline sulphides. In a preliminary test a 10-gm. lot of charcoal, on which had been precipitated 10 mg. gold, was thoroughly washed, until the washings no longer gave a KCN reaction. The charcoal was then treated on a filter by passing through it 100 c.c. of 1% sodium sulphide solution and again washed. The filtrate and washings, on assaying, were found to contain 3.4 mg. dissolved gold.

The following tests were then made:

Five lots of charcoal, each 10 gm., loaded with gold varying in amount from 12 to 13.35 mg. were washed with 400 c.c. water to remove cyanide. Then treated by standing for 19 hours in contact with

	Dissolved Mg.	Out of Mg.
a. 200 c.c. plain KCN 0.28%	1.4	12.0
b. 200 " 0.14% KCN and 0.14% Na_2S	4.4	12.4
c. 200 " 0.28% Na_2S	8.0	12.4
d. 200 " 0.28% KCNS	0.3	12.8
e. 200 " 0.14% $NaHCO_3$ and 0.14% Na_2S	7.3	13.35

Two additional samples of 10 gm. of charcoal preloaded with 14.8 mg. and 17 mg. of gold respectively, well washed and treated (allowed to stand in contact) overnight:

a. With 200 c.c. 0.3% Na_2S solution.
b. " 200 " 0.3% NaHS "

The assays of the solutions showed that

a. Dissolved 13.1 mg. gold out of 14.8 mg.
b. " 12.4 " " " 17.0 "

It was then thought worth while to see whether an analogy proved to exist between the precipitating action of both charcoal and graphitic schist also applied to the re-solution of the precipitated gold. The following experiments were therefore tried to determine whether any re-solvent effect could be obtained by treating, with alkaline sulphide solution, samples of graphitic schist on which gold had been precipitated.

Two lots of the schist, each 250 gm., to which was added 1 gm. of lime, were each treated with 600 c.c. auriferous cyanide solution containing 10.8 mg. gold per 100 c.c. The solutions were slowly passed through the bed of schist eight times.

	Gave Mg.		Mg. Pptd.
100 c.c. from No. 1 after precip'n	2.4	=	50.4
100 " " No. 2 " "	2.5	=	49.8

The No. 1 bed was then drained dry and treated, without washing, with 500 c.c. Na_2S solution 0.3% for 24 hours. It was then washed and the whole of the sulphide solution and washes assayed. The gold obtained weighed 37.3 mg. As the graphite bed was not washed previous to sulphide treatment, this does not all represent re-dissolved gold, but is made up as follows:

Adsorbed gold (based on the result of a previous test)	8.0
Absorbed in 130 c.c. solution at 2.4 mg. per 100 c.c.	3.2
Actually re-dissolved	26.1
	37.3

*Avery.

†This is contrary to the observation recorded by Morris Green. (Trans., I. M. & M., Vol. XXIII, p. 65.)

No. 2 bed was well washed to make sure of getting rid of all KCN. The bed was then treated overnight with a weak solution of H_2S. This solution dissolved 11.2 mg. gold.

Four beds of graphite were then charged with gold, well washed, and treated with sulphide solution by passing the same through slowly, 9 times in about 16 hours. The beds were again thoroughly washed and the solution and washes from each bed assayed. The following are the results:

	Gold contained, Mg.	Treated with C.c.		Gold dissolved, Mg.
No. 1	39.6	500	0.2% K_2S	22.0
No. 2	38.8	1000	0.1% "	31.6
No. 3	38.8	500	0.4% "	31.0
No. 4	40.0	500	0.29% KHS	30.0

The highly interesting fact is therefore established that the gold precipitated from cyanide solutions on charcoal as well as on graphitic schist is, to a considerable extent, soluble in alkaline sulphide solutions. Why it is not completely soluble and what the best conditions are for effecting the re-solution (why, for instance, less should have been re-dissolved from No. 1 bed as above than from any of the others) are points still requiring elucidation.

By a series of experiments it was found that both charcoal and the carbonaceous schist, when loaded with gold to a point at which precipitation stops, or is greatly retarded, and then treated with alkaline sulphide to dissolve the gold, recover practically all their precipitating power. (It had been noticed that a pre-treatment of charcoal or graphitic schist with weak alkaline sulphide solutions rather tends to promote the precipitating action than to weaken it.)

The analogy between the precipitating action of the West African carbonaceous schist and ordinary wood-charcoal, both being in contact with auriferous cyanide solutions, may now be summarized as follows:

1. Gold is precipitated (in the case of the schist in a measure roughly proportional to the amount of carbon present).

2. The gold thus precipitated is not soluble to any appreciable extent in fresh cyanide solution.

3. It is to a large extent soluble in alkaline sulphides.

4. After dissolving the gold in alkaline sulphides the precipitating capacity of both schist and charcoal is renewed practically in its entirety.

The analogy, it will be seen, is a close one: so close as to justify the assumption that any explanation of how and why the gold is precipitated by charcoal will throw a light on the action of the graphitic schist.

In considering in what form the gold is precipitated by charcoal from cyanide solutions it is necessary, in the first instance, to repeat that, according to all the evidence, the action is a quite different one from the precipitation of gold from gold chloride solution:

(*a*) Charcoal rapidly and *visibly* precipitates *metallic* gold from gold chloride solution in a form in which it can readily be dissolved in weak cyanide solutions, but in which it is quite insoluble in alkaline sulphide solutions.

(*b*) From alkaline aurous cyanide solutions of equal value the gold is comparatively slowly precipitated in a form which is not visibly metallic (indeed there is no visible coating of the charcoal of any sort). Gold so precipitated is not soluble, except for an insignificant fraction, in fresh cyanide solutions, but is to a considerable extent soluble in alkaline sulphide solutions.

The charcoal containing gold precipitated from cyanide solution can, by careful washing, be fairly rapidly freed of the last trace of alkaline cyanide, but it is found that traces of cyanogen still persist in the wash-water for a long time after the soluble alkaline cyanide has been removed. This may be due to the dissolving of cyanogen gas occluded in the charcoal or to the slow decomposition of an insoluble cyanogen compound.

When the 'loaded' charcoal, after careful washing, is treated with a solution of alkaline sulphide to dissolve the gold, the resultant auriferous solution is found to contain a quite noticeable amount of cyanogen as sulphocyanide, in quantity not apparently in any fixed relation to the amount of gold present, but in considerable molecular excess of same. In one case, for instance, when a sample of 'loaded' charcoal was treated with two successive lots of Na_2S solution, and these solutions were assayed, and, after eliminating the excess of sulphide, roughly tested for sulpho-cyanide (by colorimetrical estimation as ferric sulpho-cyanide), it was found that they

a. Contained, per 100 c.c., 3.54 mg. gold and NaCNS equivalent to 12 mg. cyanogen.

b. Contained, per 100 c.c., 1.2 mg. gold and NaCNS equivalent to 6 mg. cyanogen.

The following further interesting facts were observed, which appear to apply equally to gold precipitated on charcoal or on graphitic schist:

1. H_2S, K_2S, Na_2S, KHS, and NaHS all act as solvents for gold precipitated from cyanide solution on charcoal or graphitic schist, and all about equally well molecule for molecule. Alkaline polysulphides are less effective solvents, and ammonium sulphide still less, although these also give rise to the formation of alkaline sulphocyanide.

2. The gold dissolved by the alkaline sulphide solution is not precipitated by lead carbonate or by manganese peroxide, but is precipitated on metallic copper and to some extent on zinc and aluminum. (A solution of potassic-aurous sulphide is very completely and rapidly precipitated by either of the two first-named reagents.) The gold is therefore evidently not dissolved as a double sulphide, as at first seemed possible, but as an alkaline aurous-cyanide. Neither sodium thiosulphate nor alkaline thiocyanates, it may be mentioned, dissolve the gold from charcoal.

It is not necessary to go beyond the established fact that gold precipitated upon charcoal from cyanide solutions is practically insoluble in fresh cyanide solutions and *is* soluble in alkaline sulphide solution to arrive at the conclusion that this gold is not in metallic or col-

loidal metallic form, but is held in chemical combination. The question of *what* the chemical combination is, affords room for a great deal of, possibly, unprofitable surmise. it is, however, interesting to consider what elements or radicals are available for such combination.

1. Although the alkaline aurocyanide is undoubtedly split up, the aurous cyanide is probably not decomposed or metallic gold would be deposited. Possibly such decomposition takes place to a slight extent in time, and this may account for the small fraction of precipitated gold which becomes soluble in cyanide after the charcoal or schist bed has been drained and washed.

2. Cyanogen in considerable molecular excess of the precipitated gold is occluded* by the charcoal (which will occlude a larger volume of cyanogen than of almost any other gas). How this cyanogen is liberated from the cyanide solution is an obscure feature which is worth considering. When cyanogen gas is passed into caustic alkali solution it forms alkali cyanide and cyanate:

$$C_2N_2 + 2KOH = CNOK + CNK + H_2O\dagger$$

Possibly the adsorptive effect of the charcoal is sufficiently strong to cause a reverse action, and to cause the cyanides and cyanates to interact with liberation and immediate adsorption of cyanogen. (Some small amount of cyanates is present in all cyanide solutions after exposure to the air or after subjection to oxidizers.) A more probable explanation is, perhaps, that the HCN formed by hydrolysis is partly oxidized by the oxygen occluded in the charcoal. The action could be represented thus:

$$2HCN + O = C_2N_2 + H_2O$$

By whatever process it may get there, there is no doubt that cyanogen, whether as adsorbed gas, or in combination, or in both states, is retained by charcoal which has been used to precipitate gold from cyanide solution, long after the more freely soluble cyanides are removed by washing. Owing to its being apparently in considerable molecular excess of the precipitated gold, it is impossible to draw any definite conclusion as to its function in the precipitating action, but the fact that it is available has to be taken into account.

3. Morris Green in his paper, previously cited, has made out an excellent case for CO being the prime precipitating agent in charcoal. (If this is so in the case of charcoal, there is no inherent improbability in it also being so in the case of the graphitic schist referred to in this paper, as the schist contains colloidal matter which acts as an adsorbent, even if the graphitoid carbon present did not fulfil such function). CO gas *per se* does not precipitate gold from cyanide solutions, but when it acts as adsorbed gas in charcoal, other factors come into play—of which the ruling one is not improbably the simultaneous presence of adsorbed cyanogen gas.

Having regard to the considerations enumerated above it would not appear an unreasonable or far-fetched suggestion that the gold compound held in the charcoal may be a combination of AuCN, CO, and C_2N_2—a carbonyl aurocyanide, possibly on the model of one of the carbonyl platino-chlorides, of which several are known.

Adopting as a working hypothesis the formula $AuCN.CO(CN)_2$ the process of dissolution of the gold in alkaline sulphide could be represented:

$$AuCN.CO(CN)_2 + Na_2S = NaAu(CN)_2 + NaCNS + CO$$

the CO being re-adsorbed and the precipitating power of the charcoal being renewed (as, in great part, actually happens). Against this hypothesis there is the fact that the re-solution of the precipitated gold in alkaline sulphide is never a complete one and is generally under 75%, which would rather indicate that the action is not so simple as the above equation would make it appear.

In closing I summarize my conclusions:

1. It has been demonstrated that the graphitic schist of West Africa precipitates gold from auriferous cyanide solution in a manner which is, in all important respects, analogous to the action of charcoal under like conditions.

2. The gold is precipitated on the charcoal (and on the schist) not as metal but as a compound—possibly a carbonyl aurocyanide.

3. The gold compound is decomposed and the gold dissolved to a considerable extent by alkaline sulphide solutions (judging by the results of a large number of tests, of which only a few have been included in these notes, the re-solution is effected rather more easily from the schist than from charcoal).

Whether the discovery that alkaline sulphide solutions will dissolve gold which has been precipitated on the carbonaceous schist can be turned to practical utility in the cyanide treatment of ores containing such schist, is the subject of experiments at present being carried on. By post-treating, with sulphide solutions, sand residues from which a maximum possible extraction had previously been recovered by cyanide treatment, a further extraction has been obtained from a large number of samples, and there is some promise that an economical post-treatment may be evolved on these lines. The precipitation of the gold from the sulphide solutions (in which the gold is held as alkaline aurocyanide with hardly any free alkaline cyanide, but a large excess of alkaline sulphide) appears to be best effected by contact with metallic copper.

*The author appears to use 'occlude' and 'adsorb' synonymously.—EDITOR.

†Roscoe & Schorlemmer.

ADSORPTION is the name applied to the phenomenon exhibited by colloid substances, which are able to take dissolved substances out of solution and hold them, often with great tenacity. Some substances exhibit selective adsorption; thus seaweed adsorbs iodine from sea-water, although the quantity present is so small that it cannot be detected by any of the usual tests. Adsorption is a surface tension phenomenon; increased concentration of the adsorbed surface on the boundary of the colloid particle leads to decreased surface tension. In a few cases increased concentration leads to increased surface tension, and negative adsorption is then exhibited.

Goldfield Re-visited—I

By T. A. RICKARD

Seven years ago I made my first visit to Goldfield; it was warm then, warm with sunshine and prosperity. When I went there the other day the snow had been falling over-night, it was still falling, and the temperature was low. The air was cold and I met many people with cold feet. Goldfield has abated its exuberance of spirit and it has shrunk in size, so that it looks like a fat man who has taken the cure. The clothes of its prosperity are too ample for its severer shape. Empty houses are pitifully conspicuous. The population in 1908 was 22,000; now it is 4500. Last year it was fully 1000 less; prospects are improving; that is why it was pleasant to go to Goldfield at this time.

THE JUMBO EXTENSION MINE, GOLDFIELD.

Jumbo Extension is the main subject of talk: rich ore—and litigation. Apparently a mine must pass through the whooping cough of a lawsuit before it reaches the adult stage of development. I saw the rich ore and heard all about the disputes concerning the ownership of it. Naturally, I did not hear all that has been said on the subject, but enough to outline the story to my readers.

The Jumbo Extension property consists of two claims, the Polverde and the Velvet. Of these two the Velvet was acquired on October 5, 1914, from the Merger Mines company, owning adjoining property. The Merger Mines had failed to find any ore despite exploratory work begun in 1911 and reaching to 1772 ft., the maximum depth attained in the district. In order to assist further exploration in its Velvet claim, the Merger Mines leased the Jumbo Extension shaft in December 1912. Some low-grade ore was found, but nothing particularly encouraging. To obtain further funds, the Merger Mines then gave an option on its Velvet claim to the Jumbo Extension company, which exercised the option, as stated, in October last. This transaction might have caused no comment if immediately thereafter the Jumbo Extension company had not uncovered rich ore in the lode already cut in the Velvet claim. Shares that had been peddled for 12 to 15 cents during the major part of 1914 rose to $4 on November 30. They have not been anything like so high since, although a great deal more ore has been uncovered; but that is another story. No sooner had the discovery been heralded than the minority shareholding in the Merger Mines brought suit against the directors of that company, alleging collusion and fraud in the sale of the Velvet claim to the Jumbo Extension company. On February 21, 1915, a receiver was appointed, pending a suit to annul the deal with the Jumbo Extension company. Three days later the Reorganized Booth Mining Company, owning the Booth claims, filed an apex suit against the Jumbo Extension and the Merger Mines.

To explain this, let me refer you to the accompanying map of the territory in dispute. It will be seen that the outcrop of the rich lode traversing the Goldfield Consolidated property is shown as if it made a curve northward so as to pass through both end-lines of the Booth claim and appears to give the owner of that claim the apex rights on all ground within the end-lines projected forward in the direction of the dip of the vein. However, lodes are rarely as continuous in strike or as simple in structure as they are portrayed on maps. It is a moot question whether the vein in the Booth is an uninterrupted extension of the vein in the Red Top claim of the Goldfield Consolidated. Good evidence exists for suggesting that a fault intervenes. The vein has a flat dip, ranging from 35 to 50° east, and averaging about 40°. Geologically the Merger Mines at a vertical depth of 1750 ft. is at the same horizon as the Booth at 500 ft., although the distance between them is 3000 ft. as measured on the surface. Hence the legal ownership of ore found in the Jumbo Extension, Kewanas, and Merger Mines is threatened by the Booth apex. Before this recent entanglement supervened the Goldfield Consolidated company had entered into a mutual side-line agreement with the Jumbo Extension and the Merger companies, that is, each had waived any legal right to

extract ore beyond their side-lines vertically projected. They agreed mutually to waive any extra-lateral rights. That agreement was renewed after the Velvet was added to the Jumbo Extension property. The Booth gave a side-line waiver to the Goldfield Consolidated as late as April 24. Now comes the humor of the position. Mr. George Wingfield is the president of the Goldfield Consolidated; he is the controlling shareholder also in the Merger Mines, and he is the owner of the Booth. He is he Pooh-Bah of the comedy. As controller of the Merger he permits the sale of the Velvet claim by the Merger to the Jumbo Extension; then, having placed the proceeds from this sale into the empty treasury of the Merger company, he and his friends are attacked by the minority shareholding in the Merger; whereupon he springs the Booth apex-suit upon them and upon the Jumbo Extension company. Both the Merger Mines and the Jumbo Extension were placed in the hands of a receiver. An examination of the geological evidence in the case was made by Messrs. H. V. Winchell, J. R. Finlay, and Frank W. Royer, who reported to the attorneys of the Jumbo Extension company, and these in turn joined with the mining experts in recommending a compromise. A consolidation of the Booth, Jumbo Extension, Kewanas, and Merger was discussed, but the idea did not find sufficient support. Finally an arrangement was formulated whereby the Jumbo Extension is to increase its capital stock from 1,250,000 shares to 1,750,000, and of this amount is to pay the Booth 300,000 shares for a side-line agreement. This proposal is to be submitted to a meeting of the Jumbo Extension shareholders on May 20, while the formal meeting of the Booth is scheduled for May 31.

Meanwhile, on May 5, the Kewanas company paid the Booth—that is, Mr. Wingfield—250,000 shares for immunity from apex demands, and the Kewanas Extension was given the same side-line agreement for 25,000 shares of its capital stock. On May 6 the receivership in the Merger case was made permanent and announcement was made before the United States Court at Seattle that suit would be brought against the majority directors for unauthorized transactions, notably the sale of the Velvet claim to the Jumbo Extension company. The assertion is made that "the policy of all the business of the Merger company has been planned and carried out by the officers and persons who dictated and directed the policy and business of the Goldfield Consolidated company and allied concerns, and not by the trustees of the Merger company." On May 11 the Court authorized the bringing of a suit by the receiver for the recovery of the Velvet claim and for the value of the ore extracted by the Jumbo Extension company. From what I could learn at Goldfield, the deal between the Merger and the Jumbo Extension was a straight transaction. The Merger needed money badly, the Velvet claim apparently had no special value, and the sale would have escaped criticism if rich ore had not been found, subsequently, in the Velvet. The only complication arises from the fact that Mr. H. O. Whittemore, a Merger director, had caused Mr. E. S. Van Dyke, a former manager of the Jumbo Extension and the person who steered the deal, to give him 10,000 shares of Jumbo Extension out of a commission of 21,000 shares received by Mr. Van Dyke from the directors of the Merger. Even this need have excited no suspicion if a rich orebody had not been discovered so soon afterward in the Velvet workings. While the original complainant was a lady shareholder, Mrs. Lucy V. S. Ames, the chief opponent of Mr. Wingfield is Mr. John Erikson, of Seattle. He is a Swede who made about $200,000 at Nome, in Alaska. When he spent his money in buying tide-lands near Seattle he was supposed to have been victimized, but the extension of the Chicago, Milwaukee & Puget Sound Railway caused the land to become exceedingly valuable as an entrance into Seattle, so Mr. Erickson made a big fortune by selling it. Part of the friction at Goldfield is imputed to an old quarrel between Messrs. Erickson and Wingfield. It may be asked why the Goldfield Consolidated, at the instance of its president, Mr. Wingfield, did not finance the Merger Mines and so save the loss of the Velvet claim? The Consolidated had already put $250,000 of its money in the Merger and could well have afforded to risk $100,000 more, rather than lose the Velvet. This question is not unfair, having regard to the further fact that the Consolidated has seen fit to go outside the district, to Aurora, in order to extend its mining activities.

If the reader will now turn to the map he will see that the Florence appears to apex the Atlanta and Merger properties. Mr. Wingfield controls the Atlanta. Here is another complication. The apex rights of the Booth will clash with the similar rights of the Florence, but the prior privilege goes to the older claim. Herewith I give the names, numbers, and dates of location of the oldest claims in this vicinity.

Name.	Number.	Date of location.
Booth	2431	May 10, 1903
Florence	2357	May 19, 1903
Red King	2361	May 19, 1903
Combination	2375	May 26, 1903
Red Top	2217	Aug. 20, 1903
Mohawk	2283	Aug. 20, 1903
Miss Jessie	2564	Aug. 29, 1903
Velvet	3843	Sept. 1, 1903
Polverde	3626	Oct. 17, 1903

These incidents should go far to emphasize the absurdity of the apex law and the possibility of its use to destroy the equity acquired by discovery and development. To lay claim to the ore in the Jumbo Extension, the Booth has to jump across half a mile of ground, that is, over the intervening property of a third company in the face of an agreement waiving apex rights with that company. The Booth then extends the shadow of its apex farther along the dip over the Merger property, to be met there by the shorter shadow of a similar right thrown forward from an outcrop that is at right angles to that traversing the Booth.

Of course, this hurts legitimate mining—and the illegitimate also, for that matter. In January last a

dozen companies were ready to undertake a campaign of deep mining, encouraged by the discoveries in the Jumbo Extension, when the fiasco put an end—temporarily—to such projects. Jumbo Extension shares have fluctuated widely, as the following figures show:

Nov. 30	$4.05	April 22	$1.82
Feb. 24	0.51	May 11	0.92

The company has 1,250,000 shares. Dealings are mainly at San Francisco, but also on the New York exchange. Goldfield has no exchange, but it has several brokerage offices, where quotations are chalked on big boards. It is curious to find them open at 7 a.m., for they try to synchronize their business hours with New York. When it is 10 a.m. on Manhattan island it is 7 a.m. on the Nevada desert. Before the discovery was made, in October, the shares of Jumbo Extension were quoted at 12 to 15 cents. Many local people bought at these low prices and stood to make a nice 'clean-up,' but they used their profit to buy more stock, they 'pyramided,' forecasts being freely made that the shares would rise to $10. Some of the wiser miners gave orders to sell at $3, if the market declined. Their orders took effect automatically when the range of prices fell between $3 and $3.15 on December 28. Simultaneously a New York curb broker, then at Goldfield, circulated a report that the men at the mine were selling and that the mine was no good. Whereupon a small panic ensued. From $3.15 the market broke in a few days to 50 cents. Short-selling by brokers and by miners was influential in causing this debacle. Buying by New York helped to restore the quotation to a more reasonable figure. What the mine is worth is not known. Two experienced engineers have appraised the ore exposed, but the orebodies have not been uncovered as yet to the point where safe estimates are practicable. The ore is rich and there is a good deal of it, as will be indicated in my next article.

MAP OF THE CENTRAL PORTION OF THE GOLDFIELD DISTRICT.

SUPPLIES used at the low-grade mill at the Nipissing mine in 1914 were as follows: cyanide, 5.331 lb. per ton; lime, 5.749 lb.; caustic soda, 3.059 lb.; aluminum dust, 0.592 lb.; aluminum plates, 0.529 lb.; aluminum ingots, 0.172 lb.; flint pebbles, 3.826 lb.; coal for heating, 32.001 lb.; and power, 53.889 kw.-hr. The cost was $2.0457 per ton. In treating 79,125 tons the recovery was 89.64%, at a total cost of $3.989 per ton.

The Sapphire Mines of Yogo, Montana

By O. W. FREEMAN

Sapphire, one of the gem varieties of corundum, is composed of alumina, Al_2O_3, and is typically of a blue color; the cause of the color is not known but probably is due to the presence of extremely minute quantities of foreign material, such as a salt of iron.

Placer deposits in Burma, Siam, and Ceylon formerly were the greatest source of sapphires. These have furnished many stones of that rich deep-blue color for which the Oriental sapphire is noted. Now, most of the world's output comes from Montana, which has the largest and most productive mines in the world. The only locality where sapphires are mined from the rock in which they originate is in southwestern Fergus county, about 55 miles from Lewistown and 13 miles from Utica. These mines occur in a basin in the foot-hills of the Little Belt mountains, the sapphire-bearing rock extending across Yogo creek.

Systematic mining for sapphire in the United States has only been undertaken in Montana. A number of localities have been productive, the first stones being found about 1873 in the gravel-bars on the Missouri river, east of Helena, by miners in search of placer-gold. Actual mining, however, was not undertaken until 1891, when a number of companies were organized to work these bars for sapphire, but the production was never large and has nearly ceased in recent years. The sapphire has been discovered in placer deposits along Rock creek, in Granite county. These are worked by hydraulic mining and sluicing. Production started in 1899 and still continues. In some other prospects in Granite county sapphires have been found weighing as much as 7 to 8 carats; they have been discovered also along Dry Cottonwood creek in Powell county in 1889 and have recently been recovered by dredging. The successful exploitation of these deposits has been hindered by the color of the stones, which are most frequently of a pale greenish or greenish-yellow, varying in the case of the Rock Creek sapphire to darker shades of green and blue-green. Some red, pink, orange, and yellow gems have also been found. The source of most of the Montana sapphire, and practically all that has a deep-blue color, is from Yogo. Sapphires were first found here over twenty years ago by men engaged in placer-gold mining. An expensive ditch had been built to work the placers but the gold obtained did not suffice to pay the expense of operation. However, with the gold collected in the sluices there were found many hard blue stones, later identified as sapphire. The dike from which the gem-stones had come was discovered in 1896.

The Yogo sapphire occurs as disseminated crystals in an almost vertical dike of igneous rock, analogous to lamprophyre, 8 to 20 ft. thick, and of unknown depth. This dike has been traced by pits for over six miles. The dike-rock weathers easily to a soft, clayey material; hence no solid outcrops of it remain. Since the adjacent limestone was too hard for gophers to penetrate, the course of the dike was marked by their heaps of earth; this fact aided the early prospectors in locating their claims; many fine sapphires were picked up from these gopher dumps. Underneath the soft oxidized yellow clay the dike-rock seems to consist of three kinds, a reddish rhyolite, a porphyry, and a dark rock resembling diabase that disintegrates easily. Much of the rock has an uneven to conchoidal fracture that greatly aids in the disintegration of the rock. Most of the sapphire is found in the soft dark-gray rock, which looks to be worthless, for rarely can any sapphire be seen in the matrix when it is mined. The stones are of a dull lustre when found and generally have a rhombohedral form, in this respect contrasting with those from near Helena, which are usually more prismatic in habit. The crystal faces are often etched and striated. Several other dikes occur near the sapphire-bearing one, including one of almost identical composition only about 600-ft. away, yet no sapphire has ever been discovered in place outside of the one dike, although prospecting has been diligent.

Formerly there were two large companies operating mines on the sapphire-bearing dike, the Yogo American Sapphire Co. and the New Mine Sapphire Syndicate, a British corporation. In August 1914 the New Mine company purchased all the claims and assets of the American concern for $80,000; thus giving an English syndicate the practical monopoly of sapphire-mining in the world.

Originally the dike-rock was mined directly in open pits, now the mining is done through a shaft and by drifts, as in ordinary metal-mining. The dike-rock is broken by blasting, if necessary, and is so soft that many of the drill-holes are bored with augers. Entirely different methods are in use at the two mines for the extraction of the sapphires themselves from the broken material.

At the American mine the sapphires are removed from the matrix in a concentrator. The material is first sent through grizzlies, with spaces three inches apart, large lumps being broken with sledge-hammers. The broken rock is then conducted into trommels revolving in water; the shaking, combined with the action of the water, loosens the gem-stones, which drop through the openings along with some pyrite and other hard waste. They go to shaking-screens, which grade the material as to size. The largest and hardest pieces of rock are piled on a dump where they are left until weathering has disintegrated them, and are then subjected to the same process as the fresh rock. The finer material after screening is conducted to different jigs, depending upon its size, to be concentrated. Any large pieces of waste rock remaining

are removed by hand, and the pyrite is then removed from the concentrate by an electrostatic separator.

The process used in extracting the sapphire at the New Mine is even more interesting, as it is a curious combination of the methods in use at gold placers and the South African diamond mines. No crushing is employed for fear of breaking the larger crystals. The rock from the mine is dumped on large wooden floors. Here it is left

THE WEATHERING-FLOOR AT THE AMERICAN MINE.

to disintegrate by weathering, assisted by frequent wetting. Next it is shoveled into sluices, in which riffles are placed. The sapphire being heavier than the matrix is caught in these riffles and is daily removed by turning off the water and lifting the racks. The rough concentrate is then cleaned in a jig. The rock that has passed over the riffles is dumped on a second wooden floor and allowed to weather further, after which it is again sent through the sluices to separate the dirt from the sapphire. This process is repeated four times in all before the rock is finally rejected, but by far the greater quantity of sapphire is recovered from the first two floors. Many stones, especially the smaller ones, are not recovered by this sluicing system; in fact, it has been estimated that only 75% of the sapphire is recovered by the sluicing system, while practically all of the large and 95% of the smaller stones are recovered in the mill of the American mine.

MEN AT WORK ON THE SECOND WEATHERING-FLOOR.

The annual output of sapphire from Yogo amounts to about 90,000 oz., or nearly three tons. In 1912 the value of the rough gems produced in Montana, mostly from Yogo, was $200,585. A large proportion of the stones were culls, either too small or too imperfect for gems. These are used for watch-jewels, meter-bearings, phonograph-points, etc. Most of the sapphire is sold in London, and smaller amounts in New York and Paris; practically none has been sold directly to local buyers. The gems are cut and polished in Europe, many of them in Switzerland, it being cheaper to have the work done abroad and pay an import duty of 20% under the Underwood tariff than to have it done in America. The European war has seriously interfered with shipments to London, so that the present sapphire-mining is at a minimum.

Some cutting and polishing was formerly done at the American mine. It is interesting to watch a dull stone turned by the skillful workman into a beautiful gem. The sapphire is cemented to an adjustable handle, that can be accurately and quickly changed by the operator, so that any face or angle of the gem can be ground or polished. Grinding into the desired shape is done on a brass jewelers-wheel, covered with diamond dust; polishing is done on another wheel covered with diatomaceous earth. The sapphire crystals tend to be so flat that there is an average loss of two-thirds their weight by cutting.

Sapphire is commonly considered to lose its beauty by artificial light and is essentially a daylight stone. Most sapphires from the Far East do lose much of their brilliance at night, but the Yogo sapphires are of an exceptional clear deep blue and retain much more of their splendor by artificial light. The largest sapphire found at Yogo weighed 19 carats in the rough and 8½ carats when cut. A 1-carat cut sapphire brings from $30 to $60. Much larger sapphires have been found in Burma and India.

"The occurrence of the sapphires shows conclusively that they were formed in the dike rock itself. Their origin is believed to be the result of the action of the molten igneous rock upon the fragments of clay, shale or impure limestone, taken up by the former in its ascent. This implies the complete assimilation and digestion of

such material in the igneous rock. It is apparent from a study of the sapphires themselves that they crystallized out of the rock, but it is also evident that partial absorption took place before final consolidation, since many of the sapphires show deeply corroded surfaces; others are rounded masses whose crystalline outline is nearly effaced, while many of them are surrounded by a blackish crust. If the molten rock could dissolve the sapphires at this stage it certainly could dissolve clay shale as well. The dike undoubtedly extends a considerable distance in depth."* From a comparison with other dikes nearby composed of the same material, it is believed that the lamprophyre dike was originally too deficient in aluminum for sapphire to be formed. However, at a depth of over 1000 ft. there is a wide variety of calcareous, siliceous, and argillaceous rocks that could furnish abundant aluminum-bearing material to the molten rock as it ascended. The clear-cut crystals, and the general distribution of the sapphire also, show conclusively that they have been formed by crystallizing out of the magma.

Costs at the South Kalgurli

This property and mill are at Kalgoorlie, Western Australia, and the last annual report gives the following data:

	Cost per Ton		
Development:		Agitation	$0.38
Ordinary	$0.50	Filter-pressing	0.28
Hainault mine	0.23	Clean-up	0.08
		Disposal of residue	0.10
Total	$0.73		
Ore extraction:		Total milling	$2.34
Breaking ore	$0.98	General expenses:	
Filling stopes	...	Salaries and wages	$0.10
Tramming and hoisting	0.67	Sundry	0.02
		Maintenance and supplies	0.01
Total mining	$1.65	Rent and insurance	0.05
Ore treatment:			
Rock-crushing	$0.05	Total general	$0.18
Ore transport	0.03	Bullion realization	0.02
Ball-milling	0.60		
Roasting	0.60	Grand total	$4.92
Grinding-pans	0.22		

Development totaled 5036 ft. The mill treated 124,670 tons of ore averaging $5.30 per ton. A dividend of $29,700 was paid.

Lead and Zinc Smelting in Australia

At meetings of the Broken Hill Proprietary and Broken Hill South Silver Mining Co. in Melbourne, Australia, on February 26, official statements were made that "a basis has been found for the purchase and future operations of the Port Pirie smelting works which is mutually acceptable to the Broken Hill Proprietary Co., Ltd., the Broken Hill South Silver Mining Co., N.L. and the North Broken Hill, Ltd." This basis provides for the future operation of the works on generally co-operative lines, according to the *Mining Standard*. A detailed scheme is at present being prepared, and, until finally accepted by the three companies, will not be binding. The probability is that the scheme will take the form of a new company, the shares of which will be proportionately held by the three companies concerned. It is not improbable, however, that other companies may be allowed to participate and so make it cover the entire smelting interests of the Barrier (Broken Hill). The importance of this step can hardly be overestimated, as, if fully effective, it will eventually enable the whole of the zinc and lead concentrates of that district to be dealt with in Australia, instead of being sent to Europe for treatment.

*Weed, 20th Annual Report, U. S. G. S., Part 3, page 458-459.

Copper Exports From Japan

The influence of the War upon the copper industry is no small matter in Japan, as the exports of copper have been reduced to about one-half the amount before the War. The following statistics show the facts:

Exports of Copper from Yokohama

1914.	Pounds.	1914.	Pounds.
July	2,502,424	November	1,124,125
August	378,637	December	5,069,885
September	316,800		
October	1,274,388	Total	10,666,259

The exports of copper from Yokohama in the first half and second half-year of 1914 were:

1914.	Pounds.
January-June	19,671,154
July-December	10,666,260

Exports of copper in the five months (August to December, 1914) were made to the following places:

	Pounds.
Various Eastern ports	1,252,260
London	1,556,984
New York	1,635,880
Vladivostok	3,830,704
Total	8,275,828

Antimony ores are of common occurrence in New South Wales, and are distributed over widely separated areas. The principal ore is the sulphide, known as antimonite, antimony, glance, or stibnite, and it occurs most generally in lodes with a quartz gangue intersecting paleozoic sedimentary rocks, as well as granite and other igneous rocks. Frequently the most productive lodes are found in sediments near their junction with intrusive granites. The association of gold with antimony ores is a noteworthy feature of some of the state's productive lodes, particularly so at Hillgrove near Armidale. The most important molybdenum ore is molybdenite. An oxide of molydbenum and a molybdenite of lead occur in New South Wales. Molybdenum occurs in this state in certain silicious granites, near their margins, or zones of contact with other rocks. The molybdenite deposits have a peculiar appearance and are to be found in 'pipes' or 'chimneys.'

Costs at the Commonwealth Mine

This property is at Pearce, Arizona, and the following figures cover the period from May 1 to December 31, 1915, when 70,650 tons of ore was mined and treated:

Direct cost:	Per ton.		Per ton
Mining	$0.954	Legal	0.007
Development	0.235	Safety	0.001
Milling	1.879	Mill tests	0.002
Maintenance	0.090	Pumping mine water	0.128
Marketing	0.087		
General expense	0.152		$0.266
	$3.397	Total operating costs	$3.663
Indirect cost:		Shaft-sinking, etc.	0.208
Fire insurance	$0.054	Construction, etc.	0.179
Liability insurance	0.066	Interest	0.265
Taxes	0.005		$0.643
Water	0.003	Total expenditure	$4.306

Mining and development costs were as follows:

Items of cost.	Mining.	Development.
Ore breaking	$0.416	$0.149
Tramming and shoveling	0.217	0.038
Timbering	0.101	0.004
Hoisting and dumping	0.090	0.015
Foremen and bosses	0.033	0.008
Assaying and sampling	0.044	0.001
Tool sharpening	0.022	0.007
Mine machines	0.014	0.005
Surveying	0.007	0.008
General expense	0.010	....
Total	$0.954	$0.235

Of the total of $67,433 for mining, labor cost $49,416; supplies, $14,282; electric-power, $1257; and steam-power, $2478. And of the development total of $16,621, the charges were $11,473, $4037, $168, and $943 respectively.

Treatment costs were as under:

	Per ton.		Per ton.
Crushing and conveying	$0.079	Precipitation	$0.116
Elevating and separating	0.060	Agitating	0.296
Sampling	0.021	Refining	0.043
Stamping	0.231	Pumping solution	0.051
Re-grinding (Hardinge)	0.311	Mechanical department	0.049
Re-grinding (tubes)	0.339	Water	0.012
Settling	0.118	Assaying	0.013
Filtering and discharging	0.113	Superintendence	0.027
		Total	$1.879

The total expenditure in the mill was $132,726, of which $28,300 was for labor, $50,195 for supplies, $48,001 for electric-power, and $6229 for steam-power.

Oil Refineries at Kurokawa, Akita-ken

A large flow of oil in Kurokawa village, Akita-ken, last year led the Nippon Petroleum Co. to build a new refinery there. After much investigation the company decided to build a refinery with modern machinery of Russian make. The company has sent an engineer to Petrograd, who will return to Japan in April with the required plant and a Russian engineer, who will supervise the erection. Meantime the Hoden Petroleum Co. is putting up a new refinery of nearly the same size with machinery of the American continuous type. The Nippon Petroleum Co. expects to secure better results in refining with Russian machinery because the oil from Kurokawa much resembles that found in Russia. Which of the new refineries will give better results will be known after they have been put into operation. In any case the oil-refining capacity of Japan will be greatly increased.

Experiments on Copper Ores by the Phelps-Dodge Companies

The annual reports of Phelps, Dodge & Co.'s subsidiary companies contain the following notes on experimental work done to improve the recovery of metals:

Copper Queen, Arizona.—The development of several million tons of concentrating ore in the Sacramento hill imposes on the Company the necessity of erecting a concentrator. In order to solve subordinate problems a small test mill, with a capacity of 90 tons per day, was constructed. The best results were obtained by combined hydraulic and flotation methods, flotation increasing the mechanical recovery by about 12%, and raising the total saving to 87%. In addition to this mill for determining exclusively the best methods for handling certain of the Copper Queen ore of special composition, a series of exhaustive experiments have been under way for several years in the Company's laboratories and in a plant on a working scale, having in view the recovery, by hydraulic extraction and electrolytic precipitation, of the large losses in fine slimes, wherever the Company has had to resort to concentration. The results are not yet sufficiently conclusive to act on.

Moctezuma, Sonora.—At the concentrating mill the principal addition has been a flume to carry the slimes to a large natural reservoir on the opposite side of the Nacozari river, where they will be preserved for subsequent treatment, experiments in this direction are still being conducted at Douglas. In the meanwhile some experiments on the spot have been made in the direction of economies in the mill, and others looking to radical reforms in the direction of flotation. These unfortunately have not as yet been attended with much promise.

Burro Mountain, New Mexico.—As a preliminary to the active construction of the new mill a systematic series of experiments on mechanical concentration and flotation were made to determine the methods and machinery best suited to the Burro ores. While engaged in making these tests the erection of the mill was suspended, but the experiments have proved sufficiently encouraging to justify the resumption of the construction of a mill with a capacity of 1000 tons per day. The tables of results of the experimental mill show a gradual improvement in extraction from 53.90% in May to 79.80% in December, largely through modifications in the mechanical appliances and practice.

Costs at the Porcupine-Crown Mine, Ontario

In 1914 this property, worked down to 500 ft., produced $691,324 from 40,857 tons of ore at the following cost:

COSTS PER TON MILLED.

Mining, development, etc.	$3.20	General mine expense	$1.12
Tramming and hoisting	0.39	Depreciation, taxes, office	0.76
Treatment	1.31		
Power, maintenance, heat	1.51	Total	$8.29

Alternating Current in Electrolysis

*1. When an alternating current of high frequency, about 30,000 per minute, passes through a cell consisting of two platinum electrodes dipped in any electrolyte, the electrode potentials change, thus indicating that some chemical action at the electrode surface takes place in that short amount of time.

2. When an alternating current passes through a reversible voltaic cell, there is no change in the electrode potential. If, however, one of the electrodes consists of a metal covered with its insoluble salts, the alternating current has pronounced effect on that electrode.

3. A greater amount of current could be supplied by a cell with one reversible and another irreversible electrode, when an alternating current plays in the circuit.

4. In cells like Cd–$ZnCl_2$–Hg, and Cd–$ZnCl_2$–Pt, the e.m.f. of the Hg or Pt electrode approaches the value of the zinc electrode on the passage of the alternating current.

5. In perfectly reversible electrolytic cells the alternating current has no action when impressed on the cell along with a direct current.

6. But if the electrolytic cell be irreversible, the alternating current greatly increases the current strength through the circuit.

7. This increase in current strength is due to the diminution in the back electro-motive force of polarization.

8. This diminution in the discharge potential is also observed in electrolytic cells consisting of two cathodes and two anodes, the alternating current playing between the anodes or the cathodes, but not passing through the whole circuit.

*Summary of a paper by J. C. Ghosh in Jour. Amer. Chem. Soc.

Changing Compressor Into Steam-Engine

Power has been deficient at Porcupine and Cobalt, Ontario, for some time, and several mines are working at reduced capacity. At the Hollinger, the compressor plant consists of three machines, each having a capacity of 4500 cu. ft. free air per min. They are driven direct by 11,500-volt synchronous motors. One compressor is a Fraser & Chalmers with Hoerbiger valves, and auxiliary volumetric control-valves. The other two machines are from Nordberg, compound with full Corliss valves.

To help the power situation two air-compressors and motors were converted into steam-engines and generators. This arrangement may be explained as follows: When current is impressed on the motors of the Nordberg machines they rotate and drive the machines as compressors. When steam is admitted to the cylinders, the erstwhile compressors reverse their direction of rotation, and become steam-engines driving their motors as generators. The operation is about as simple as the above description. Some adjustment of the eccentrics is necessary, in order to secure proper lap and lead of the valves for maximum steam economy. The plant has been designed for such an emergency, sufficient boiler-capacity having been installed to operate the two Nordberg machines as engines.

Under normal conditions the mine and mill are operated by hydro-electric power, but sometimes in February and March there is a shortage of water which makes recourse to steam-power necessary.

Supplies Used at the Goldfield Consolidated Mill

In 1914 this plant treated 332,750 tons of ore, consuming the following supplies:

Item.	Price per unit.	Quantity per ton, pounds.	Cost per ton.
Cyanide	$0.17105	1.87	$0.321
Zinc-dust	0.08417	0.46	0.039
Lime	0.00733	14.79	0.109
Lead acetate	0.09161	0.84	0.077
Muriatic acid	0.04891	0.21	0.010
Water	0.2238	*230.92	0.052
Belting	.....	....	0.015
Lubrication	.....	....	0.007
Borax	0.1205	0.06	0.007
Litharge	0.07499	0.13	0.010
Pig lead	0.0637	0.05	0.003
Shoes and dies	0.04904	0.48	0.024
Pebbles	0.01653	5.29	0.088
Tube-mill linings	0.0568	0.27	0.015
Chilean steel	0.06057	0.40	0.024
Machinery and repairs	.....	....	0.012
Screens	.....	....	0.005
Office supplies	.....	....	0.002
Filter cloth	.....	....	0.007
Iron and steel	.....	....	0.006
Assaying	.....	....	0.018
Hose and fittings	.....	....	0.001
Pipe and fittings	.....	....	0.002
Lumber	.....	....	0.003
Crusher parts	.....	....	0.007
Coal	15.46	0.39	0.003
Coke	0.00726	0.49	0.004
Slag	0.00751	0.16	0.001
Pump parts	.....	....	0.004
Waste	0.1175	0.02	0.002
Electrical operation and repair	.....	....	0.014
General stores	.....	....	0.015
Fuel oil	1.64	†0.001	0.002
Total	.....	....	$0.909

*Gallons. †Barrels.

CONCENTRATES

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Silver produced by the Nipissing mine, Cobalt, Ontario, amounted to 36,585,280 oz. to the end of 1914.

Cost of stoping at Mt. Lyell, Tasmania, is $1.34 per ton. This includes all charges on ore delivered to bins at the incline hoist.

Magnetite anodes are advantageous because the magnetite is unaffected by oxygen, chlorine, or SO_4 ions in electro-chemical operations.

Mining and development at the Anaconda properties in 1914 cost $4.06 per ton treated. Transportation to the smelters cost 27c. per ton.

Malapai, a term often used in the Southwest to designate lava flows, is a corruption from the Spanish *malpais*, or bad lands, from *mal*, bad, and *pais*, country.

Erection of stamp-mills over mine-workings is undesirable. At the Simmer & Jack, on the Rand, the vibration of the 320 stamps can be felt on the hanging wall 300 ft. below the surface.

Cost of producing lead by the Bunker Hill & Sullivan company in 1914 was 1.5c. per pound at the mill and 1.91c. at the smelter, a total of 3.41c. The average price received was 3.862 cents.

In the Pearce method of tin assay the ore is fused with caustic soda or potash, in an iron or nickel crucible, and the solidified melt dissolved in water to which an excess of hydrochloric acid is afterward added.

Ore at the Copper Mountain mine of the British Columbia Copper Co., 130 miles west of Greenwood, consists of a mineralized grano-diorite that has been intruded by an intricate system of quartz-porphyry dikes.

Recovery of copper at the Washoe concentrating plant of the Anaconda company is 78%. Flotation is expected to increase the saving to 90%. Unprofitable ore in the mines will be made to yield profit thereby.

Fully 20% of the consumption of metals is met by recovery from scrap. In 1913 such secondary copper amounted to 136,500 tons and the secondary lead to 72,834 tons, in the United States.

World's production of vessels in 1914 amounted to 3153 of all kinds. These had a tonnage of 3,471,937, and horse-power of 2,986,819. The previous year's figures were 3890, 3,984,556, and 3,822,499, respectively.

Ozokerite is a mineral wax found in the vicinity of deposits of bitumen and petroleum, especially in Galicia and Utah. It is used for making shoe-blacking, artificial bees-wax, candles, ointment, insulating material, and phonograph records.

Gasoline production from natural gas in commercial quantities commenced in Pennsylvania in 1905. The output from this source in the United States in 1913 amounted to 24,060,817 gal., valued at $2,458,443. Gas totaling 9,899,441,500 cu. ft. was used in manufacture.

In the Horwood modification of the flotation process, the slime containing galena and zinc-blende is given a roast sufficient to produce a film of lead sulphate on the galena, leaving the blende unaffected, the consequence being that this blende can be floated, leaving the deadened galena behind.

Mineralogical analyses of sand should include the following investigation: igneous rocks, shale, quartz (including chert and quartzite), dolomite (including calcareous sediments), feldspar, and heavy minerals. Often the sand which passes 100-mesh, when less than 1.5% of the total, is not examined.

Panama Canal revenues from July 1, 1914, to March 1, 1915, amounted to $2,334,515. Operation and maintenance cost $2,595,613. The loss on operation was $261,098. These figures need the following explanation: Operation and maintenance proper are summarized under the following heads: admeasurement of vessels, local inspection, aids to navigation, pilotage, damage to vessels, maintenance of transportation tracks, Gatun locks,

Gatun spillway, Gatun dam, Pedro Miguel lock, Pedro Miguel dam, Miraflores locks, Miraflores east dam and spillway, Miraflores west dam, dredging, and maintenance of Gatun lake, Gatun-Mindi levee, and Naos Island breakwater. The total cost of the work in Culebra cut (now Gaillard cut), attributed to operation and maintenance, is $1,012,695. This includes the work north of Gold Hill, where the channel was once opened, but not the work at Cucaracha slide, which has been considered construction work, as the channel was not clear on July 1, 1914.

EXTRACTION of gold and silver at the Belmont mill, Tonopah, in 1914-1915 was 95.78 and 91.81%, respectively. The total was 92.99%, or 1.46% lower than in 1913. Several conditions were responsible for this. Chief among these was the more refractory nature of the ore. It contained considerably more sulphides of the base metals. As illustrating this with the 1914 ores, averaging 0.2336 oz. gold and 22.3 oz. silver, and with no change in concentrating methods or appliances, about 52.5% more concentrate (by weight) was made than in 1913. The ores then averaged 0.2675 oz. gold and 26.331 oz. silver, according to the mill superintendent, A. H. Jones. The table herewith shows the comparative concentrating results of the two years, and the increase in the refractory content of concentrate made:

	1913.	1914.
Average gold content of ore milled, ounces	0.2675	0.2236
Average silver content of ore milled, ounces	26.331	22.3
Concentrate, tons	794	1211
Percentage by weight	0.463	0.668
Gold per ton, ounces	3.167	2.368
Silver per ton, ounces	611.08	446.05
Iron, per cent	27.0	28.5
Sulphur, per cent	24.4	28.3
Copper, per cent	0.39	0.30
Lead, per cent	1.16	0.9
Zinc	0.8	0.6

In this connection it will be noticed that in 1913 the ratio, by weight, of silver to gold was 101.6:1, while in 1914 it was 95.4:1. In Belmont ores, at least (and aside from the high-grade ores), an increased proportion of gold seems to be indicated with the lower grade and more base ores.

THE FORMATION and distribution of residual iron ores is summarized as follows by C. L. Dake, in a paper to be presented to the September meeting of the A. I. M. E. in San Francisco: (1) Residual soils rich in iron are produced both by weathering and by hydrothermal alteration. (2) Weathering produces important accumulations of iron sediments only from limestones and basic igneous rocks. In other rocks, such concentration is of minor importance. (3) Only temperate and tropical regions of moderate to heavy rainfall yield residual weathering products in abundance. Polar and arid regions are more favorable to mechanical disintegration. (4) Laterites, which by reason of their lower silica content and the nature of the parent rock are richer in iron than ordinary residual clays, are developed only from basic igneous rocks, in tropical regions of heavy rainfall. Such laterites are widespread in the tropics, and represent enormous concentration of residual iron. (5) Hydrothermal decay has, in the Hawaiian islands, produced iron-rich residual soils comparable to laterites. Observation is limited. Little is known of the distribution or importance of this type of residual deposits. (6) Of the above types, hydrothermal decay, normal weathering, and lateritic weathering, the latter is probably of the greatest importance. This is due both to the great abundance and to the higher iron content of the laterites.

IN SUMMARIZING their investigations into the electric smelting of copper ores, Dorsey A. Lyon and Robert M. Keeney, in *Bulletin* 81 of the U. S. Bureau of Mines, conclude that the process is nothing more than the substitution of electric heat for the heat derived from the combustion of carbon. Inasmuch as the carbon which is used either in the reverberatory-furnace or in the blast-furnace plays no important part in the reactions that take place in these furnaces, there is no reason metallurgically why electric heat may not be substituted for the heat derived from the combustion of carbon. In fact, as the authors have attempted to point out, in some cases the reactions would take place to better advantage in the neutral atmosphere of the electric furnace than in the reducing or partly reducing atmosphere of the combustion furnace. Therefore, the practicability of using the electric furnace for the smelting of copper ores would largely depend on the relative cost of coke and electric power. As the use of the electric furnace is not advocated as a competitor of the combustion furnace, but as a substitute for it, in those localities where it is not advisable, because of the high cost of fuel, to use the combustion furnace, there is no apparent reason why the electric furnace may not be developed as a substitute for the combustion furnace where the conditions are such as to warrant its use, especially in the treatment of copper-bearing ores. In this connection it is to be remembered that the development of the electric furnace in the iron industry for the reduction of iron from its ores was due to necessity. As a matter of fact the field for the electric furnace in the reduction of iron from its ores is a limited one. Perhaps the same is true as regards the possible application of the electric furnace to the treatment of copper ores; but, judging from the comparative costs, which would be about equal, it would seem that the possibilities of the electric furnace for the treatment of copper ores are greater than those for the treatment of iron ores, because there is not so great a difference between the cost of coke and of electric power in copper-mining districts as there is in iron-smelting centres. Also the cost of electric power is constantly becoming less, through improvements in gas engines and steam turbines, so that in districts where water-power is not plentiful but cheap fuels unsuited to coke making are available, it may be found more advantageous to use electric heat than the heat derived from the combustion of coke.

Missouri Minerals at the Exposition

When the mineral production of Missouri is mentioned, one naturally thinks of lead and zinc. This state leads all others in the output of these metals. In 1914, out of 534,982 tons of lead from domestic ore, 194,275 tons was supplied by Missouri. In the case of spelter the contribution was 114,019 tons out of 343,418 tons for last year. In 1913 the total value of minerals in Missouri was $54,001,088. Of this, lead was $15,498,208; zinc, $13,995,856; coal, $7,468,308; clay products, $6,602,076; cement, $4,556,822; and stone, $2,538,699.

In the Palace of Mines and Metallurgy at the Exposition, minerals produced in Missouri are well displayed. A fitting facade to the booth is one which at one side is represented a lead-mine face, at the other a zinc-mine face, a railing of pigs of lead and spelter, a cornice of finished spelter above all, and a main entrance of dressed limestone from the Carthage quarries.

On entering the booth the first exhibit is a model of the well-known Oronogo Circle zinc-lead mine near Joplin. The scale is 1 in. to 15 ft. It was constructed by Messrs. Ruhl and Shanklin. Otto Ruhl is in charge of the mineral booth. The model represents 22 acres. Two levels are shown, 160 and 230 ft. The former has a 60-ft. face. Ore in pillars is worth $1,000,000. Ore is carried from drift-headings and stopes to shaft bottoms by endless rope-haulage. From the shafts gasoline motor trains haul the ore to the 1000-ton mill. An average of 4% zinc ore is treated in this plant. It is planned to work the property by steam-shovels. From 15 to 45 ft. of overburden will have to be moved. About $1 per ton covers mining and milling charges. This is about the average cost for the southwest zinc region.

A case of 60 to 64% ores contains highly interesting specimens. These are sphalerite from the Baltimore mine, Coahuilla at Duenweg, Oronogo Circle at Oronogo, Waneta Pearl at Joplin, Otis at Joplin, and Napoleon at Joplin. Ruhl and Shanklin exhibit pseudomorph sphalerite after calcite crystals.

Another case contains calcites and dolomites. The former show twining. There are also rice-grained dolomites and breccias. 'Mineral eggs' or nodules of chert are found in limestone in small groups, sometimes in ore. Several samples of these are shown. A fine collection of calcite crystals is in the same case. From mine La Motte, in the southeast, is on view a complex sulphide ore containing nickel, cobalt, lead, and copper. This is a noted mine. Glass tubes containing borings from drill-holes at Belleville, Neck City, Wentworth, Chitwood, Prosperity, and Duenweg are of interest.

Mineralogists will find much to study in the case of sphalerite coated with crystals of chalcopyrite, barite, calcite, silica (rare), marcasite, cadmium, chalcopyrite and barite, and casts of marcasite showing leaching. Calamine, silicate of zinc, is a regular product of the district. Specimens of this ore are shown, including large slabs from the Granby property, pseudomorphs (zinc carbonate after calcite), ore in transition from sphalerite to the oxide form, and calamine coated with zinc carbonate.

The next case shows the deposition of ores in the zinc region. Included are the following: zinc ore from the 'free-ore' or 'soft-ground,' 'spar ground,' 'disseminated,' 'shale,' 'watercourse,' and 'sheet-ground' types of deposits. The last named yields 60% of the ore from the districts. Calamine from the disseminated deposits of Duenweg is hard and is troublesome in the mills.

The large double terminated scaleno-hedron calcite crystals, amythist colored calcite crystals, and calcite crystals with barite crystals on their surfaces are of great interest.

A large number of photographs illustrate the character of all stages of development and production of the southwestern Missouri region, such as prospecting by horse, Keystone, and churn-drills, hoisting by windlass, whim, and steam plants, underground work with timbering, pillars, drifts, and ore transport, power-plants, crushing, concentration, and large heaps of concentrate. One picture is of interest. It shows the only shipment of ore to Europe. This came from the Joe Louis mine at Webb City in 1898. The State Geological Survey exhibits drill records of deep wells in the state. The deepest is down to 2700 feet.

Ore treatment in the zinc district is simple. This is well shown by a working model of a Joplin mill. It has a capacity of 25 tons in 8 hours. The process is as follows: Ore is broken in a Carterville crusher, and further reduced by slow-speed rolls. The product is elevated to a ⅜-in. trommel, undersize to rougher jig, oversize to return rolls to be crushed and sized again. The rougher jig has four 14 by 22-in. cells and a dewatering box. Concentrate from the jig goes to an elevator, which feeds a cleaner jig. The latter jig consists of five 12 by 20-in. cells and a dewatering box. Tailing is dewatered, screened, and the fines further concentrated. Tailing or 'chats' from the zinc mills are used for many purposes. When mixed with cement a fine artificial stone is produced. The Joplin railway station and a large department store are among the many buildings made from this material. Such a plant uses about 30 hp. Treatment charges are from 10 to 25c. per ton.

Concentrate is shipped to the Matthiessen & Hegeler Zinc, Grasselli Chemical, Edgar Zinc, American Zinc Lead & Smelting, Illinois Zinc, Granby Mining & Smelting, and Hegeler Bros. companies smelters in Oklahoma, Illinois, and Kansas. Most of the concentrate goes to Illinois plants. Most of the smelters mentioned were described in the *Press* during 1914. Each firm exhibits slabs of zinc. A stand holds pig zinc, rolled plates, and rolled sheets. A case contains the following zinc products; nails for roofs, greenhouse points, shoe nails, plate-glass points, fruit-jar lids, wet and dry-cell batteries, and washboards for domestic purposes. Ore treated in the southwest in 1914 amounted to 6,774,000 tons.

The exhibit of lead ores and products is also a valuable one. The largest ore deposits are in the southeast at Flat River. They are known as the disseminated type. A pyramid of ore weighing two tons is displayed by the Federal Lead, Doe Run Lead, St. Louis Smelting & Refining, and Des Loges companies. Lead ore also occurs in the southwest in limestone, spar, disseminated, and sheet ground. Galena crystals shown are highly interesting. One case contains large ones with smaller ones on their faces. Another has crystals from the American Davey mine, Webb City. Galena with blende from F. C. Wallower mine, galena coated marcasite from the Sitting Bull; interwined crystals from Flynn & Co., Central City, galena coated with carbonate from the Delta, Spring City; and partly leached crystals, the marcasite gone showing the action of acid waters.

Missouri galena is considered the best for wireless telegraphy. Ore treated in the southeast in 1914 amounted to 4,718,300 tons.

The Picher Lead Co. exhibits four tons of 99.99% lead in pigs, also sublimed lead products of various colors for paint and glass manufacture.

Other mineral exhibits are as follows: Coal, sections of 42 to 60-in. veins, reserves in Missouri are estimated at 79,000,000,000 tons; clay products such as building and sewer tile, glazed and unglazed brick, fireclay for furnaces and chemical works, firebrick and terra-cotta (a large U. S. flag is made of this colored material); iron ore, pig iron, and products; tripoli; and barytes. The last is interesting from the fact that it is mined by farmers.

The total tonnage of lead, zinc, and copper ores mined in Missouri in 1914 was 11,492,300. With a few exceptions, the zinc ore is produced by small syndicates and companies; on the other hand, lead ore is mined by large well-known companies. The difference is most striking.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

CRIPPLE CREEK, COLORADO

Mill Competition.—Blue Bird Mine.—'Split-Check' System. Lessees on Ingham Vein.—District Outlook.

As predicted in my letter of May 15, a merry war is about to begin among operators of mills, ancient and modern, which treat Cripple Creek ores. The most recent news comes in the form of a circular to the bondholders of the United States Reduction & Refining Co. It is as follows:

"The newspapers have announced the formation of a so-called protective committee for the bondholders of the U. S. R. & R. Co., and it is therefore to be assumed that you will shortly receive the customary notice from this committee requesting you to deposit your bonds. The present management of the Reduction company is of the opinion that you should, for the present, be very cautious before identifying your interests with the committee. At the last annual meeting of the stockholders, held April 23, 1915, an entirely new management was elected as a consequence of proxies solicited by Byrne and McDonnell. The gentlemen who controlled the old management, in anticipation of failure to re-elect their candidates, caused a receiver to be appointed for the company the day before the meeting, at the instance of the trustee for the bondholders. The bondholders' committee just announced is formed in sympathy with the same bondholders who secured the appointment of a receiver when it became apparent that they were about to lose control of the company through action of the stockholders. The newly elected president of the Reduction company, Robert E. McDonnell, is now in Colorado with his counsel investigating the local situation. It appears from the papers in the receivership suit that the property of the Reduction company has been rendered of little value by reason of the acts of the old management whereby the Reduction company agreed with a competing company not to engage in the business, and thereby permitted the competing company to secure for itself the business of the Reduction company. It is the intention of the newly elected officers of the Reduction company to thoroughly investigate the affairs of the company, with particular reference to the relations of the gentlemen in control of the Reduction company with this competing company. For the present we desire to suggest to the bondholders that they should not give their adherence to any committee until the investigation now being conducted by the new management is concluded and its results announced." This is signed by the secretary, R. Mason Kirkland.

Mr. McDonnell, the new president, was a visitor to Cripple Creek on May 8 and 9.

The Franklin Leasing Co., operating the Blue Bird mine on Bull hill, is greatly elated over a recent discovery which was opened simultaneously on the No. 17, 19, and 21 levels. From the centre of the vein, selected samples have assayed as high as $50 per pound. The vein matter as mined will average about 3 oz. per ton. The company secured its lease on the mine some three months ago. It began shipping almost at once, subletting various blocks in the mine on the 'split-check' basis. This is the local term applied to the system wherein the company provides all supplies and the lessee furnishes the labor only, the company and the lessee then dividing equally the net proceeds from the ore sold. The only feature against the present development is the previous history of the mine. It always was a spotted or pockety mine. It is to be hoped that the new shoot will develop into a persistent vein.

Probably the most profitable lease in the district is that of Starkweather and Wilson, on the Ingham vein of the Doctor Jackpot Mining Co.'s property. It has been returning a net profit of $25,000 per month to the partners. This ore was exposed in the old Anaconda-Raven adit. It had been unnoticed for years, and was opened recently by accident.

In general, the district is fairly quiet. Steady work is the slogan on all sides. The ill effects of the boom at the beginning of the year, influx of men for whom there was no work, and of speculators of various kinds, due to the Cresson development, have been safely passed, and the district resumes the even tenor of its way. Such discoveries as that of the Cresson are wonderful, and highly pleasing to the owners; but the average laborer fails to understand that they do not result in employing a single man more in the particular mine. Seldom do they result in new work being started. We doubt if six more machines are drilling today than there were six months ago, before the famous vug was opened. One amusing thing about the rich ore, however, is the amount of freak advertising that it has given rise to. The local sampling company, which feverishly bought the initial shipment, being stung considerably by the operation, now seeks to draw business its way by issuing facsimiles of the check which it gave in payment, claiming it to be "the most valuable single shipment ever made." Most technical men will recall the shipment from the Mohawk at Goldfield, Nevada, to the Selby smelter in February 1907. It still leads as "the most valuable single shipment," as the following comparison will show:

	Net tons.	Gross value.	Net returns.
Mohawk	48	$591,637	$574,958
Cresson	150	.....	468,637

Of course, to boost your home town, or district, is natural, but this district has had all the boosting it needs, and what it wants now is development along safe and conservative lines.

TORONTO, ONTARIO

Iron and Steel.—Fond du Lac Silver District.—Porcupine Gold Output. Hollinger. McIntyre. Rea. Dome Lake. South Thompson.

The depression that has so long prevailed in the iron and steel industry is giving place to activity, owing to large orders received for munitions of war. The total value represented by these contracts to Canadian firms, according to a statement by the Minister of Militia, amounts approximately to $175,000,000. Plants are working day and night. The value of the daily output is about $500,000. Hitherto this industry has been confined to the Eastern provinces, but the Western manufacturers are now coming in for a share of this profitable business. Contracts for shrapnel are being let to plants at several industrial centres west of Winnipeg. The increased demand for steel has greatly stimulated the iron-mining industry. The Dominion Steel Corporation and the Nova Scotia Steel & Coal Co. have between them about 700 men employed in their iron-ore mines at Wabana, Newfoundland. These forces will be largely increased this month. The mines are to be operated to capacity. In addition to the orders for shells, there is heavy demand for toluol, a by-product of steel manufacture used in making explosives, for which orders to the amount of from $2,000,000 to $3,000,000 have been received. The manufacture has been

already commenced by the Dominion Steel Corporation. A plant is being installed for that purpose in connection with the Algoma Steel Works at Sault Ste Marie.——Business in the ordinary lines is also showing some improvement. The Dominion and Algoma corporations have each received contracts from South Africa for 35,000 tons of steel rails, at a reported price of $29.20 per ton f.o.b.

Glowing reports continue to be published as to the richness of the new silver-mining district at Fond du Lac, at the northeast corner of Lake Athabasca, in Saskatchewan. Numbers of prospectors have gone out there. Sufficient importance has been attached to the accounts of extraordinarily rich finds, corroborated to some extent by samples shown by returning prospectors, to induce the Geological Survey to take action. An authoritative statement as to the value of the field will shortly be available. A party in charge of Charles Camsell will make an examination of the district.

Now that the difficulty arising from power shortage has been, temporarily at least, overcome, production at Porcupine is normal. May 1 was a record day for bullion shipments. The total value amounted to $154,661. The Hollinger contributed $48,000; Dome Mines, $64,500; Porcupine Crown, $30,961; and McIntyre, $11,200.——The Hollinger has 120 stamps dropping. The McIntyre is improving. No. 4 vein on the 600-ft. level is showing a width of 26 ft., assaying $12 per ton. Other levels are also looking better. Some important changes have been made in the directorate. Alexander M. Hay, of Toronto, has been elected president, and Sir Henry M. Pellatt, a prominent Canadian financier, is one of the new directors.——The Rea mine, which has been temporarily closed down, is being financially re-organized, and is taken over by the New Ray company. Diamond-drilling, which has been carried on for some weeks, is reported to have been successful in finding additional orebodies. It will be continued.——The Dome Lake has also been closed down pending financial re-arrangements.——The South Thompson property has been taken over by the Krist-Porcupine, which will now be known as the Krist-Thompson Co.——The Gold Reef has been unwatered. It will be operated with new equipment.

VICTORIA, BRITISH COLUMBIA

MINING SITUATION.—PLACERS, GOLD, COPPER, SILVER-LEAD, ZINC ORES.—FRENCH PROCESS.—COAL *v.* OIL.—ROCHER DÉBOULÉ MINE.—HAZELTON DISTRICT.

Generally mining in British Columbia is not now affected to any considerable extent by the War. Those properties that last year experienced a decided set-back have in a large measure resumed work, or, where production is not normal, other influences now being mainly responsible for lack of progress.

For instance, placer gold mining was continued as usual throughout the whole of the 1914 season. Now that the opening of the current season is at hand, all the larger placer mines that were operating last year are being prepared for this year's hydraulicking or other systems.

In lode gold mining, the chief important mines on the list of producers at this time last year, but not now contributing to the production of this metal, are those of the British Columbia Copper Co., the continued suspension of which is attributable to other causes.

Several lead and silver-lead mines, notably the Bluebell, in Ainsworth division, and the Standard, in Slocan, have not yet resumed production, owing mainly to less favorable terms now obtainable from the smelting company. The last named, if not both the latter, will most likely shortly be again on the shipping list. Zinc-lead ore is being treated at the concentrator of the Silverton Mines, Ltd. It owns the Hewitt-Lorna Doone claims, situated a few miles from Slocan lake. The Rambler-Cariboo and Ivanhoe mills, in Central Slocan, are also turning out a silver-zinc as well as a silver-lead product. Both the Ruth and the Slocan Star concentrating plants, in the same neighborhood, are being prepared for early resumption of milling. Both are equipped for making the two products mentioned. Further, the Standard mill, at Silverton, is having added to its present modern equipment for concentration of silver-lead-zinc ores a small experimental unit, with the object of giving a trial to French's process for separation of zinc and lead. This process, as stated in an official description published in the Annual Report of the Minister of Mines for British Columbia for 1911 "aims at the extraction and recovery of the zinc contained in ores, such as the silver-lead-zinc ores of the Slocan, leaving as a residue the silver-lead, iron, and gangue-matter, which would afterward be smelted in the same manner as a lead-ore free from zinc."

The Granby Consolidated company is now operating its mines and smelting works in the Boundary district to normal capacity, thereby again contributing largely to the production of copper and, in much smaller measure, to that of lode-gold and silver.

In the Kootenay district, the Consolidated company has not yet resumed production of silver-copper ore at its Silver King group, near Nelson.

MAP OF BRITISH COLUMBIA.

On the Coast, production temporarily has been stopped at the Britannia mine as a result of the destruction, on March 22, of its aerial tramway upper terminal and other works at the mine. Preparations for resuming ore production are being energetically carried on. The Granby Consolidated Co.'s comparatively large addition to the output of copper in the Coast district, is however, more than compensating for the present loss in total quantity caused by the enforced suspension of production from the Britannia mine.

As to coal mining, the position is not generally satisfactory. To a considerable extent this is attributable to the substitution of oil for coal as fuel by railway and steamship companies. With the object of reducing the advantages fuel oil has in competition with coal in the Coast and lower mainland districts, the Dominion Government is being urged to place a sufficiently high custom duty on fuel oil as will in large measure protect the coal-mining industry. On the other hand, transportation companies are also making strong representations to the Government, showing that their considerable expenditures in making provisions for the use of oil as fuel must also be taken into serious account.

Another mine has been added to the list of copper producers in the Coast district of British Columbia, namely, the Rocher Déboulé mine. It recently made its first large shipment, consisting of about 450 tons of ore, consigned to the Granby Consolidated company's smelting works at Anyox, Observatory inlet. This property is described at some length by John D. Galloway, assistant mineralogist, in *Bulletin* No. 4, Omineca Mining Division, issued a few weeks ago by the Provincial Department of Mines. It is situated in Juniper basin, at the head of Juniper creek, and is distant 10 miles from Skeena Crossing, a flag station on the Grand Trunk Pacific railway, 10 miles west from New Hazelton. The property comprises six mineral claims on Rocher Déboulé mountain. It is owned by the Rocher Déboulé Mining Co. There are three main veins, in grano-diorite; the highest vein contains copper-iron minerals, the middle and lowest veins galena and zinc. In August 1913 the mine was leased to the Montana Continental Development Co., a Butte, Montana, organization. Under the terms of the lease, this company agreed to equip the mine with machinery, construct aerial and surface tramways necessary for the transport of ore to the railway, and develop the top vein by a cross-cut adit, in return for the right to extract as much ore as possible during a two years' tenure of lease. The lessee company put in on Juniper creek, about five miles above Skeena Crossing, a small hydro-electric power-plant, and constructed a transmission line thence to the mine; installed a 6-drill Canadian Rand compressor; drove a cross-cut adit about 500 ft. to the vein; constructed a surface tramway to the upper terminal of the aerial tramway near the summit of a ridge overlooking Skeena river; and built the aerial tramway, in two sections, nearly four miles down to orebins on a spur from the railway at Carnaby; erected mine buildings; and put in a portable saw-mill driven by a 20-hp. electric motor. The main vein is described as varying from 2 to 12 ft. in width, and includes a fairly regular shoot of from 1 to 4 ft. of ore, samples of which taken by Mr. Galloway ranged up to 1.20 oz. gold and 1.80 oz. silver per ton, and from 9 to 13.8% copper. Other properties on Rocher Déboulé mountain being worked are the Red Rose and the Great Ohio group.

Several silver-lead properties in the neighborhood of Hazelton are preparing to ship ore.——The Silver Standard group, on Glen mountain, four miles east of Old Hazelton, last year shipped to Trail 736 tons of ore that contained approximately 200 oz. of gold, 122,000 oz. of silver, and 282,000 lb. of lead. Production was discontinued when the metal markets were disorganized by the War. Now that the ore can be disposed of, it is intended to resume shipping to the smelter.——The American Boy is on Nine-mile mountain, eight miles from New Hazelton. Last year 48 tons of ore was sent to Trail to determine the value in bulk. There occurs in the group of eight claims a series of parallel veins, in four of which development has been done. Mr. Galloway states that the American Boy, like the Silver Standard, has a considerable quantity of ore that could be handled at a profit if concentrated before shipment. Freight and treatment charges were last season about $23 per ton, exclusive of the cost of hauling down the hill to the railway at New Hazelton, so that under the conditions only high-grade ore could be shipped at a profit. Average assay returns from ore on the main dump from the shaft on No. 3 vein show a value of more than $20 per ton. Such ore may not at present be shipped crude. It should, however, be possible to effect a simple water concentration that would result in a product running from $150 to $200 per ton.——Another prospective shipper is the Silver Cup group of four claims, also situated on Nine-mile mountain, under lease to George and Roy Clothier. Last season they opened a body of good ore. They have already commenced this season's work. Several veins have been found; half a dozen drifts have been run on the main vein at different elevations. A test shipment of 23 tons of selected ore contained about 140 oz. of silver per ton.

FAIRBANKS, ALASKA

Tolovana, Trails, and Prospects.—New Custom Mill at Fairbanks.—Quartz Mines.—Antimony Producer.

By far the most interesting topic at present, April 9, is the new Tolovana district, in which at least two creeks with fair sized pay-streaks have been located. It is 60 miles by winter trail to Livengood creek, the discovery-creek, from Olnes, a station on the Tanana Valley railroad. The best 'pay' so far has been located on Olive creek, a tributary of the Tolovana river. Various estimates place the grade of the ground up to $5 per square foot of bedrock, which is high grade. So far the width of the streak is slightly over 200 ft., although the face of the cross-cut is still in good pay. On Livengood creek, fair pay has been cross-cut for 75 ft., but it is not as rich as that on Olive creek. All the ground is rather shallow, from 20 to 40 ft. deep where the pay has been found. It is easy to work. The winter trail will not last for over a week longer, in fact, most of the trail is bare at present. Only small plants can be taken in that way, 10 hp. being about the limit, there being seven divides between the railroad and Livengood creek. Summer travel will go in on the Tolovana river, as gasoline boats with good-sized scows can make the mouth of Livengood creek after several log-jams are cleared out. These are quite extensive, however, of many years' accumulation, consisting of large timber. As most of the larger jams are on horse-shoe bends, there is a project on foot to open a new channel across the bends by dynamite just before the break-up, the spring freshet being able to clear out a good channel if given a start. It is also possible to get freight in by Mike Hess creek, direct from the Yukon river, there being a water route to the head of Livengood with only a slight divide to freight over. The first deal of any importance in the new area was the purchase of all Jay Livengood's interests by Dave Caseaden for about $40,000. This purchase covers the pay on Olive creek so far as opened. Many men are going in to the new diggings this summer, and many old-timers outside have been wired to get in as soon as possible.

In the Fairbanks district the completion of the Helig custom mill is the latest event of interest. This enables for the first time the many good claims on Fairbanks creek to have ore milled cheaply. One custom mill had been erected previously at the head of the creek, but did not prove a success. It was scrapped. The new mill will treat about 25 tons per day, according to the first runs. It is of substantial construction throughout. Plenty of water is available. Being situated within a few hundred yards of some of the best mines, it should prove a boon to the creek prospectors. The crusher is a Huntington mill. It is well suited to the free-milling ores of the district. A gyratory crusher made by the Straub Mill Co. supplies fine feed to the mill. Mines that have ore ready to be hauled to the mill include the American Eagle, on which Foss & Farvean are the lessees; L. J. McCarty; Stevens, Boyd & Kleinsmidt; Heaton & Bogberg; August Hess; Huddleston & McNeil; Marino, Brankovits & Co.; and others. Over 1000 tons is ready to haul. The reserves in some of the properties are difficult to estimate.

It is reported that Sy Scrafford, who holds an option on the Chatham Mining Co.'s holdings, has a 4000-ton contract with San Francisco people for antimony ore. A large body of 7% ore, free from the other minerals, was cut in the main adit two years ago. This is being developed. The run-of-mine ore is put through the crusher and hand sorted. It is said that there is 200 tons or over ready to ship. Mr. Scrafford also has a crew working on an antimony prospect on Treasure creek. On the surface this shows chances for a large body of good ore, but the extent is not known. The transportation company has given a $9 rate from Fairbanks to San Francisco.

Details of the quartz mine operations will be published in another issue of this journal.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press.

ALASKA

Cordova

On May 4 a total of 1950 tons of copper ore was awaiting shipment to Tacoma on the wharf at Cordova. Fifty tons was from the Mother Lode mine, the remainder from the Bonanza and Jumbo. The ore averaged 67% metal. The total value of the ore was about $500,000.

Fairbanks

It is estimated by the First National Bank that the spring clean-up for the Fairbanks district will be $355,000.

ARIZONA

Gila County

The combined reports of the Old Dominion Copper Mining & Smelting Co., United Globe Mines, and Old Dominion Co. for 1914 have been issued. The last named controls the other two operating companies at Globe. It received $860,410 in dividends from these companies. Including increase in value of Old Dominion Copper shares, the income was $1,415,009. Out of this $1,173,412 was distributed in five dividends totaling $4 per share. The year commenced with a surplus of $191,468, and ended with $433,065. Dividends to date total $5,853,713.

Mining operations at the United Globe property were confined to prospecting, development, and ore extaction on the Old Dominion, Maggie, Josh Billings, Buffalo, and Grey veins. Development totaled 13,864 ft. A total of 155,205 tons of mixed ores was extracted and shipped, averaging 3.57% copper. Of this, 121,812 tons was concentrating ore. The yield in 1913 was 167,920 tons of mixed ores. The ore last year contained 11,086,674 lb. copper, 91,582 oz. silver, and 1580 oz. gold.

Revenue from metals, etc., was $1,095,561. The profit was $432,538. Dividends amounted to $425,500. The year started with a balance of $372,739 and ended with $238,520. Dividends to date amount to $1,955,000.

The Old Dominion Copper company's report states that development totaled 17,783 ft. Some of this work was expensive and unpleasant. The flow of water varied between 3,350,000 and 5,625,000 gal. per 24 hours. The average was 3,754,542 gal. Of the 1,349,210,000 gal. pumped, 729,580,000 gal. was sold to the Miami company. Of the considerable amount of work done, motor haulage was started on No. 12 and other levels. On the former it is 7000 ft. long. The west end orebodies supplied most of the ore. High-grade oxide ore was mined here and sent direct to the smelter. The centre part of the mine produced most of the concentrating ore. Ore extracted totaled 129,813 tons, averaging 7.44% copper. Cost of mining was $5.20 per ton, an increase due to troubles mentioned. The new mill started at the end of October. Flotation has considerably increased extraction. The two plants concentrated 151,893 tons at a cost of 93.2c. per ton. The furnaces reduced 207,595 tons of charge, costing $2.669 per ton of new charge smelted. Including custom ores the yield was 30,210,361 lb. copper, 148,459 oz. silver, and 3309 oz. gold. From the company's output on 17,816,284 lb., 33,311 oz., and 603 oz. respectively, the revenue was $2,473,582. Other revenue made $2,674,206. Net earnings were $978,510. Dividends amounted to $445,500. The year started with a surplus of $1,193,247, and finished with $967,293. Depreciation amounted to $752,878.

Globe men have taken a six-year lease of the Amster copper claims. They are known as the Virgin Lady and adjoin the Old Dominion Keystone on the east.

Pima County

Articles of incorporation for the Tucson, Cornelia & Gila railroad were filed last week at Phoenix. The authorized capital is $3,600,000. Directors are C. A. Briggs, L. D. Ricketts, J. C. Greenway, G. R. Campbell, C. L. Knapp, Joe Curry, T. M. Schumacher, H. J. Simmons, and Walter Douglas. Work will begin as soon as possible. One-half of the survey is already finished. The first construction will probably be from the junction with the Southern Pacific at Gila Bend to Cornelia, a distance of 45 miles, but this has not been fully decided.

ARKANSAS

The value of the mine output of lead and zinc in Arkansas for the year 1914 was $65,214, against $55,120 in 1913.

CALIFORNIA

In *Bulletin* 594 of the U. S. Geological Survey, James M. Hill discusses some mining districts in northeastern California and northwestern Nevada. With maps, illustrations, and index, the work covers 200 pages. There were three districts in California examined, and sixteen in Nevada in 1913, in Lassen and Modoc, and Mineral, Douglas, Washoe, and Lander counties respectively. As will be seen by the map, these places are widely scattered. In the region covered, sedimentary rocks ranging in age from Paleozoic to Mesozoic were noted. In nearly each district they have been intruded by granitoid rocks, of a generally remarkably constant mineralogic composition. Lava flows cover a considerable part, particularly along the western border of Nevada, and northeast California. In a few places are accumulations of partly consolidated gravels, especially in northwest Mineral county and along

REGION DESCRIBED IN REPORT. NUMBERS REFER TO TYPES OF ORE DEPOSITS SUMMARIZED.

Truckee river near Reno. In a tabulated summary of the ore deposits of the area described in the report, the following show the chief characteristics:

Hayden Hill, Lassen county, gold in fine-grained porcelain-like white quartz-adularia veins, and open brecciated veins. Winters, Modoc county, gold in calcite and quartz adularia (silicate of aluminum and potassium) veins. High Grade, Modoc county, gold in brecciated country rock cemented by quartz and adularia, pyrite in glassy rhyolite. Gardnerville, Douglas county, gold and pyrite, and copper in quartz veinlets and in replacements in crushed altered andesite. Red Cañon, Douglas county, silver-lead, copper, and gold-silver in veins in sediments, contact-metamorphic deposits, and veins in quartz-monzonite. Wellington, Douglas county, gold-silver in veins in quartz-monzonite. Battle Mountain, Lander county, silver-lead, antimony, and gold-silver in veins in sediments, copper in contact-metamorphic deposits; gold in veins in andesite, also local placers. Skookum, Lander county, silver-lead in veins in dark silicious shales. Rees River, Lander county, silver-lead in veins in shales and quartzite, and in quartz-monzonite. Washington, Lander county, silver-lead and antimony in veins in shales; gold and copper in replacements in silicified limestone. Kingston, Lander county, silver-lead and gold-silver in veins in sediments and in quartz-monzonite. Granite, Mineral county, copper in veins in grano-diorite. Pine Grove, Mineral county, gold-silver in veins cutting into andesite. Aurora, Mineral county, gold-silver in fine-grained porcelain-like white quartz veins. Hawthorne, Mineral county, silver-lead and gold-silver in veins in sediments and intrusive; copper in contact-metamorphic deposits. Santa Fe, Mineral county, copper in contact-metamorphic and associated replacements in limestone; silver-lead in veins in sediments; gold-silver in veins in quartz-monzonite. Silver Star, Mineral county, gold-silver in fine-grained white quartz veins in sediments; gold-silver and silver-lead in quartz veins in sediments. Cottonwood, Washoe county, silver-lead and gold in veins in slate, quartz-monzonite, and volcanic rocks (these are not definite); Peavine, Washoe county, copper and gold-silver in veins in sediments and intrusives; gold-silver in veins in andesite.

Metal production of the districts is as follows: Hayden Hill, $1,684,774; Winters, about $1000 to $1500 per month during the past two years; Gardnerville and Red Canyon, $29,165; Battle Mountain, $276,843; Reese River, approximately $50,000,000 (in 1911 it was $77,199); Pine Grove, $163,741; Aurora, estimated at $27,000,000; Santa Fe, $163,570; Silver Star, over $400,000; and Peavine, about $25,000.

This report is interesting. Individual properties and the possibilities of the areas are discussed.

Amador County

The Plymouth Consolidated reports as follows for April: ore treated, 10,550 tons; gold yield, $55,860; operating expenses, $21,855; development, $9392; and surplus, $24,613.

Calaveras County

On No. 4, 5, and 7 levels of the Calaveras copper mine the faces average 3%. Streaks assay 15%. The sorting belt is working well. A flotation process will be in operation in a few days. Prospects generally are considered bright.

Inyo County

The 10-stamp mill at the Casa Diablo is nearly complete. A Fairbanks-Morse gasoline engine will drive the plant. The mine is expected to produce $40 ore.——The Bishop Creek mill was started on May 20. Some good ore has been opened on No. 2 level.

Nevada County

Fifteen inches of $107 ore has been cut in a rise from 800 to 665 ft. in the Union Hill mine. Generally development is encouraging.

Placer County

In *The Placer Herald* for May 15, T. F. Haney describes the Last Chance mining district. Owners and lessees are doing a fair amount of work in the Pacific Slab, Rublin, El Dorado, Home Ticket, Brooklyn and Olympia, Belle Verne, Dixie Queen, Pinenut, Blue Eyes, Big Bar, Haney Consolidated, Glenn, and Harmeson and McKinley. Some of these are gravel mines.

Shasta County

(Special Correspondence.)—San Francisco people are negotiating for the Greenhorn copper property, near Tower House. An examination is being made. A small amount of work has exposed high-grade copper ore. Some assaying 13% has been extracted. Operations will be in charge of M. E. Dittmar.

The Mammoth Copper Co. is actively developing the Spread Eagle and Friday-Lowden copper claims, which were acquired last year. The new ore-separating plant near the Mammoth mine is in operation, and large quantities of high-grade zinc ore are being shipped to Oklahoma smelters. It is reported that a fourth furnace will be blown in at the Kennett smelter at an early date. This leaves No. 5 in reserve. The bag-house has been enlarged sufficiently to handle fume from four fur-

The Field Process Co. is preparing to enlarge its plant at Redding. Chambers for chemical treatment of SO_2 gases escaping the refrigerating apparatus will be installed. An attempt will be made to manufacture commercial by-products from smelter fume.

The Lane mill recently installed at the Midas mine is giving excellent results. It is understood that additional units may be installed this summer. Development is proceeding vigorously in the Midas and Gold Hill mines. The company plans to replace the old steam power-plant with an electrical system. The mines are located at Harrison Gulch, with C. A. Jackson manager.

H. F. Musser has started men working in the American mine, in the French Gulch district. A large tonnage of mill ore is exposed.

Gold mining is active near Stella, with Gambrinus, Bright Star, Mad Ox, and other properties in operation. On the 500-ft. level of the Gambrinus a vein averaging three feet wide has been developed, averaging $15 per ton. Five stamps are dropping. H. W. Rogers is manager. Activities at the Mad Ox are largely centred on the 600-ft. level, where the vein has been opened to the deepest working point. Sinking probably will be resumed soon. Oakland people are interested. W. H. McEwen is manager.

The Shasta Dredging Co. is building a new townsite near Gas Point, known as Smith's Center. Removal of the dredge from Horsetown to the new camp is proceeding.

Redding, May 10.

The Greenhorn mine in the western part of this county has been leased by Warren Bros. to M. E. Dittmar of Redding. Ore shipments in July last averaged 20% copper.

COLORADO

Boulder County

Buyers of tungsten ore at Boulder have advanced their quotations again; $8 per unit for 60% concentrate is now offered, against $5.80 before the War.

Gilpin County

Mills at Black Hawk are crowded with ore, while large quantities are waiting at the mines.——Shipments of ore from the Gilpin-Orion mine on Bobtail hill have returned up to 3.92 oz. gold, 7.6 oz. silver, and 2.8% copper.

Lake County (Leadville)

Ten burros have been purchased by the manager of the Lackawanna Belle, F. De Haven, to carry ore from this property in the Lackawanna district, for shipment to the smelter. Some rich gold ore has recently been opened.——The St. Louis is shipping about 75 tons of $30 oxide and sulphide ores per month.——Sixteen roasting furnaces are working at the zinc

smelter. The plant is working well. Another car of zinc oxide was shipped last week.

OURAY COUNTY

A 50-ton plant is to be installed by the Gold Crown Mining & Reduction Co. in the Foerster mill building near Ouray. Two crushers, rolls, tables, and flotation apparatus are being ordered. The company's mine is developing well. Ore worth $10 to $12 per ton is being opened. J. R. Roots is manager.

SAN JUAN COUNTY

Sixty-three cars of concentrate was shipped from Silverton during April. ——The Intersection 10-stamp mill has started for the season.——Lessees at the Ledge mine have a large tonnage ready for the mill on that property.——Machinery has arrived for the Kittimac mill.——Work has been resumed at the Champion and Old Green Mountain mines.——The Wilfley plant, which treats tailing from the Silver Lake mill, is to be started by A. R. Wilfley. Multiple-deck tables are installed. ——The Amy and Highland Mary have resumed.

SUMMIT COUNTY

The leasing system is being tried at the King Solomon company's property at Frisco. Lessees are working on the No. 11 vein in the adit, which is 3700 ft. long.

The report of the Tonopah Placers Co., operating at Breckenridge, appears in the annual statement of the Tonopah Mining Co. of Nevada. From 2,995,256 cu. yd. of gravel dredged there was recovered 22,542 oz. gold and 4782 oz. silver. The average value was 15.5c. per yard. The profit was 9.6c. per yard. Gross value of bullion was $467,204. The net profit was $176,677. Adding the previous surplus the total on February 28, 1915 was $269,580. The Tonopah Mining Co. holds 83.3% of the Placers company's shares. There remain 4836 acres to be dredged.

IDAHO

SHOSHONE COUNTY (COEUR D'ALENE)

Trouble over apex rights has arisen between the Pandora and Snowstorm copper companies. The former alleges that the latter has extracted ore from part of its property. The Court is asked for permission to inspect and survey the underground workings of the Snowstorm.—The Gold Hunter mill is reported to be making 90% extraction of minerals in its ore. Flotation is aiding the recovery.——Work is to be resumed at the Idora mine and mill near Wallace.——An Ingersoll-Rand 2500-cu. ft. compressor has been installed in No. 6 adit of the Morning mine.

MICHIGAN

HOUGHTON COUNTY

Amygdaloid ore from the New Arcadia was recently treated at the Franklin mill. From 1870 tons stamped the output of mineral (66% copper) was 59,045 lb. This is equal to about 30.5 lb. per ton. At 900 ft. depth the lode is 16 ft. wide.

McDonald and Cole have secured a contract to diamond-drill 75,000 ft. on the Smith land in the Porcupine-White Pine district. Six drills will be used.

MONTANA

SILVERBOW COUNTY

A large crowd witnessed the safety-first contest at Butte on May 9. The final winners were as follows: One-man event, Leonard mine team, first; Poulin mine team, second. Two-man event, Washoe Reduction Works' team, first; West Colusa mine team, second. Team event, Anaconda mine team, first; High Ore team, second; Washoe team No. 16, third. Highest general average for all of the events, Leonard mine team, 99.25%; Washoe team No. 16, 98.71%; and Anaconda mine team, 98.4 per cent.

The April pay-roll of the Butte district for 12,000 men was about $1,170,000. Miners are receiving $3.75 per day under the present agreement depending on the price of copper.

Furnaces at the East Butte smelter were blown-in on May 11.

NEVADA

CHURCHILL COUNTY

The Nevada Hills company reports as follows for the first quarter of 1915: ore treated, 17,007 tons; yield, $88,335; profit, $3991; net resources, $260,678. Development amounted to 1642 feet.

HUMBOLDT COUNTY

Bullion valued at $32,500, the first from the new mill at Rochester, was sent last week to the Selby smelter. This was from the Big Four, Codd, and Four Jay leases. They are supplying 35 tons daily each.

MINERAL COUNTY

Rich ore has been opened in No. 4 rise in the Lucky Boy at Aurora. This mine was part of the Aurora Consolidated before it was sold last year. A 5000-ft. adit is being driven to drain and prospect the ground.

NYE COUNTY

The Tonopah Extension, Victor, and Merger properties have been consolidated. The first named is to purchase the others and assume their debts. One share of Extension will be paid for seven of Merger, and one for eight and a half of Victor.

During the second week of May, Tonopah mines produced 10,617 tons of ore valued at $217,066.

April returns were as follows:

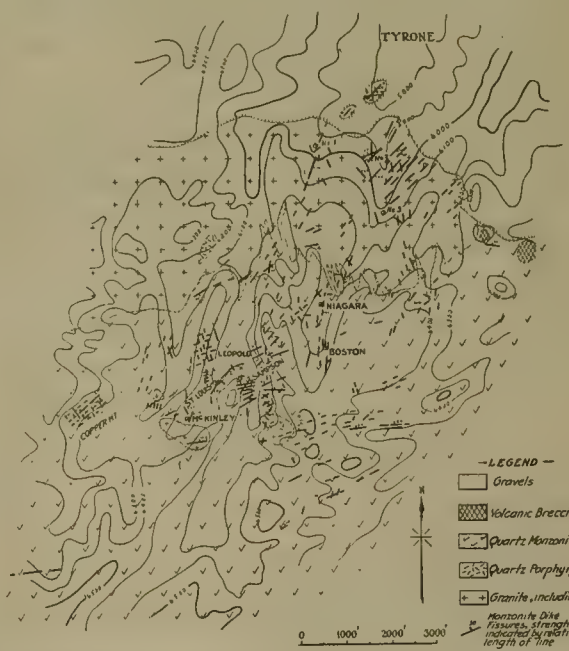
Mine.	Tons.	Ounces bullion.	Profit.
Belmont	14,661	273,201	$90,113
Jim Butler	4,590	.....	43,431
Tonopah Mining	11,925	211,080	63,845

The West End treated last week 783 tons from the West End, 107 from the Halifax, 258 from the Merger, and 52 from the North Star.

NEW MEXICO

GRANT COUNTY

In a 40-page illustrated paper, to be read at the September meeting of the A. I. M. E. at San Francisco, R. E. Somers



GEOLOGICAL MAP OF THE BURRO MOUNTAIN COPPER DISTRICT.

discusses the geology of the Burro Mountain copper district. The elevation of the area is from 6000 to 8054 ft. The climate is arid. Two classes of ore deposits occur, namely,

quartz veins with gold and silver, and copper ores in fracture zones with more or less disseminated replacement of the walls. The former have not been extensively worked. The latter have attracted considerable attention. At Tyrone the Burro Mountain Copper Co. is preparing for the ultimate production of a large tonnage of ore. The accompanying map shows the chief features of the district. In the building of the town of Tyrone, Phelps, Dodge & Co. purpose spending $200,000.

OKLAHOMA

Oklahoma was the only one of the Central states which showed a larger output of both lead and zinc in 1914 than in 1913. The value of the silver, lead, and zinc produced at mines in Oklahoma in 1914, as stated by J. P. Dunlop, of the U. S. Geological Survey, was $2,019,973, compared with $1,855,217 in 1913. The metal content of lead concentrate increased from 6228 tons, valued at $548,064, in 1913, to 7556 tons, and $589,368, in 1914; and the recoverable spelter increased from 11,664 tons, valued at $1,306,368, to 13,992 tons, and $1,427,184.

UTAH

Juab County

Ore shipments from Tintic last week totaled 147 cars.——It is now proposed to erect a large custom plant for the district. The Knight and Dern companies are said to be behind the movement.——The Ridge & Valley Mining Co. plans to resume work on June 1. It owns 351 acres of ground near Eureka. A shaft is down 800 ft. Considerable ore has been extracted. For some years lessees have done the only work in the property.

Salt Lake County

The Kennebec Mining Co., whose property of 400 acres in the Alta-Cottonwood district includes the Reed and Benson mines, is to extend its operations. Work at present is done by a cross-cut adit driven 1000 ft. It is proposed to drive another adit, lower down, to cut the vein at a vertical depth of 1100 feet.

Summit County

Ore shipments from Park City in April totaled 6948 tons. The producers were: Silver King Coalition, 3545; Daly West, 1066; Daly Judge, 1519; Silver King Consolidated, 262; Mines Operating Co., 462; and Charles Moore, 99 tons.

The recent report of the general manager of the Daly-Judge Mining Co., George W. Lambourne, covers the year 1914. The superintendent, O. N. Friendly, states that development amounted to 11,559 ft., excluding work done in ore. On account of the metal markets no ore was produced from August 10 to September 20. The mine is in splendid condition for supplying ore. The output during the year was 5606 tons of shipping ore, while 49,095 tons was concentrated. The former had the following average metal content: silver, 29.65 oz.; gold, 0.027 oz.; lead, 19.29%; copper, 1.51%; zinc, 12.37%; and iron, 7.40%. The mill produced 12,543 tons of concentrate, assaying 24.01 oz. silver, 0.04 oz. gold, 29.19% lead, 0.87% copper, 11.66% zinc, and 18.02% iron. The total metal content was as follows: silver, 519,979 oz.; gold, 723.6 oz.; lead, 9,675,220 lb.; copper, 384,782 lb.; and salable zinc, 3,548,896 pounds.

Ore sales realized $508,802, mining cost $167,731, and concentration $37,488, and all charges $376,618. A dividend totaling $180,000 was paid, the previous surplus being drawn on to the extent of $52,197. The balance on January 1, 1915, amounted to $440,153.

The Snake Creek tunnel was advanced 3751 ft. during the year, according to the engineer, Guy R. McKay, the best month being August, when two machines drove 419 ft. At the beginning of the current year the tunnel was in 10,448 ft., at a depth of 2500 ft. from the surface.

Many improvements were made at the mine. These added greatly in increasing labor efficiency and safety of operations, as well as lowering costs. The progress for all two-man machine headings has practically doubled, notwithstanding the fact that machine-men are now required to do their own timbering. Two-thirds of the distance driven is required to be timbered. In some of the drifts where timbering was unnecessary high records were made. The fast rate of advance has been in a measure due to the adoption of a premium system. This has worked to the mutual advantage of the company and the miners.

One of the most interesting parts of the mill report is that showing results obtained by a flotation process. During the latter half of the year a 40-ton mill was operated. This gave a high recovery of metals. The only difficulty experienced was in making a separation of the concentrate into desirable lead-silver and zinc products. Results have been sufficiently encouraging to justify the installation of a ball-mill for the purpose of making a test-run after regrinding the entire table-feed and jig tail, preparatory to treatment by flotation.

The cost-sheet shows that extraction costs for the 54,701 tons taken out were $3.067. In the mill account the concentration cost of 49,095 tons treated was 76.3c. per ton. The general expense cost against all ore extracted was 44.8c. The operating cost was $4.656. Marketing of the 22,201 tons of ore and concentrate was $1.124.

Utah County

A 5000-ft. adit is to be driven by the Major Evans Consolidated Mines Co. in American Fork cañon. It is already in 400 ft. At 4000 ft. it will be at a vertical depth of 2000 ft. A number of properties can be operated from this adit. It will also serve for transport and drainage.

WASHINGTON

Whatcom County

(Special Correspondence.)—After years of inactivity the Mt. Baker mining district is showing signs of a revival. Share-selling schemes and poor management characterized former work. A number of companies will commence work this season. The Hammond Mining Co., owner of the Great Excelsior mine, has been reorganized with a capital of $500,000. Control is held by Fred J. Wood and Frank Wright, both well known at Seattle. F. C. Hammond is general manager. A cyanide plant costing $150,000 will be complete in about three months. A 20-stamp mill and two re-grinding mills are already erected. The previous company, the Great Excelsior, only saved 39% of the gold in the ore milled, and paid $17 per ton for concentrate shipment to Tacoma. The mine has been well developed by 2500 ft. of adits and considerable stoping. The ore assays from $4 to $20 per ton.—— The Boundary Gold or Lone Jack claims are to be worked by G. H. Thomas and S. Q. Clark of Seattle. Three 12 to 36-in. veins of $15 free-milling ore have been opened. An air-compressor and drills will be installed. Five stamps are ready for crushing.

Bellingham, May 1.

CANADA

British Columbia

After being idle for several months the Standard Silver-Lead company's mill at Silverton is to resume work. Between 175 and 200 men will be employed at the property. Ore sales in 1914 amounted to $712,026. From 14,487 tons milled was produced 4154 tons of concentrate averaging 65.75% lead and 103.31 oz. silver per ton, and 5618 tons of ore assaying 43.84% zinc and 35.23 oz. silver. There was also shipped 4714 tons of crude ore containing 49.17% lead and 86.65 oz. silver per ton. Costs were $4.97 per ton mined. The surplus on December 31, 1914, was $170,000. Dividends were paid in 1914.

Ontario

The report of the Nipissing Mining Co. for 1914 contains the following information: Development totaled 12,148 ft. Prospecting by hydraulicking covered 96 acres. Ore reserves are estimated to be 2824 tons containing 5,034,838 oz. silver and 222,610 tons with 4,982,238 oz., a total of 10,017,076. The

high-grade mill treated 929 tons of Nipissing ore averaging 2439 oz. per ton and 965 tons of 2421-oz. ore from other mines. The low-grade plant treated 79,125 tons, yielding 2,261,924 oz. The refinery shipped 6,300,117 oz. Revenue in 1914 from all sources was $2,558,733. The cost of producing 4,689,333 oz. of metal from 80,037 tons of ore was $11.60 per ton, or 19.8c. per ounce. Net profit was $1,578,715. Dividends amounted to $1,380,000. On January 1, 1914, the surplus was $1,259,061, at the end of 1914 it was $1,602,776. Dividends to date are $13,233,297.

The McIntyre Mines Co. held its annual meeting on May 5. The year ended March 31, 1915, resulted in a loss of $12,000. In April net earnings from the mill were $40,000.——An electric hoist with a capacity of 5000 tons per day from a depth of 1500 ft., is to be installed at the new central shaft of the Hollinger, Acme, and Millerton properties.

Unwatering Cobalt lake is making good headway. It is expected that it will be empty at the end of May. There is a good depth of mud in it, which will take some time to remove. During April the Nipissing high and low-grade mills treated 132 and 5206 tons of ore respectively. The output was valued at $170,577. Adding custom ore the yield was $380,921. Hydraulic prospecting was resumed on April 22. Development at No. 73 shaft was encouraging.

Nickel ore shipped from the Alexo mine from April 7 to May 1 totaled 665 tons.

YUKON

Two of the Canadian Klondyke company's dredges started again on April 17 and April 19, respectively. No. 4 was receiving a further overhaul, but was expected to start by the end of the month. No. 2, which capsized in October last, is not yet ready.

KOREA

The Seoul Mining Co., operating the Suan concession in Whang Hai Province, reports the following results for April:

Total recovery	$78,000
Operating expenses	26,000
Net earnings	$52,000

Construction of the new 400-ton mill at the Tul Mi Chung mine is proceeding satisfactorily. It is expected to commence operating about August 1.

Cable advice from Korea to New York states that the Oriental Consolidated company's output in April was $139,300. In March the mills and plants treated 23,500 tons, yielding $145,365. Extraction at the Taracol plant was 92.3%. At the Maibong tube-mill recovery was 72%. Transport is still delayed by the cattle disease.

MEXICO

EL ORO

A recent telegram from the Esperanza company to London states that No. 3 rise on the Descubridora vein is up 148 ft. above No. 3 level. The last 70 ft. shows 17 in. assaying 1 oz. gold and 24 oz. silver per ton. The mill is not working. The property is intact.

SONORA

Shipments through Agua Prieta to Arizona in April amounted to 26,280 tons. Of this, 25,884 tons was concentrate from the Moctezuma company's plant at Nacozari. El Tigre shipped 132 tons, also 105 bars of bullion weighing 12,160 lb. The total estimated value of the traffic was $3,744,000.

NICARAGUA

An option has been taken on the Tunky Mining Co.'s Potosi mine by the Tonopah Belmont Development Co. of Nevada. The property consists of 265 acres. There are also placer rights along two rivers for 30 miles. Water-power is available. The claims are 20 miles from the Eden mine of the Tonopah Mining Co. Pittsburgh people own the La Luz and Los Angeles nearby. The latter have been highly profitable.

PERSONAL

SPENCER PENROSE is at the Fairmont.

C. S. HALEY is at Bridgeport, Oregon.

FRED S. ELY is at Houghton, Michigan.

GEORGE S. RICE has gone to Los Angeles.

COURTENAY DE KALB is at Nacozari, Sonora.

SPENCER PENROSE is here from Colorado Springs.

GEORGE KISLINGBURY was here from Los Angeles.

HOWLAND BANCROFT is examining mines in Arizona.

COLIN TIMMINS is now at Angels Camp, California.

T. WALTER BEAM, of Denver, is visiting the Exposition.

FRANK R. SHORT has returned to San Francisco from Peru.

COREY C. BRAYTON is leaving San Francisco for Nome, Alaska.

W. H. LANAGAN has returned to California from Eastern Siberia.

H. C. BELLINGER passed through San Francisco on his way to Ely, Nevada.

E. L. WOLCOTT, assistant secretary of the American Mining Congress, is in San Francisco.

A. JOHN SUB is making an exploratory journey through the Athabasca and Peace river country.

J. A. KERNS succeeds P. F. ROGERS as manager of the Hypotheek mine, in the Coeur d'Alene.

W. F. FERRIER has received the honorary degree of Doctor of Science from the University of Alberta.

BRADLEY STOUGHTON has returned to New York, having completed his work on the International Jury of Awards at the Exposition.

ALVIN R. KENNER, superintendent for the Rio Plato Mining Co., attended a director's meeting in New York in April and left early in May for Mexico City.

RUSH J. WHITE has retired from the staff of the Federal Mining & Smelting Co. and is opening an office as consulting mining engineer at Wallace, Idaho.

Obituary

WILLIAM JOLLY, mining captain at the Baltic mine, was instantly killed on April 28 by a fall of loose rock on the 17th level. He had been a miner in the Michigan district for 33 years.

LEONARD ORYNSKI, SR., formerly of San Antonio, Texas, but for the past 15 years interested in the Canoas mines near La Paz, Baja California, Mexico, died at La Pas on April 29, at the age of 70 years, after an illness of four days from ptomaine poisoning. He leaves a widow, three sons, and two daughters. His son, John B. Orynski, who recently joined him in his mining enterprise, will continue the development of the property so long as conditions permit.

Schools and Societies

STANFORD UNIVERSITY held its commencement on May 17. There were 456 degrees conferred on students and graduates.

A phonograph-telephonic lecturer has been devised by the WESTERN ELECTRIC Co. of New York. It is in operation at the Panama Canal at the Exposition, San Francisco. This apparatus should be of service at colleges.

The PAN AMERICAN FINANCIAL CONFERENCE will be held at Washington from May 24 to 29 inclusive. Proceedings are to be opened by the President of the United States. Many important subjects relative to the Americas will be discussed.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, May 20.

Antimony	35 —35¾
Electrolytic copper	19¼—19½
Pig lead	4.45— 5.45
Quicksilver (flask)	$75.00
Spelter	13¾—14
Tin	45 —46½
Zinc-dust, 100-kg. zinc-lined cases	20

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, May 20.—Copper is dull nominally; lead is inactive but firm; spot and nearby spelter is extremely scarce.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
May	13	Apr. 7	15.75
"	14	" 14	16.03
"	15	" 21	16.85
"	16 Sunday	" 28	17.93
"	17	May 5	18 63
"	18	" 12	18.75
"	19	" 19	18.68
	18.75		
	18 75		
	18.75		
	18.75		
	18.62		
	18.50		

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13 60	July	13.26	....
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	....	Nov.	11.75	....
June	13 60	....	Dec.	12.75	....

Exports during the week ended May 1 totaled 15,351,637 lb., valued at $2,504,298. Of this, 8,029,020 lb. went to England, 3,472,633 lb. to Sweden, 2,042,432 lb. to Canada 896,715 lb. to Italy, 700,460 lb. to France, and 193,687 lb. to Brazil.

Anaconda held its annual meeting at Anaconda on May 19. Shares in the company were reduced from 6,000,000 at $25 to 3,000,000 at $50 par value.

Calumet & Hecla is reported to be mining 12,000 tons of ore daily. Michigan output in May is expected to be 26,000,000 pounds.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
May	13	Apr. 7	50.04
"	14	" 14	50.06
"	15	" 21	50.18
"	16 Sunday	" 28	50.60
"	17	May 5	50.33
"	18	" 12	50.06
"	19	" 19	49.93
	50.00		
	50.00		
	50.00		
	50.00		
	19 87		
	19.75		

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	....
Feb.	57.53	48 45	Aug.	54 35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58 52	50.25	Oct.	51.12	....
May	58.21	....	Nov.	49.12	....
June	56.43	....	Dec.	49.27	....

The above quotations need no comment. They show the steady market of the past few weeks. London advice states that the tone is good, due to less arrivals of metal from abroad. Imports from Mexico via New York to England are small. An element of uncertainty is introduced by the fact that over £1,000,000 of silver is held in London on China account. At any opportunity deemed favorable for such an operation, China is prepared to unload a portion of its holding, possibly to be replaced later on. On April 26 silver prices rose, China suddenly offered freely, quotations dropped sharply. Exports from London to the East in four months were £1,877,000, against £2,726,000 in that period of 1914, a decrease of about 8,500,000 ounces.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			Week ending	
Apr.	21	80.00	May 6	70.00
"	28	70.00	" 13	75.00
			" 20	75.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60.00	Aug.	80.00	....
Mch.	39 00	78.00	Sept.	76.25	....
Apr.	38.90	77.50	Oct.	53 00	....
May	39.00	....	Nov.	55.00	....
June	38.60	....	Dec.	53.10	....

Stocks in New York are reported to be low.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
May	13	Apr. 7	4.23
"	14	" 14	4.20
"	15	" 21	4.20
"	16 Sunday	" 28	4 23
"	17	May 5	4.20
"	18	" 12	4.20
"	19	" 19	4.20
	4.20		
	4.20		
	4.20		
	4.20		
	4.20		
	4.20		

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3 80	....
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	....	Nov.	3.68	....
June	3.90	....	Dec.	3.80	....

There is a large demand reported for lead. One inquiry amounted to 10,000 to 15,000 tons.

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
May	13	Apr. 7	8.75
"	14	" 14	9.12
"	15	" 21	9.37
"	16 Sunday	" 28	11.04
"	17	May 5	12.21
"	18	" 12	14.33
"	19	" 19	15.08
	14.25		
	14.50		
	15.00		
	15.25		
	15.50		
	16.00		

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	5.22	9.05	Aug.	4.45	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9 78	Oct.	4.75	....
May	4.91	....	Nov.	5.01	....
June	4.84	....	Dec.	5.40	....

Spelter in London jumped to £70 per ton (15c. per lb.) on May 19. Last week at Joplin ore prices ranged from $63 to $75 per ton.

The report of the Butte & Superior company for the first quarter of 1915 contains the following figures as to zinc production:

Ore treated, tons	117,860
Average zinc content, per cent	17.356
Concentrate produced, pounds	70,634,000
Average zinc content, per cent	52.9246
Metal in concentrate, pounds	37,382,742
Cost per ton of ore	$ 4.8664
Revenue from zinc, lead, and silver, etc.	2,011,511
Profit, estimated	1,163,157

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	....
Feb.	39.76	37.23	Aug.	30.20	....
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	....	Nov.	33.51	....
June	30.72	....	Dec.	33.60	....

On May 19 tin was dull and easy at 36.75 cents.

Eastern Metal Market

New York, May 14.

Copper is quiet. Nominal prices are strong. The domestic demand for lead is light. The market is firmer in the West. Nominal quotations for spot and nearby spelter are a little easier. The scarcity remains the great factor. Tin sold heavily following the sinking of the *Lusitania*. An upward trend in prices was quickly checked. Antimony prices continue to soar as never before. Aluminum is stronger.

COPPER

The week has been uneventful, domestic and foreign demand continuing quiet. There is a feeling that buying, either directly or indirectly for export, will be renewed on a large scale, therefore the market is strong. There is less re-sale metal offered. During the week 18.75 to 18.87½c. cash, New York, has been the range for electrolytic. In London the market for spot and future standard copper advanced over £2 per ton, May 12, but £1 was lost the following day. Electrolytic advanced 10s. to £89, May 12, and was unaffected by the decline in standard. The *Lusitania* incident did not have any great effect on the market. In her cargo were 111,762 lb. of ingot copper, and 260,000 lb. of sheet brass. The latter was valued at $50,000, copper and copper wire, $32,000; copper manufactures, $21,000; and ammunition, $200,000, according to the manifest.

Producers of electrolytic are now getting a larger share of the war business than they received prior to Lake becoming so well sold up. A choice brand of the latter has been sold in large quantity for August delivery at 23c. Good prime brands are obtainable at 21c., and less favored brands at around 20c. A dispatch from Houghton, Michigan, contains the announcement that June 12 the Calumet & Hecla Mining Co. will distribute a bonus of over $500,000 among the 10,000 employees of the Company and its subsidiaries. Last Autumn it passed its dividend, reduced wages 10 to 15% and placed its men on three-quarter time. Since the war demand developed, the men have gone back on full time, and their wages have been restored to the former scale. Some of the high-grade contract miners and foremen will receive about $200 each as their share of the bonus. Bridgeport and vicinity plants, where a great deal of copper is consumed, are not only working night and day, but in many cases factory extensions are being rushed to increase production. It is understood that practically all of the large orders for munitions of war were taken with satisfactory assurances that they would be completed regardless of the length of the war.

SPELTER

Prices for the week ended May 14 were almost entirely nominal. On that day 14 to 14.25c., New York, was quoted for prompt shipments of prime Western. Choice grades of brass mill metal are practically out of the market, while early June deliveries are difficult to obtain. Some complaint is heard that deliveries are lagging. Inquiries for early delivery outnumber the offerings. There has been renewed effort to depress the price, and with some effect, but the market is strong. Foreign inquiry and buying has subsided to an appreciable extent, but this is believed to be but temporary. Prices will not recede far while the war demand lasts, and this promises to increase rather than diminish. Keen interest is shown in the importation of Australian ore.

TIN

News of the destruction of the *Lusitania*, May 7, was followed by greater activity in tin than the market has seen in a long time. That day and the following one, usually an off-day in tin, probably 800 tons changed hands, all positions being called for. The price May 7 was 39.50c., but it mounted to 42c. the next day. Contrary to expectations the London market did not advance sharply on Monday, May 10, and the market here became easier and dropped to 40.50c. On May 13, the quotation was 39.50. At the present writing much more generous arrivals are in sight than has been the case of late. There is afloat 4095 tons, part of which is on four vessels *en route* from London. Arrivals this month total 1690 tons, 615 tons of which came from Batavia, and the remainder from England on six vessels.

LEAD

The market, since the last report, has been dull, but firm at 4.20c. New York. At St. Louis a firmer tone prevails, and 4.12½ is quoted. A peculiarity of the present situation is that buyers of carload lots can get a lower price in the West than can those inquiring for 1000 tons upward. The explanation is that the smaller buyers are regular consumers whose wants can be easily cared for, while those who might take the larger quantities are interested in war requirements and pay a premium. Carload lots have sold at 4.10c. f.o.b. St. Louis, while for large tonnages 4.15c. f.o.b., St. Louis, is quoted. On the whole the export demand has been lighter, and home consumers show no tendency to load up.

The Department of Commerce, Bureau of Foreign and Domestic Commerce, reports that the total quantity of lead remaining in warehouse March 31, 1915, was 17,081,952 pounds.

ANTIMONY

A market price cannot properly be placed on English brands of antimony. An instance is heard of where a consumer disposed of a couple of casks at 40 to 45c. per lb. Chinese and Japanese, all there is to be had, is quoted at 35 to 36c. A sale is reported at 38.50c. duty paid.

ALUMINUM

This metal is firmer although there appears to be little in the way of increased demand. With the *Lusitania* there was lost 144 packages of aluminum manufactures. Sales have been made at 19.50c. Quotations for prompt delivery metal, 98 to 99% pure, range from 19.50 to 20 cents.

Exports of metals, May 1 to 14, 1915 were as follows: copper, 11,720; lead, 3822; and spelter, 1769 tons. Since the beginning of the war 92,252 (gross) tons of spelter has been exported. The monthly figures are: August, 3079; September, 17,005; October, 9160; November, 11,381; December, 16,309; January, 13,660; February, 13,394; and March, 8264 tons.

COPPER PRODUCTION OF MICHIGAN; LEAD AND ZINC IN KANSAS.

The production of copper from the mines of Michigan in 1914, as reported by B. S. Butler, of the U. S. Geological Survey, amounted to 164,344,058 lb. against 135,853,409 lb. in 1913. The output of silver was 413,500 oz., against 295,173. Value of the copper was $21,857,759 in 1914 and $21,057,278 in 1913. The silver output was $228,665 in 1914, against $178,285 in 1913. The production of refined copper in 1914 was 158,009,748 lb., compared with 155,715,286 lb. in 1913.

The value of the lead and zinc produced from mines in Kansas in 1914 was $1,260,870, against $1,343,432 in 1913. The decrease was due to the lower prices of spelter and lead and to the decline in the galena output from 3102 tons in 1913 to 1808 tons in 1914. All the mines in the Badger-Peacock district were idle, and the production of the Galena district was less in 1914 than in 1913. The Lawton district was active, several new concentrating plants were in operation, and the mine output was about double that of 1913.

COMPANY REPORTS

PHELPS, DODGE & COMPANY

With an authorized capital of $50,000,000, $45,000,000 issued, this Company controls the following operating companies: Copper Queen Consolidated Mining Co., Detroit Copper Mining Co. of Arizona, Moctezuma Copper Co., Burro Mountain Copper Co., Stag Cañon Fuel Co., and the Phelps-Dodge Mercantile Company.

The total copper ore extracted from the mines amounted to 1,777,243 tons, of which 1,046,728 tons was submitted to preliminary concentration, and 730,515 tons smelted direct. The quantity of copper made during the year 1914 by the constituent companies controlled by Phelps, Dodge & Co. was 140,231,384 lb., of which 8,569,060 lb. was made from the Miami company's ores, and the resulting product in blister copper was delivered to them. Including copper received from outside sources, 188,687,378 lb. was sold and delivered to buyers at an average price of 13.57c. per pound, net cash f.o.b. New York.

The president, James Douglas, states that the current of the copper trade has been deflected from its normal channels, like other markets of the world, by the war which started on August 1. From January to August the demand for copper was more sluggish than it had been in 1913. During the period from August to December both the domestic and foreign demand fell off to such a degree that it became imperative to reduce production. The output of the Douglas and Detroit smelters was contracted 40.48%. As a result, copper shipments from the smelting works of the Company during this period were only 59.34% of normal. The revolutionary movements in Mexico have slightly embarrassed operations there and correspondingly reduced the output.

At both the Copper Queen mine and at the mines of the Moctezuma Copper Co. the visible reserves have been notably increased, and improved methods in both mining and smelting have reduced the cost of production. The tendency of legislation in the new state of Arizona has been somewhat radical, but the people as well as their representatives recognize the dependence of the state on the prosperity of mining, and may be counted upon to encourage rather than depress that industry, even though some drastic experiments may be tried before an equitable system of state regulation and taxation will be reached.

The general manager, Walter Douglas, briefly covers the various operations and said that the financial loss involved through the reduced output of the Copper Queen smelter during the later months of the year was partly compensated for by the lower cost of both mining and smelting. The departmental reports show that the ore reserves at the Copper Queen mines have been increased, and that the radical changes recently introduced in the smelting plant, to meet the larger percentage of sulphur in the ore, and the growing volume of concentrate, have increased the savings and reduced the costs.

The Company's revenue from subsidiaries was $6,350,000, and commissions, etc., $541,651, a total of $6,891,651, of which $6,300,000 was paid in dividends. The surplus is $7,011,109. During the year the Tombstone Consolidated property was acquired, and will be operated under the name of the Bunker Hill Mines Company.

Reports of the subsidiaries contain the following information:

Copper Queen Consolidated Mining Company

The general manager, S. W. French; mine superintendent, Gerald Sherman; and smelter superintendent, F. Rutherford, included the following in their statements of their respective departments:

The Limestone mine reserves have increased from 211,199 to 257,077 tons of lean sulphide, and 2,357,729 to 2,834,862 tons of mine run ore. Most of the porphyry ores of Sacramento hill must be submitted to preliminary concentration. Methods of mining in 1914 showed the following: square set, 76.1%; top slice, 13.9%; cut and fill, 8.2%; and shrinkage, 1.8% in 694,942 tons extracted. Stoping costs were reduced.

The smelter treated 654,669 tons of Copper Queen ore and other material, averaging 6.25% copper, 0.02 oz. gold, and 1.01 oz. silver, yielding 76,842,973 lb. copper, 14,987 oz. gold, and 627,612 oz. silver. The total material treated in the plant amounted to 1,012,177 tons, yielding 119,957,017 lb. copper, 1,405,301 oz. silver, and 26,259 oz. gold. This included concentrate from the Moctezuma in Sonora, and custom ore. There were 946 men employed in the departments.

Ore shipped to El Paso amounted to 23,930 tons, containing 8,889,175 lb. lead, 399,106 lb. copper, 332,106 oz. silver, and 1822 oz. gold. The experimental plant also treated 3150 tons for 130,342 lb. copper.

The Copper Queen metal output was 86,066,143 lb. copper, 8,889,175 lb. lead, 1,036,672 oz. silver, and 15,769 oz. gold, from 732,829 tons of ore, precipitate, and slag. Net earnings totaled $6,042,001, and $4,500,000 was paid in dividends.

The report contains a great deal of interesting matter on experimentation, accidents and safety, and the hospital department, which will be dealt with separately in other issues of this journal.

Detroit Copper Mining Co. of Arizona

The reports of the general manager, A. T. Thomson; mine superintendent, M. H. McLean; and smelter superintendent, V. P. Hastings, contain the following data:

Development amounted to 12,766 ft. in the five principal mines, and 13,609 ft. in outside properties, a total of 26,375 ft. Ore production was 217,876 tons from the Ryerson mine, 85,119 from the Yankie, 128,641 from the Copper Mountain, 39,310 from the Arizona Central, 1202 from the Colorado, and 46 from the Antietam, a total of 472,194 tons. This averaged 2.899%. Out of this tonnage, 459,473 tons was concentrating ore. Lessees mined 773 tons containing from 4.71 to 21.19% copper from 13 mines, and 61.7 tons of precipitate averaged 52.13%. Exploration on the outside property was not encouraging and ore reserves decreased, in spite of good results in the Ryerson and Yankie.

The blast-furnace smelted a total of 129,530 tons of mixed charge, and the output of copper was 20,274,367 lb. Net earnings for the year were $602,319, and $280,000 was paid in dividends. There were 1438 men employed.

Moctezuma Copper Company

This Company, in charge of J. S. Williams, Jr., operates at Nacozari, Sonora, Mexico, and has been the scene of revolutionary movements for some time past, and the general manager states that nothing but the political unrest in the country would prevent the property being a more active producer than it has been.

Mining operations show an increase of 500,000 tons of ore in reserve. The Pilares, the main hoisting shaft, was sunk to 1285 ft., and a little work there exposed a considerable tonnage of good average-grade ore. The Esperanza and Guadaloupe shafts are down 1266 and 1000 ft. respectively.

The mill produced 120,655 tons of concentrate, which, with some slime and other ore, was shipped to the Copper Queen smelter at Douglas. It contained 1006 oz. gold, 435,482 oz. silver, and 32,229,211 lb. copper.

Net earnings totaled $1,189,100, and $1,170,000 was paid in dividends.

Burro Mountain Copper Company

This Company's property at Tyrone, New Mexico, was described in the *Press* of February 6, 1915. Mining operations consisted in the development of the so-called Bison orebody cut while driving the main tunnel from Tyrone to the east-

ern orebody in the Leopold property. In addition to exploring it, the best method of attacking the Tyrone deposits has been carefully studied, according to the superintendent, E. M. Sawyer. The hoists of No. 2 and 3 shafts on the Chemung property have been replaced by machinery of greater capacity, and the shafts themselves are being overhauled for active service. Churn-drilling operations have been systematically carried out during the year. Thirteen holes, with an aggregate of 11,571 ft. have been drilled, as might be expected, with variable results. They will prove valuable as guides when looking for new ore.

The first of the two 1000-hp. Diesel engines was started, the second is being installed, while a third will be needed as a stand-by. Systematic experiments were made in treatment of the ores. Although selection of a townsite was difficult, owing to the broken character of the country, one was set out about midway between the mill and the mouth of the main tunnel and the two principal Chemung shafts. The sum of $25,000 was donated by Thomas S. Parker for a new public hospital, and the Company will add an equal amount.

The year ended in a deficit of $267,180, the balance at the end of the previous year being $158,179 at credit.

Stag Cañon Fuel Company

This Company operates a coal mine and coke ovens at Dawson, New Mexico. T. H. O'Brien is general manager and J. B. Morrow superintendent of the coke department.

Development in five mines amounted to 30,998 ft. of entry driving, an increase of 772 ft. over that in 1913. The production of coal amounted to 1,355,938 tons, an increase of 33,125 tons. There were five fatalities underground. The washery handled 517,736 tons of coal, and the coke output was 239,966 tons, a decrease of 53,123 tons, due to conditions in the copper industry. Net earnings amounted to $297,785.

Phelps-Dodge Mercantile Company

The general manager, W. H. Brophy, reports that sales in the stores at Bisbee, Dawson, Douglas, Morenci, Nacozari, Tyrone, and Pilares totaled $5,920,233, on which the net profit was 8.38%. Net earnings were $460,656, and dividends amounted to $400,000.

CANADIAN MINING & EXPLORATION CO., LTD.

In 1914 this Company completed its full season of active search in the field for mining properties. A large number of investigations were made in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, Yukon Territory, Alaska, Arizona, California, Colorado, Minnesota, Missouri, Nevada, New Mexico, Oregon, South Dakota, Mexico, and Cuba. In the examination of newly opened districts, Canada continued to receive particular attention. Of the properties considered, several had merit, and would have justified exploitation under favorable terms. Up to the end of 1914 no business had been concluded that justified a call on shareholders for subscriptions. The gross income was $137,596, and expenditure $99,732. Investments are valued at $2,136,812. Current assets include $321,446 cash. W. W. Mein is consulting engineer.

ALLOUEZ MINING COMPANY

Results of this Michigan copper company during the past three years may be compared from the following table:

	1914.	1913.	1912.
'Rock' stamped, tons	354,457	236,663	333,618
Refined copper recovered, lb.	6,056,548	4,091,129	5,525,455
Refined copper sold, lb.	6,056,548	3,819,324	4,367,964
Average price received, cents per pound	12.853	15.672	16.668
Total revenue	$791,821	$650,205	$918,435
Cost, cents per pound	11.18	12.09	13.52
Net profit	$114,530	$155,728	$171,264
Balance, assets over liabilities	363,822	249,292	93,564

Work was resumed at full capacity on February 1, 1915.

MINING DECISIONS

Timber Cutting on Mining Claim in Forest Reserve

Jurisdiction over matters relating to the cutting of timber on lands within the surface areas of mining claims located in national forests is vested exclusively in the Department of Agriculture. Officials of the Department of the Interior will not interfere in such matters.

H. T. Mecum, 43 Land Decisions, 465.

Possession of Surface Not Possession of Severed Mineral Rights

After a severance of minerals in place from the surface above them, the acquisition of title to the surface by adverse possession thereof does not result in the acquisition of title to the mineral interests of the land. To acquire by adverse possession the title to the mineral interest so severed, there must be an actual taking or use under claim of right of the minerals from the lands for the period necessary to effect a prescriptive title.

Birmingham Fuel Co. *v.* Boshell (Alabama), 67 Southern, 403. December 17, 1914.

Discovery Must Precede Application for Patent

A mining location is not perfected or completed until a discovery of mineral within the limits of the claim has been made; and where no discovery was made prior to the filing of an application for patent, such application and the proceedings thereunder, being without legal foundation, cannot be recognized as a basis for mineral entry or patent, even though a discovery be made after the filing of the application and after the expiration of the posting and publication of notices thereon.

Bay City Oil Co. *v.* Alvarado Oil Co. (Land Department), 43 Land Decisions, 397. September 19, 1914.

An Act to Provide for the Leasing of Coal Lands in the Territory of Alaska, and for Other Purposes

Section 3. * * * And provided further, that any person, association, or corporation qualified to become a lessee under this Act and owning any pending claim under the public-land laws to any coal lands in Alaska may, within one year from the passage of this Act, enter into an arrangement with the Secretary of the Interior by which such claims shall be fully relinquished to the United States; and if in the judgment of the Secretary of the Interior, the circumstances connected with such claim justify so doing, the money paid by the claimant or claimants to the United States on account of such claim shall, by direction of the Secretary of the Interior, be returned and paid over to such person, association, or corporation, as consideration for such relinquishment. * * *

Sec. 15. That on and after the approval of this Act no lands in Alaska containing deposits of coal withdrawn from entry or sale shall be disposed of or acquired in any manner except as provided in this Act: Provided, that the passage of this Act shall not affect any proceedings now pending in the Department of the Interior, and any such proceeding may be carried to a final determination in said department notwithstanding the passage hereof: Provided further, that no lease shall be made, under the provisions hereof, of any land, a claim for which is pending in the Department of the Interior at the date of the passage of this Act, until and unless such claim is finally disposed of by the department adversely to the claimant.

Approved October 20, 1914.

The foregoing are the only provisions, in the recent Act of Congress, providing for any preference or protection to be given to locators of coal lands under prior laws.

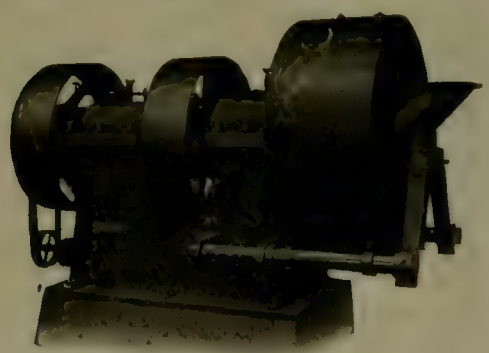
New Machines and Devices

Information based on letters and catalogues from manufacturers.

Disc-Crushers

In the *Press* of May 8 it was stated that Symons disc-crushers were to be used at the new 14,000-ton mill of the Inspiration company, Arizona. *Section* R, fourth edition, issued by Chalmers & Williams, Inc., of Chicago Heights, Illinois, describes these machines. The firm states that five years ago one such machine was at work; now there are hundreds.

The 36 and 48-in. machines are made of great strength for hard ores, and have a large capacity. Crushing is done between two discs of manganese steel. They are dish-shaped and are set with their hollow or concave sides facing each other, forming a cavity between them. These discs both rotate in the same direction at the same speed. The discs are supported at an angle to each other. This provides a wider opening between the edges of the discs at one part of their circumference than at the opposite part. When ore is fed through



SYMONS DISC-CRUSHER.

the central feed opening, it is thrown by centrifugal force into the opening where the discs are widest apart. It is carried around with them to where they are closer together, and is crushed by the operation. The smaller particles fly out from between the discs, into the encircling chute, while the larger particles are caught again and the operation repeated.

The two sizes mentioned have the following details:

	36-inch.		48-inch.	
Approximate shipping weight, lb.	23,500		39,000	
Size of feed, inches	3½		6½	
Minimum opening for best results, inches	¾		1	
Minimum capacity, tons per hr.	Size of ring.	Tons per hr.	Size of ring.	Tons per hr.
	¾	25–30	1	45– 60
	1	30–45	1½	60– 80
	1½	45–60	2	80–100
	2	50–65	2½	100–120
Main pulley speed, r.p.m.	133		100	
Eccentric pulley speed, r.p.m.	300		250	
Size of pulleys, inches	44 by 14		54 by 16	
Horse-power required	30 to 40		50 to 65	

Dust is prevented by paper coverings. Support of speed spout is adjustable. Shaft and eccentric bearings work in a bath of oil. All Symons disc-crushers are manganese equipped. The catalogue also describes the 48-in. Symons fine reduction disc-crusher. The Arizona Copper Co. is installing two 48-in. machines.

Portable Electric-Drills

The Western Electric Co. claims that its 'Temco' electric portable drills have been designed to give long and efficient service under severe conditions. These machines have the general shape of an ordinary breast-drill, are compact and light. The weight is well balanced, making handling easy. The electric switch is conveniently placed near the handle. A special feature is the ease with which the motor may be reversed when the drill jams. These drills will also tap holes, the reversing feature being here of great advantage. For working inside objects, or upside down, and in other inconvenient places, these portable drills are said to have no equal. The motors are constructed to operate on either direct or alternating current at standard voltages. Connection is made to the nearest lamp-socket by means of a flexible cord and attachment plug. The two principal sizes are models B and C. The former has one motor and the latter two. The former weighs 12 lb. and will drill ⅜-in. steel. The latter weighs 19 lb., and will drill ½-in. metal.

PORTABLE ELECTRIC-DRILL.

Commercial Paragraphs

A four-page pamphlet on the operation and cost of filter-presses in metallurgical work has been issued by WILLIAM R. PERRIN & Co., Chicago.

The SULLIVAN MACHINERY Co., of Chicago, announces that Robert J. Raley, representative in the iron and copper country of Michigan and Minnesota, is at room 910 Alworth building, Duluth, Minnesota.

A 36-page catalogue, No. 46, issued by the WITTE ENGINE WORKS, Kansas City, Missouri, deals with the firm's organization, shops, costs of running engines, details and superior points claimed for its oil engines for all purposes, and other interesting information.

The Exposition edition, *Bulletin* 52, of the BYRON JACKSON IRON WORKS, San Francisco, covers 48 pages with illustrations, and is described as containing useful engineering data pertaining to pumping problems. The subjects discussed are as follows: methods of developing water for irrigation, the amount of water used in irrigation, hints on irrigating different crops, methods of checking waste of water, measurement of water, conveying water, electric pumping, and cost of gasoline and current, and a considerable amount of useful information on pump details, pipes, efficiency, measuring water, and pumps suitable for mines. This firm manufactures a large variety of pumps up to 50-in. size driven by a 650-hp. motor. A. C. Paulsmeier is chief engineer.

Mining and Scientific Press

Edited by T. A. RICKARD

Volume 110 | SAN FRANCISCO, MAY 29, 1915 | Number 22

ON THE WHITE PASS RAILWAY, THE GATEWAY TO THE YUKON

THE CALL OF THE NORTH is heard again in these days when the ice breaks and the rivers are opened to navigation throughout the great mineral regions of Alaska and the Yukon. Already several new finds of gold are heralded from Nome and Dawson. We record these developments on our pages; also the new mining regulations in Alaska.

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Very Important Improvements
have been made on the card, making a cleaner concentrate as well as separating the middlings entirely from the gangue

YOU CANT MAKE GOOD SEPARATION

on a Concentrator with riffles projecting above the surface of the table. While it is true that they arrest the coarse mineral, the fines are inevitably excavated and washed over riffle after riffle, going thence into the creek. You need a table with *channels* cut below the surface of the table.

In other words, you need a *CARD.*

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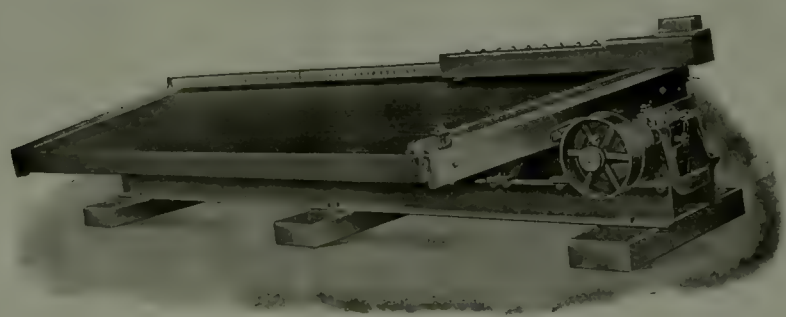

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SAN FRANCISCO, MAY 29, 1915

Advertisers Index Last Page
Buyers Directory Page 28

TABLE OF CONTENTS

EDITORIAL Page.

NOTES 821

THE MINING INDUSTRY 822
As contrasted with the mining game.

PROFESSORS OF MINING 823
Considerations governing such appointments.

COPPER IN AMMUNITION 824
An important use now to the fore.

DISCUSSION

SPECULATION IN MINING.
By F. A. Ross 825
Commendation of the Editor's views.

VALUATION OF DREDGING GROUND.
By J. J. Bristol 825
A simplification of the method suggested by J. T. Dixon.

FLORENCE ZINC.
By H. G. Clopper 826
It is produced by the New Jersey Zinc Co. and not by the Vieille Montagne.

FLOTATION OF COPPER ORES.
By J. M. Callow 826
Useful details furnished by one who speaks with authority.

A CORRECTION.
By Regis Chauvenet 828
The reaction between silver nitrate and cupric sulphide.

AMALGAMATION IN HARDINGE MILLS.
By George R. Pringle 828
Details of operation at Incaoro, Bolivia.

ARTICLES

GOLDFIELD RE-VISITED—II.
By T. A. Rickard 829
Extraction at the Goldfield Consolidated mill is now 92%; 8 lb. lime per ton was formerly added to the pulp, now 20 lb. per ton is required because of the increased acidity of the ore. Few changes in the mill have been necessary. Daily output of concentrate is 80 tons; this is roasted and cyanided after removing the copper by leaching with acid. In the boom days much gold was lost by 'high-grading.' Fortunes were made over-night and as lightly expended.

NOTES FROM SOUTH AMERICA.
By Mark R. Lamb 832
The Chuquicamata was started on May 15 by the President of Chile. Interest is shown in quicksilver mining; copper mines are hampered by the inability to secure freight room for their ore on account of the scarcity of ships; coke is scarce at the smelters and none is being received.

TECHNICAL REMINISCENCES—II.
By Albert R. Ledoux 833
Thirty-five years ago much American copper ore and metal was sent to Wales for smelting and refining. Sampling methods employed in Wales were to the disadvantage of the shipper. Ledoux & Co. was able to demonstrate that its method was more accurate and brought about a desirable change in practice, greatly to the shippers' advantage.

THE METALLURGY OF ALLUVIAL MINING.
By John M. Nicol 837
Attempting to save all the gold in alluvial deposits in a single operation is illogical, since the current required to keep riffles from filling with heavy concentrate is sufficient to carry away a good deal of gold. The gold is also not always free. Useful suggestions for the solution of the problem are made and will be discussed in the second article of the series.

SECONDARY SULPHIDE ENRICHMENT OF COPPER ORES.
By Arthur L. Day 841
Study of this important problem in economic geology is being carried on jointly by the Carnegie Institution of Washington and Harvard University. The director of the geophysical laboratory of the former lucidly sets forth the essential factors of the problem.

DEPARTMENTS

CONCENTRATES 843

REVIEW OF MINING 845
Special correspondence from Miami, Arizona; Goldfield, Nevada; Toronto, Ontario; Cripple Creek, Colorado; Boston.

THE MINING SUMMARY 848

PERSONAL 853

SCHOOLS AND SOCIETIES 853

THE MARKET PLACE:
Metal Prices 854
Eastern Metal Market 855

COMPANY REPORTS:
Butte & Superior Copper Co.; American Zinc, Lead & Smelting Co. 856

BOOK REVIEWS:
American Mining Law, by A. H. Ricketts; Railroad Field Manual, by William Raymond; Mining Manual and Mining Year Book, by W. R. Skinner; Industrial Chemistry, by Allen H. Rogers; Explosives, by Arthur Marshall 857

RECENT PUBLICATIONS 858

NEW MACHINES AND DEVICES:
Dredges at the Exposition 859
Vacuum Filter at the Exposition 859
New Drill Sharpener 859
Commercial Paragraphs 859

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DREDGES

EDITORIAL

T. A. RICKARD - - - - Editor THOMAS T. READ - Associate Editor

BOLIVIAN tin concentrate is to be smelted in Chile. It is reported that a plant is to be erected at Arica or Mejillones.

NATOMAS re-organization is proceeding smoothly, the last obstacle being removed by the permission granted by the British Treasury for the London company to raise the necessary capital.

FLOTATION is being made applicable even to copper ores containing oxides; for instance, an extraction of 85 to 86% is being obtained on a 1.75% copper sulphide in which 0.2% copper exists in oxidized form.

SPECULATION in 'war stocks' is more risky than mining. The trade in munitions and armament is based on a demand exceedingly precarious as compared with the inevitable and persistent need of the metals.

CONSOLIDATION of the activities of the Anaconda Copper Mining Company is proceeding apace, the dissolution of the United Metals Selling Company having been announced. This was a subsidiary of the Amalgamated Copper that refined and sold the metal from the properties under the control of the latter. This part of the business will now be continued by the refining and selling departments of the Anaconda company.

ABSORPTION of the Stratton's Independence property, at Cripple Creek, by the Portland Gold Mining Company, is announced by our correspondent at Cripple Creek. The famous mine passes to its neighbor for $300,000, while the British company formerly owning the Independence will maintain its organization and acquire new property, not necessarily in the Cripple Creek district. We shall refer to the matter at greater length in our next issue.

ARCHANGEL is now open to navigation. A new Russian-American line has been established, the first steamer to leave New York for the White Sea being the *Czaritza*, on May 22. The resumption of direct communication between Scotland and Archangel is important to the many mining engineers attached to the companies operating in Siberia, for the normal lines of travel across Europe are barred.

CLAIRVOYANTS and crystal gazers receive respectful mention from the Commissioner of Corporations, Mr. H. L. Carnahan, who warns the public against the purchase of securities on the advice of such persons. It is recorded that during the past three years one clairvoyant disposed of 163,000 shares of mining stock to his 'clients,' paying 1 cent per share for the stock and selling it to his victims at prices ranging from 15 to 50 cents per share. The Blue Sky law offers some measure of protection to so-called investors in California, but its effectiveness only applies to issues made since December 19, 1914. If you want advice on mines, go not to those that study the stars but to those that watch the signs underground.

THE ONE-EYED is always eager to guide the blind. Recently, in a hotel foyer, we heard one man ask another what 'spelter' was? The second hastened to explain that it was "a sort of dross, composed of lead, zinc, and tin, and other impurities." Whereupon the first suggested: "A kind of pewter," to which the knowing one assented cheerfully. It is curious that the trade name of zinc should be 'spelter.' The latter word is derived from *spiauter*, a term borrowed from India in the 16th century, for the art of extracting zinc from its ores originated in the East. Arriving in Europe, the word became the old German *spialter*. 'Pewter' is a derivative from *spialter* through the old French *espeautre*, so that 'pewter' and 'spelter' are allied etymologically, although no longer synonymous.

WHILE the first evidence of Italy's participation in the War was regarded cheerfully on Wall street, as tending to shorten the duration of international hostilities in Europe, it is noteworthy that the quotations for 'war specialties' advanced on the New York Exchange, as if the demand for munitions would be greater, and longer presumably. Certainly American participa-

tion in the War, for which we have no wish or expectation, would intensify the need for manufacturing munitions and would tend to consume more metals in death-dealing apparatus. We would like to see the useful metals employed in the service of man, instead of his destruction, but we recognize that this aspect of the War has proved helpful to the mining industry to a degree unsuspected a few months ago.

SMELTER SMOKE abatement has reached a further point by the Supreme Court's decision, as between the states of Georgia and Tennessee, in the matter of the sulphurous fume emitted by the Ducktown Copper Company, in Tennessee. The Court rules that an inspector be appointed to limit the amount of deleterious smoke that may be diffused from the state of Tennessee into the state of Georgia. We trust that the inspector will use a scientific gauge for measuring the volume of noxious fume that crosses the line.

GOLDFIELD'S complexities are becoming straightened. On May 21 the deal between the Booth and Jumbo Extension companies was confirmed by the directors of the latter. That the place of consultation should have been Phoenix, Arizona, is a minor anomaly due to the custom whereby a company doing business in one state chooses to be incorporated in another, where restrictions are less onerous. By this arrangement, now in a fair way of being consummated, the Booth receives 300,000 shares of Jumbo stock, recently increased for that purpose, and $15,000 in cash, representing a dividend of 5 cents per share on the new issue of stock. In return the Booth transfers to the Jumbo all the ore in the Velvet claim. Thus an explicit side-line agreement is avoided, but the benefits of such an agreement accrue to the owners of the Velvet claim. Another effect of this method of settling the trouble is to help the Jumbo company in its defense against the Merger Mines, in case the latter presses its suit for a recovery of the Velvet claim. But we hope that this matter also will be adjusted without further recourse to the courts.

The Mining Industry

In our last issue we discussed one phase—the humorous or pathetic—of mining; this week we turn with satisfaction to the more important and more satisfactory phase that represents the real industry. The ultimate purpose of mining operations is to make money through the winning of the metals, by finding, extracting, and marketing them profitably. The rest is the frill on the outside. In places like New York and London, in localities like Wall street or Throgmorton street, or even Bush street, it is forgotten sometimes that the purpose of mining is not to create counters for a gamble, but to dig ore profitably. Fortunately we who live in San Francisco need not go far to see this basic operation being performed with a maximum of skill and success. A few days ago the present writer re-visited Grass Valley, where two notable examples of mining enterprise have been on view for many years. Indeed, we recall no locality where the mining industry wears a more benevolent look. The little town, founded 65 years ago, at the time of the first discoveries of gold in the district, is a pretty settlement, embowered in flowers and foliage. From the outskirts comes the muffled thunder of stamp-mills, which, themselves and their predecessors, have made sweet music for over half a century. Two mines, the Empire and North Star, have been in operation for over 60 years and productive under their present management for fully 30 years; yet today their vitality seems unimpaired. The Empire is 4800 feet deep on the dip and 2200 feet vertical, while the North Star has gone down to 6300 feet on the dip, or 2400 feet vertical, which is exactly the altitude of Grass Valley above the Pacific ocean. Since 1854 the Empire group has produced $13,500,000, while since 1851 the North Star properties have contributed no less than $18,250,000 in gold. Both are private properties in so far as neither has shares that are subject to public dealings; in other words, the ownership is divided among a few men, of large means, who have put their money into the enterprise just as they would invest it in a farm or a foundry. Indeed, in cases such as these, mining does become an investment, for capital is employed with a view to deriving an income, not with the idea of enhancing the value of the principal so as to be able to dispose of it at an advance. These two enterprises have prove abundantly profitable, for in each case the original capital has been returned many times, while all development and equipment has been paid out of revenue. Thus conducted, it will be confessed that mining is a pretty business. No one is robbed or injured. Dormant natural wealth is put into useful circulation. Workmen are employed and a community supported. Most of those working in these mines have their homes in the vicinity; many of them are the sons, or even the grandsons, of men that have found steady employment with the same company. Besides giving employment to a succession of technical men, these mines have served to train many engineers who are now doing good work in various corners of the earth. Finally, it is not impertinent to say that the mine-owners themselves include a number of our best citizens, men notable in other branches of industry. Viewed thus, the activities maintained at Grass Valley, aboveground and underground, will commend themselves not only to the engineer but to the philanthropist. It is mining at its very best.

We understand, of course, that mining thus conducted, as a private affair, has its disadvantages. Owing to the absence of a free market for the holdings of the various proprietors, their property in such mines is not a liquid asset. It can be sold only by negotiation with other partners in the business. Moreover, if all mining enterprises were conducted on a similar basis the capital available for mineral exploration and exploitation would be severely restricted, for only rich men can afford to buy large fractions of big mines. In this department of human activity, as in others, each extreme has its dis-

advantages. In order to distribute the risk of mining so that it will not cripple any individual it is convenient to divide the financial commitment among a large number of persons, and in order to enable such persons to withdraw their capital when occasion arises it is likewise convenient to arrange for a daily quotation of the subdivisions or shares in the enterprise. But the many good features of the clean method and wise policy of the private company can be imitated by the public joint-stock corporation without impairing its vitality or lessening its essential prosperity. Chicane is no more inherent in a company of a thousand men than in one of five. When practised it is usually at the expense of the many and to the gain of the few. All the boosting, booming, and balderdash of share-peddling, such as we described in these columns last week, operates to the public's loss, for it may be taken as axiomatic that the insiders unload on the outsiders. It is said that it promotes interest in mining; we doubt it, any more than the lottery stimulates interest in the resources of Louisiana. If it be a stimulant, it is like many others in being followed by a depressing reaction. Being false in its essence, it can only work for harm. We commend the Grass Valley example as an ideal.

Professors of Mining

The fact that at least four institutions of learning are looking for new heads of their mining departments gives timely interest to a subject that must always deeply concern those having at heart the welfare of the mining profession and of the industry to which it ministers.

At first sight it would seem as if professors of mining, like poets, were born, not made. Assuredly the effective teacher of this subject is rare. This is due partly to the enormous expansion of the technology involved and its world-wide application. The scope of knowledge required is staggering. Concurrently the increase in the number of students and the large size of the classes to which the professor must lecture introduces the second, and ever present, factor of personality. To hold the attention of his students, the teacher must have force of character as well as a large stock of information.

During the past decade those responsible for the selection of professors have become impressed with the idea that a teacher of mining failed to be effective if he lacked experience in the field; it has seemed to them that actual contact with the realities of industry was needed to enable the teacher to appreciate the ultimate purpose of the mining art, namely, to make money by exploiting mineral aggregates. In other words, they wanted the practical man: the practitioner in place of the academic authority. This notion became dominant. In its ascendancy it gave us one or two professors of the highest ability; their names will leap to mind, but the number of them is so small as to constitute exceptions rather than evidence in support of the new departure. As a matter of fact, expert teachers are made no more quickly than expert mining engineers or metallurgists. The eminent practitioner does indeed enter the lecture room with the vital air of the man that has done things in that world for which his students are preparing, but he is rarely a good expositor, and he is better used to managing grown men than disciplining youths. His knowledge of the subject is probably specialized in a particular direction, for no man can keep step with the advance in every branch of mining, least of all those who are fully occupied in a successful consulting practice or the absorbing administration of a mining enterprise. Indeed, the masterful acquaintance with the details of a particular business or special branch of industry is likely to militate against an express recognition of the fundamentals of the subject as a whole. In any case, such detailed knowledge does not carry with it the ability to convey the underlying principles from the practitioner's brain to that of a number of young listeners. Neither width of experience nor breadth of knowledge assures the aptitude to instruct others. The gift of clear exposition is not acquired over night; it may be latent, but in most cases it comes only from earnest effort and practice.

Despite one or two notable exceptions, therefore, we conclude that the successful practitioner is rarely endowed with the gift of teaching. The alternative is to give the trained teacher a chance to acquire first-hand knowledge in the field. To teach mining, or any art to which science is applied, requires a familiarity with the related sciences and the capacity to convey a supply of fundamental knowledge to those as yet detached from contact with actualities in the field. The training of the mind of the young in preparation for the post-graduate teaching of life itself is the aim of scholastic instruction. The professor of mining does not make mine managers and smelter superintendents, he prepares likely young men for that apprenticeship to minor posts which precedes promotion to positions of greater responsibility. No lecturer can give the practical training of which people speak so glibly; that comes only by actual participation in technical work. The minutiae of daily work are only confusing to students engaged in grasping the elements of their subject. They find it difficult to see the wood for the trees. Those elements are best taught by one who has learned how to teach, rather than to practice. He must be a student himself, and grow with his subject, which, in the case of mining, is undergoing rapid and constant development. To do so, he should be given an opportunity to spend his summer vacation among mines, mills, and smelters, away from his students, absorbing new ideas and acquiring new knowledge from those in charge of technical operations.

On the whole, therefore, it appears to us that the type of man best fitted for this special branch of instruction is one who has been first an eager student and then a trained teacher of the sciences applied to mining, a man preferably of general culture and wide sympathy, a man with the inborn thirst for knowledge and the acquired ability to convey it to others. We should select an alert young man, expecting him to grow with his work, and develop in the course of his teaching to that splendid

fitness that makes the true expositor and the effective educator. But, to supplement the inevitable deficiences of individual teaching, we should advise the authorities of a mining school to invite distinguished practitioners to give short courses of lectures on special subjects. That is where the practitioner is invaluable. He is a man who has done things, his lectures will illustrate the principles elaborated by the professor, and his reference to work accomplished will serve to heighten the student's interest in the regular lectures from the chair. If possible, sundry mining engineers should give three or four lectures on special subjects regularly from year to year, so as to maintain the continuity of instruction. This method, if done in a cordial spirit of co-operation, should give the students the best preparation for taking a useful and successful part in a great industry.

Copper in Ammunition

Among the many and varied uses of copper, its consumption in the manufacture of ammunition is not the least important, as is attested by the fact that some 20,000,000 pounds of copper is used for this purpose each year in the United States alone, in spite of the small degree to which military preparation for war is here developed. Within the past few months huge orders for the ammunition required in Europe have been placed with firms in this country, many of them concerns formerly engaged in making other kinds of goods, but who are not unwilling to modify their plants and procedure in order to benefit by the high prices paid for quick delivery of the various munitions now being consumed so lavishly. It is impossible to estimate how much copper is now being used for this purpose, but some idea may be gleaned from the way in which the price of the metal has risen in the past few months, and continues to rise in spite of the efforts of the mining companies to increase their output.

When copper in ammunition is mentioned the natural association is with the brass cartridges used for ordinary rifles. Greater interest attaches to the cartridge cases for quick-firers and field-guns. The case of the cartridge for a 3-inch gun weighs 1 lb. 5 oz., while that for a 6-in. gun weighs 28 lb. 14 oz. As in a million rifle-cartridges only 23,000 to 26,000 lb. copper is used, it is seen that the greater weight of the larger cartridges tends to compensate for the less frequency with which they are fired. But there are other uses of copper in ammunition. Every shrapnel shell must have a copper band about it in order to prevent the escape of the gases of the explosion past the projectile; these rings average 2½ to 3 lb. in weight per shell. The copper expands under the impact of the explosion and makes a tight fit against the sides of the gun. This saves the wear caused by the rush of the gas past the projectile, and increases the power of the gun; it also makes the projectile follow the rifling better.

Every cartridge requires a primer; these are made of copper or a soft brass rich in copper. The old-style lead bullet is not suitable for use in the modern high-power rifles, so the projectile is commonly made with a hard jacket over a lead core. An alloy of 85% copper and 15% nickel is the most suitable for this purpose. The Germans use sheet-steel cases for bullets, plating them to protect them from rust. The steel is believed to wear the rifling of the barrel more rapidly than cupro-nickel, but does not foul it so quickly, being harder. One of the armies of Europe uses a solid brass bullet. The lead used in all projectiles, especially shrapnel, contains antimony, hence the present demand and high price of that metal.

Spelter advances with the demand for copper in war. The brass used in the making of ammunition must be of the best quality, containing about 70% copper and 30% zinc, so it will not crack in working, nor be destroyed in firing, as all cartridges are re-loaded. The specifications of the United States Army require cartridges to stand 20 re-loadings without failure. The reason for this is that the case of a rifle-cartridge costs 1½ cents, while the complete cartridge costs only 2½c., thus it is good economy to re-load as often as possible. In making a case, flat discs are stamped out of brass sheets of the requisite thickness. The next operation cups the disc, and by a series of these it is formed into a cylinder, 'necked-down' to the shape required, and the head is finally formed from the thick metal left in the base. After each operation the brass must be annealed, as the working makes it hard and it would crack on further working. Both the copper and spelter must be pure, as impurities make the brass hard and cause it to crack. Good electrolytic copper is pure enough, but the spelter must be purer than ordinary brands, which contain too much lead for this purpose. Spelter made from the franklinite and zincite ores of New Jersey and the blende from Tennessee, which are free from lead, therefore commands a premium over prime Western. This premium has recently been large enough to warrant the re-distilling of ordinary spelter in order to purify it. Another reason for using brass of the highest quality should be pointed out. Brass is used for cartridges rather than copper because the cases must possess sufficient resilience to spring away from the sides of the gun-chamber, after firing; otherwise the shell cannot be extracted, and the gun is temporarily out of commission. This is especially important in the case of quick-firing guns. If the case splits or cracks, it will stick in the chamber.

As previously stated, all cases are re-loaded. But it must be remembered that it is a long long way from Bukowina to the Naugatuck valley of Connecticut, while many shells are lost on the battlefields and will not find their way back for re-loading for a long time. Orders for ammunition are being based on immediate requirements; in the event of the War being protracted the rate of consumption will probably decline, and when peace is concluded enormous quantities of scrap brass will find their way into the markets of Europe. What effect this is likely to have on post-War copper consumption it is difficult to prophesy.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

Speculation in Mining

The Editor:

Sir—Your excellent editorial on speculation in mining and Mr. Todd's article on 'Financing Mining Operations,' appearing in your issue of April 17, arrived just in time to be of great service to me in the preparation of a paper on 'Speculation in Mining Stocks' upon which I was then at work and which was read at the regular meeting of the Spokane Mining Men's Club, on April 29, in view of the increased activity in mining.

So fully did your ideas, and those of Mr. Todd, accord with my own that I found it very advantageous to quote, *verbatim,* entire paragraphs from your articles, thereby greatly strengthening my own definitions and arguments.

Always such articles as these are in order; even if they often fail of their intent they are justified as educational measures which the wise will heed if the foolish will not; like the danger signs on our speedways these financial warnings are old in themselves yet they are ever new to newcomers and invaluable aids to the cautious.

Assuredly, then, to try to lessen losses from fake promotions, and to show inexperienced mine-owners how best to organize their ventures so long as they persist in the error of acting on their own initiative, is not only well within the province of technical journals but is also a part of the duty of every organization of mining men that has the industry's welfare at heart.

F. A. Ross.

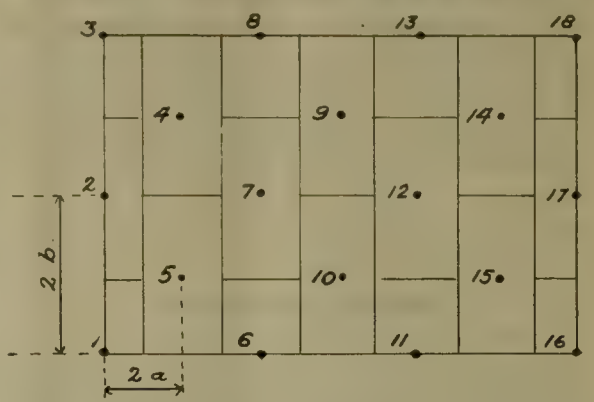
Spokane, May 15.

Valuation of Dredging Ground

The Editor:

Sir—I notice in your issue of December 19, 1914, a letter from J. T. Dixon on this subject. Mr. Dixon's method is analogous to the method in general use for the calculation of ore reserves. The average depth of a tract of ground corresponds to the average stoping-width; the value per cubic yard to the value per ton over the stoping-width; the volume at each hole to the tons in each block; and finally the total cubic yards at so many cents per cubic yard over an average depth to the total tonnage at so many pennyweights per ton over a certain stoping width.

Mr. Dixon states the average value is the total value divided by the cubic contents of the ground in question, and in order to arrive at the cubic contents assumes that the distance between the lines of holes is $2a$ and between the holes is $2b$. Further, referring to hole No. 1, the area to be included in the calculation is ab, the volume



is $40ab$ and the value contained therein $5200ab$. By similar calculations the following results are obtained:

	Area.	Feet.	Volume.	Cents.	Value.
1	$a \times b$	$\times 40 =$	$40ab$	$\times 130 =$	$5{,}200ab$
2	$a \times 2b$	$\times 30 =$	$60ab$	$\times 35 =$	$2{,}100ab$
3	$a \times b$	$\times 20 =$	$20ab$	$\times 60 =$	$1{,}200ab$
4	$2a \times 2b$	$\times 20 =$	$80ab$	$\times 50 =$	$4{,}000ab$
5	$2a \times 2b$	$\times 20 =$	$80ab$	$\times 40 =$	$3{,}200ab$
6	$2a \times b$	$\times 30 =$	$60ab$	$\times 50 =$	$3{,}000ab$
7	$2a \times 2b$	$\times 20 =$	$80ab$	$\times 160 =$	$12{,}800ab$
8	$2a \times b$	$\times 30 =$	$60ab$	$\times 42 =$	$2{,}520ab$
9	$2a \times 2b$	$\times 25 =$	$100ab$	$\times 25 =$	$2{,}500ab$
10	$2a \times 2b$	$\times 25 =$	$100ab$	$\times 20 =$	$2{,}000ab$
11	$2a \times b$	$\times 35 =$	$70ab$	$\times 8 =$	$560ab$
12	$2a \times 2b$	$\times 35 =$	$140ab$	$\times 10 =$	$1{,}400ab$
13	$2a \times b$	$\times 30 =$	$60ab$	$\times 15 =$	$900ab$
14	$2a \times 2b$	$\times 25 =$	$100ab$	$\times 12 =$	$1{,}200ab$
15	$2a \times 2b$	$\times 30 =$	$120ab$	$\times 10 =$	$1{,}200ab$
16	$a \times b$	$\times 30 =$	$30ab$	$\times 10 =$	$300ab$
17	$a \times 2b$	$\times 32 =$	$64ab$	$\times 12 =$	$768ab$
18	$a \times b$	$\times 25 =$	$25ab$	$\times 9 =$	$225ab$
Total	$48ab$		$1{,}289ab$		$45{,}073ab$

At this point the method is rendered much simpler by deleting the remainder of Mr. Dixon's procedure and simply finding the total volume (necessary in any case in order to obtain the cubic contents). This volume, as indicated above, is $1289ab$. Dividing the total value, $45{,}073ab$, by the total volume, $1289\ ab$, the result is 34.967 cents per cubic yard, since the value at each hole is given in cents per cubic yard. If the average depth of the tract of ground is desired, then dividing $1289ab$ by $48ab$ the result is 26.854 feet. The reason that the results are the same whether taking the lines of boreholes

vertically, horizontally, or diagonally across the diagram is simply because the area at each hole remains the same in each case.

J. J. Bristol.

Liverpool, March 25.

Florence Zinc

The Editor:

Sir—On page 733 of your issue of May 8, 1915, the following appears: "Florence oxide is the name applied to oxide of zinc made by the French process. The best known of these products are produced by the Vieille Montagne." This is not entirely correct. Florence zinc is the brand applied to the oxides of zinc made by the French process by the New Jersey Zinc company. The Vieille Montagne company makes French-process zinc, but its product is not known as the Florence brand. The best known French-process oxide of zinc in this country is the Florence brand, which unquestionably equals and is superior to most of the imported French-process oxides.

H. G. Clopper.

New York, May 13.

Flotation of Copper Ores

The Editor:

Sir—The mention of my name in your recent article on this subject tempts me to offer a few remarks that may be of general interest.

Pneumatic flotation is already fully established in a number of places and the results in comparison with the other and older schemes fully justify the opinion of your correspondent that it constitutes the most distinct advance in flotation in recent years.

The first pneumatic flotation plant in this country was erected by me in February 1914 for the National Copper Company at Mullan, Idaho, a description of which has already been published. The results were fully up to expectations from the very start. This plant consists of 8 rougher and 2 cleaner cells and treated 500 tons per 24 hours. A 30-hp. motor furnished power for all the air necessary for both mixing and separating, and the oil consumption averaged as low as 0.13 lb. of refined pine-oil per ton of ore. It was an ideal floating ore. Since then the Callow scheme has been adapted by nearly all the other mills in the Coeur d'Alene for the treatment of their lead-zinc fine sand and slime-feed, and has been a means of simplifying their plants and adding greatly to their recoveries.

The other plants that I have since erected have followed the same general lines as were laid down at the National, namely, air or tube-mill mixing and emulsifying of the feed followed by the separatory cells run in parallel. Recent results at the Inspiration mine would indicate some advantage (on that ore, at least) in running the cells in series of two instead of parallel, and without any sacrifice in capacity for a certain set number of cells. On an ore carrying a large percentage of mineral there is not much doubt that the series plan will give the best results and possibly dispense with the necessity of cleaning the concentrate.

The various elements that compose the scheme in general are illustrated in the accompanying diagram. The preparation of the pulp by any form of violent or propeller agitation is not necessary for good results with the pneumatic process. Where the oil can be introduced into the tube-mill no further refinement in mixing is necessary. This, of course, cannot always be done and in such cases air-mixing with the Pachuca becomes necessary.

A standard separatory cell has a capacity that will vary from 35 to 75 tons of feed per 24 hours when run in parallel, depending of course upon the characteristics of the feed. Two cells in parallel will have about the same capacity as two cells in series, but a slightly lower tailing may be expected with the series treatment.

The porous medium in the bottom of the cell is a loosely woven canvas-twill four layers thick, secured to the upper surface of a perforated plate with bifurcated rivets and washers. This is the present standard construction and has been adopted after a great many disappointing experiments with other materials. It is good for a three or four months' continuous campaign, and becomes inoperative only through the filling up of the pores by dust that has been introduced by way of the blower. Four or five pounds of air-pressure is ample in all cases to give the proper aeration, the quantity of air varying from 6 to 10 cu. ft. per square foot of blanket-surface. When the cell is properly adjusted and doing its best work there should be no violent agitation within the cell, but only such agitation as is incident to proper aeration. Any violent agitation producing a surging of the liquid contents has proved detrimental to good results.

A slope of 3 in. per foot on the bottom has been found sufficient to treat all ordinary ores after crushing through 30 or 40-mesh. Treating coarser material or ores that contain a large percentage of heavy gangue (such as in the Coeur d'Alene), it has been found advantageous to increase this to as much as 4½ in. per foot to prevent the blanketing of the porous medium by coarse sand collecting on the bottom.

The air from the separatory cells has so far been furnished from positive blowers, but turbine-blowers would be preferable where the size of the installation justifies their adoption. An air-pressure of 15 lb. is ample for the Pachuca mixer and 25 cu. ft. of free air per minute is sufficient volume for mixing 250 tons of *minus* 48-mesh pulp, and of course should be furnished from a low-pressure compressor.

The density of the pulp may vary from 2½:1 on a sandy feed up to 7:1 on a strictly slime-feed. The particular density is not a matter of so much importance as that the supply of pulp shall be uniform as to its density, since each variation in the density requires a readjustment of the oil-supply, the quantity of oil required increasing in proportion to the increased volume of the pulp independent of its solid content.

The advantages of the pneumatic scheme are greater recoveries, less oil, greater simplicity, and less skill required to operate. The difference in wear and tear is obvious.

Proof of the increased recoveries is shown in Table I, which represents a 30-day competition. It is noticeable that this increase in recovery lies principally in the finer and slime portions of the feed.

TABLE I

ANALYSIS OF TAILING—THIRTY-DAY PERIOD

Mesh.	Weight.	Total copper. Flotation tailing. A.P.	Flotation tailing. P.P.	Table tailing. A.P.	Table tailing. P.P.	Copper oxide in combined tailings.
	%	%	%	%	%	%
+ 65	7.0	0.38	0.37	0.30	0.29	0.13
+ 100	15.0	0.43	0.44	0.29	0.24	0.13
+ 150	12.0	0.44	0.50	0.30	0.25	0.16
+ 200	9.8	0.54	0.44	0.34	0.26	0.22
— 200	56.2	0.58	0.42	0.56	0.43	0.33
Average for all sizes.	100.0	...	...	0.44	0.35	...

TABLE II

ANALYSIS OF CONCENTRATES

For the same period

	Cu, %	Insol., %	Fe, %	S, %
Agitating process	32.34	26.50	15.01	22.79
Pneumatic process	31.24	23.70	16.79	23.84

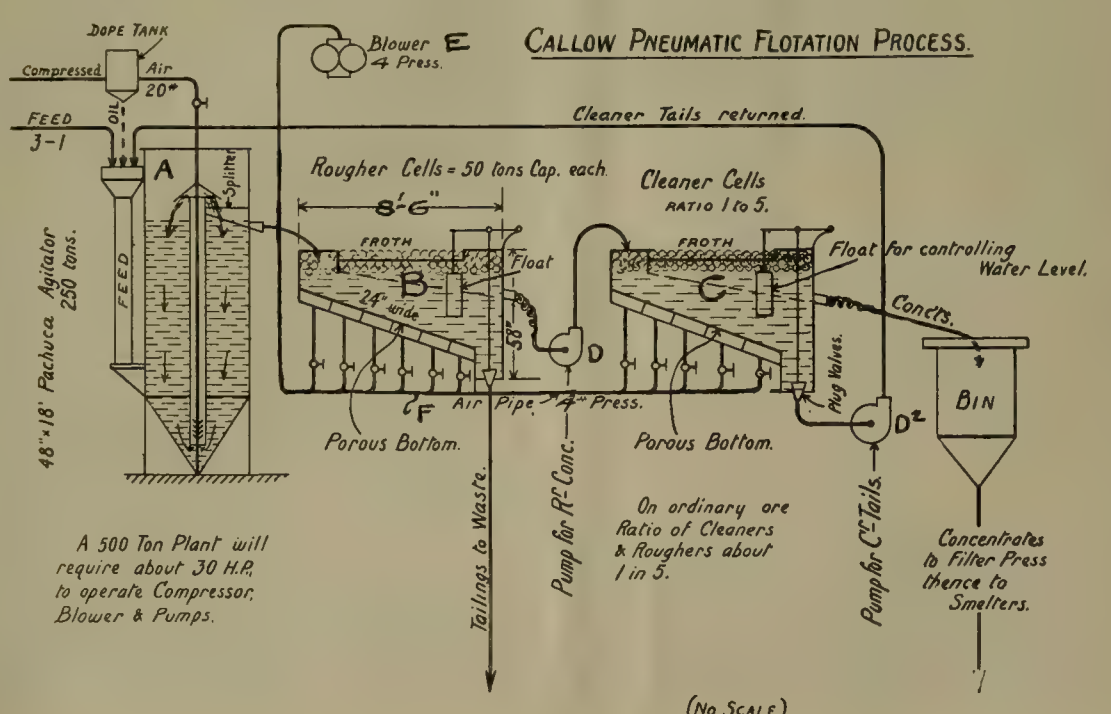
The resulting concentrates from the same competition are shown in Table II, which indicates that the slightly lower grade of copper is more than offset by the lower insoluble and higher iron contents.

The proof of lower power consumption is that the 10 cells of the National Copper Co. were run with a 30-hp. motor and treated 500 tons per day, the same tonnage treated by a propeller machine would have taken close on to 100 hp. This figure has also been confirmed at other places. The power required will vary from 2 to 3 kw.-hours per ton.

The froth produced from the pneumatic process is much more ephemeral than that produced by propeller-agitation machines, a self-evident advantage when it comes to collecting and handling the resulting concentrates.

Regarding oils, the remarks of your contributor with regard to cresylic acid and the methods of analysis given are extremely interesting and valuable. So far as my own experience goes, I have not found cresylic acid indispensable; at the present time and price it is out of the question as a flotation agent; it would seem, moreover, that the same results can be obtained by the use of less refined and expensive reagents. In the Coeur d'Alene on the zinc-lead ores, wood creosote seems to give the best results. The Inspiration uses a mixture of 80% El Paso coal-tar and 20% creosote. At one time we used a 2½ to 5% addition of pine-oil, but this has since been found unnecessary. A mixture of 20% pine-oil, 20% cresol, and 60% carbolic was tried experimentally at the Miami mine, but just as good results were obtained by substituting Salt Lake creosote for the cresol and carbolic. These are both chalcocite ores with some pyrite; the chalcocite is easier to float than the pyrite. The pulp is neutral. The recoveries will approximate 95% of the sulphide-copper contents.

I have tried a great many of the wood-oils, both the



steam-distilled refined products and also the destructively distilled crude tars and creosotes, but have generally come back to the coal-tar mixtures. The pine-tar products are excellent frothers but the coal-tar products seem to act as collectors and a combination of the two is often necessary. Acid sludge has been used with good success on Butte copper ores, but the disadvantages of this are that it requires heat and also additional quantities of acid to get the best results. This means working with an acid pulp and prevents the introduction of the oil into the crushing mill because of the destructive effect of the acid on anything but a silex-lined mill. Some ores work best in an alkaline pulp and others in a neutral one. My own opinion is that in most cases the same results can be obtained in alkaline or neutral pulp as can be obtained in an acid one and the advantage of an alkaline or neutral pulp is self-evident.

In one plant we had an interesting experience of this kind. The water-supply was limited and all the milling-water was returned back to the mill. The flotation results gradually deteriorated as the mill-water accumulated acid; the more acid it got, the poorer the results. Lime was then added in the tube-mill and the pulp made alkaline; this produced a tremendous increase in the volume of froth made, but without any definite improvement in the tailing. By reducing the lime and allowing the pulp to work back to the neutral point the results again became normal; and it is at the neutral point that we now do our best work.

There is a great deal of work yet to be done with oils, especially in compounding, modifying, and in making them miscible without heat. The right combination of oil is everything; the quantity per ton has less influence on the results than the right mixture. The effect with too much oil is mechanical rather than metallurgical; too much oil produces so much froth that it overflows everything and cannot be handled in the plant. Some experiments made in this direction gave the following results:

Oil per ton, lb.	Grade of concentrate, %	Extraction, %
2	15.55	90.08
30	9.82	95.91
100	7.95	93.46

But this is a large subject and altogether beyond the scope of these random remarks.

J. M. Callow.

Salt Lake City, April 23.

A Correction

The Editor:

Sir—In your issue of May 15, page 766, the following statement is made: "Silver sulphide only, and no metallic silver, is formed by the reaction between cupric sulphide and silver nitrate, the equation for this reaction being $CuS + 4AgNO_3 = Ag_2S + 2Ag + 2Cu(NO_3)_2$."

This equation, to begin with, flatly contradicts the statement "no metallic silver." Also the equation is itself false, as it shows one Cu atom in first member, and two in second. Probably the real equation would be: $CuS + 2AgNO_3 = Ag_2S + Cu(NO_3)_2$. This, at all events, is consistent, and also verifies the assertion of "no metallic silver."

Regis Chauvenet.

Denver, May 19.

[We are glad attention has been called to this error, which arose from a mistake in copying. The equation as given by Mr. Chauvenet is the correct one. The second half of the equation given above is the product of the reaction between silver nitrate and cuprous sulphide.—Editor.]

Amalgamation in Hardinge Mills

The Editor:

Sir—R. B. T. Kiliani, who has given you an account of results obtained with Hardinge mills at the mill of the Incaoro Mines Company, in Bolivia, must have obtained his information from some one who did not know how we do things here. I have been here for three years, or since the company started work, and for the benefit of those interested I will record the results actually obtained. When we started the plant we lined the pebble-mill with silex brick, which was a failure. Hard granite was then tried, for want of better material; it lasted but a short time. Flint pebbles of 6-in. diameter are now being used with good results. These are set in cement. For grinding purposes, instead of flint pebbles, lumps of hard quartz from the mine, rounded up a little with a hammer on the sharp edges and weighing 2 to 3 lb., are used. These work just as well as flint pebbles and are much cheaper. The neck-piece that connects the feeder to the ball-mill was too short and caught pieces of quartz between the feeder and the feed-box. One made 6 in. longer works well. The mill crushes but 60 tons per 24 hours. Mercury is fed into the ball-mill every hour. This leads to a small loss from 'flouring' inside the mill, but it has proved the best method. We clean-up every 15 days, and the amalgam is found distributed from the ball-mill to the pebble-mill. Large pieces of amalgam collect around the door of the pebble-mill, but no loose balls of amalgam are found inside the mills. Three-quarters of the amalgam is collected from inside the mills and one-quarter on the plates. The amalgam contains 40% gold before retorting. Our gold runs 900 fine; we ship it to New York. I used to think that a stamp-mill was the best mill made, but I have changed my mind. We find it very hard to keep mill-men here, as the altitude is 14,000 ft. above sea-level. We very often have to break in some of the natives to run our plant, which would be difficult to do if we had a stamp-mill.

George R. Pringle.

Sorata, Bolivia, April 20.

[Mr. Pringle's letter is welcome. The longevity of the stamp-mill astonishes even its friends. We expect many important changes in milling practice to come about as a consequence of the development of flotation and leaching. —Editor.]

Goldfield Re-visited—II

By T. A. RICKARD

On the occasion of my former visit, in April 1908, the richest ore from the mines of the district was being sent to the smelters near Salt Lake and San Francisco, while the lower-grade ore was subjected to amalgamation, cyanidation, and chlorination. Now amalgamation and chlorination have been displaced; cyanidation alone survives. At that time the Goldfield Consolidated company had just begun the erection of its big mill. F. L. Bosqui, as consulting metallurgist, expected to make an extraction of 95% by cyanidation at a total cost of "under $2.50" per ton. The mill did achieve an extraction of 95.4% at a cost of $1.60 per ton. This does great credit to J. W. Hutchinson, who was mill superintendent until he became general manager for the Goldfield Consolidated Mines Company in January last. His detailed description of the mill appeared in successive issues of the *Mining and Scientific Press* during May and June 1911.

MAIN STREET OF GOLDFIELD.

On entering the mill the rhythmical noise of the stamps sounded to me like familiar music. The 100 stamps crush 1015 tons per day in cyanide solution through 4-mesh screens. The circulating solution contains 0.4 lb. cyanide per ton. Crushing in solution saves cyanide, but it decreases the extraction of gold in sulphide ores. The advantage, however, exceeds the disadvantage. There is also a saving of water, which, at Goldfield, costs 50 cents per 1000 gallons. The extraction made by the mill is now 92%; it has been higher. The percentage could be increased, but to do so would not be economical, for the expense would exceed the monetary gain.

The first observation to be made inside the building is the tremendous foaming of the pulp as it passes through the different machines, culminating in a vast mess of bubbles in the dewatering vats. This is due to the reaction between the lime and the sulphates in the ore. When the mill started, only 8 lb. lime per ton was required to neutralize the acidity of the ore; when the roasted concentrate was treated the addition increased to 11 lb. per ton; now it is 20 lb., this final increase being due to the treatment of caved ground, remnants, and dump, all of which contains the sulphates produced from the oxidation of the pyrite and chalcopyrite. Most of the lime is added to the ore as it passes through the first gyratory crusher, the lime being fed by a traveling belt moving 2 ft. per minute. Further rectification is made in the mill, by adding an emulsion or milk of lime.

One of the few defects of the plant is seen in the crusher-house, where there is insufficient room for screening between the bins and the first crusher, a Gates gyratory. There is also lack of grade between the trommel below the first gyratory and the two secondary crushers. Another apparent defect may be mentioned here, namely, the harnessing of three tube-mills to one motor; each might be operated separately or at least not more than two should be placed on a single drive, with ability to cut out one tube-mill when convenient. On the other hand, by the existing arrangement the high starting-torque required for tube-mill operation, necessitating 40 hp. extra, is distributed over three mills.

Since the mill was constructed the only modification in the design has been the elimination of the 36 Deister tables for the treatment of middling, this change being due to the milling of lower-grade ore. At present 60 Deister tables (of the No. 3 size) are in use. On asking the manager if they were doing good work, he replied "Excellent." On the white rubber covering of the Deister tables one can see the free gold clearly, for it forms a yellow rim just above the pyrite. Another minor change is the increase in the number of leaves in the Butters vacuum-filters; 386 are in use as against 336 formerly; two boxes, containing 50 leaves, having been added.

The high price of spelter is not without interest to the superintendent, for the mill requires 425 lb. of zinc-dust per day, or about 6 tons per month.

The concentrate averages 6% by weight of the ore milled and contains 67% of its valuable contents. Formerly this product was treated with acid wash, bromo-cyanide and peroxide; later this method gave way to a preliminary treatment with alkaline cyanide, which extracted 85% of the gold, leaving a comparatively low-

grade product to be roasted. Thus the loss in roasting was minimized. Now the raw concentrate, which has decreased in assay-value from about $200 to $30 per ton, is sent direct to the roasting-furnace.*

The daily output of concentrate is 80 tons, containing 18% sulphur. This is roasted in two Edwards duplex furnaces (112 by 13 ft.) having 54 spindles (or rabbles arranged in two rows for each furnace. The fuel used is crude oil, 14°B., from Bakersfield, California. Nine gallons of oil is required per ton of concentrate. Contact with the heat is maintained for 10 hours. It is found necessary to fire only at the feeding end, the fineness of the material facilitating the advance of combustion so as to obviate the need for firing at the finishing end of the furnace. The roasted product is wetted as it leaves the furnace, the resulting pulp flowing to a series of 5 air-lifts giving a total lift of 45 ft. to the collecting-vats, where the pulp is dewatered to a consistence of 1:1. Then 10 lb. of sulphuric acid per ton of dry concentrate is added. Agitation is maintained for 8 hours, with subsequent water-washing, for recovering the copper and eliminating the sulphates. All the washes and decantations are passed over scrap-iron for the precipitation of the copper. The recovery of copper is at the rate of 3 lb. per ton of concentrate. This pays for the acid treatment.

Meanwhile the pulp, freed of its copper, is neutralized with lime and delivered by a centrifugal pump to one of two Pachuca agitators, where the dissolution of the gold is accomplished. When completed, the residue is delivered to storage-tanks in the mill proper; there it is filtered, and finally sent to waste with the mill-tailing. The solution goes to a separate circuit and precipitates its gold on zinc-dust. The total cost of treating the concentrate is 90 cents per ton.

Outside the mill a couple of imposing steel structures command attention; these are the dominant portions of a plant for returning the tailing to the mill for re-treatment. The tailing has been carefully impounded; it covers about 100 acres, and weighs 2,000,000 tons, averaging $1.60 per ton. To treat this residue the company has erected a Lidgerwood radial aerial cable-way with two stationary revolving towers and a traveling car. The towers are 160 ft. and 125 ft. high respectively. The lower tower moves in the arc of a circle along a standard-gauge track, having 135-lb. rail. The two tracks are 70 ft. apart, centre to centre. The rope is of 2¾-inch diameter. The capacity of the machine is 500 tons in 8 hours and the cost of it to date is $91,600. The expense of returning the tailing to the mill is estimated at 6 cents per ton.

A visit to this mill leaves a strong impression of the skill shown in its original design and an appreciation of the fact that it has accomplished its purpose most effectively. From the day the mill started (December 26, 1908 to the end of 1914, the mine has produced 1,895,338 tons of ore yielding $43,710,665. The only regret is the apparent termination of its useful activities, for the Goldfield Consolidated mine cannot continue to furnish sufficient ore for long, and no other mine in the vicinity shows any prospect of yielding a supply adequate for so large a plant.

In 1908 one of the principal technical operations in the district was 'high-grading,' a polite term for the theft of ore by the miners, who took their spoil to the 'fences' or assay-offices, where it was bought and reduced to bullion. During the summer of 1907 fully $1,000,000 worth of ore was thus stolen from the Mohawk and Combination mines. It is said that at one time 36 so-called assay-offices were running all night, some of them miniature smelters, and all brightly illuminated by electric light. That was the time of the Frances Mohawk and Hayes & Monette leases, when, in the summer of 1906, Goldfield seemed to sweat gold. In the Frances Mohawk lease at a depth of 200 ft. there was an 8-inch vein that assayed $250,000 per ton, mostly free gold and the telluride of gold (calaverite). The various leases on the Mohawk mine yielded a total of $50,000 per day for 106 consecutive days. When the principal lease was about to terminate, the lessees paid the miners $10 for 8, or even 6, hours of labor. No discipline was maintained, for a refusal to work would have prevented the lessees from gathering their golden harvest before the expiration of the lease. The miners came from underground with their jeans and jumpers stuffed with specimen ore. The worst element in the Western Federation of Miners was in control of the labor supply and the rights of property were treated humorously. Then came the big strike (not of ore, but of miners) in the fall of 1906. Troops under General Funston (recently at Vera Cruz) paraded through Goldfield and a bloody conflict was only just avoided, thanks to the respect felt for the regulars. When a committee of citizens paid a call on the General, he remarked that he had never seen so many overcoats on a hot day. All of them were armed with revolvers and sawed-off shot-guns. Every building had gun-men on its roof. On the Montezuma club, the headquarters of the mine operators, there were 15 such sentinels on the alert for trouble. Everybody expected the town to 'go up' any minute. It was like living on the edge of a volcano or the rim of a copper converter. Thus I return to my metallurgical simile.

Journalism also had its romance amid this explosive environment. Charles S. Sprague, recently identified with the Jumbo Extension mine, had formerly owned the Colorado Springs *Daily Telegraph;* at the height of the Cripple Creek boom he sold it for $65,000 and drifted to Goldfield. Arriving there he was engaged as editor of the *Tribune*, at $75 per month and one-third interest. The boom was in full swing. The only unpaid matter appearing in the paper was a 'stick'—about two inches—on the first page; all the rest of the reading matter was inserted for 60 cents per line, paid by promoters and brokers. Not every promoter was a broker, but every broker was a promoter. The 'mining game' was *in ex-*

*A description of the treatment as conducted in 1912 was written by J. W. Hutchinson for the *Mining and Scientific Press* in the issue of January 25 and February 1, 1913.

cents. Yes, those were glorious days. When a deputation of citizens went to Carson City, to persuade the legislature that Goldfield was particularly fitted by man and nature to be the county seat, the gentlemen from Goldfield began to throw nickels among the boys and ended by chucking $20-pieces. Having succeeded in their enterprise, they invited the legislators and their families to visit Goldfield; they chartered a train of pullmans for their guests and on their arrival in the golden city they ladled champagne from wash-tubs, because, of course, it takes time to pull corks.

Yes, those were the good old days. It seems long ago, but it was only yesterday. Among the more pleasant stories I like to recall that of Smith and Benedict, two stock-commission men from Chicago, who in 1906 had placed his money in stable investments. The discoverer of Goldfield, Harry Stimler, is running a mine at Goldfield. When he located the Sandstorm and started Goldfield on its bullionic career, he was working under a grubstake from Jim Butler, the discoverer of Tonopah. It will be remembered that Tonopah was the parent of Goldfield, the one being discovered in August 1900 and the other in December 1902. After Jim Butler had made some money, his wife persuaded him to buy a ranch at Bishop, in Inyo county, California, where he now lives comfortably. Finally, T. L. Oddie, who took a prominent and intelligent part in these discoveries, became one of the owners of the Tonopah mine and was elected Governor of Nevada, for the four years from 1910 to 1914. He is now operating at Willard, near

THE MOHAWK MINE, GOLDFIELD.

bought into a lease near the Sandstorm. They came to look at their mine, but the shaft had caved, owing to faulty methods, so they spent a night gambling with some of their acquaintances. During the evening they agreed to pay $10,000 for a half-interest in the Hayes & Monette lease. Leaving next day, they went to San Francisco and Portland, with an uneasy feeling of uncertainty as to what they had done. Not being clear about it, they telegraphed to Hayes and Monette to meet them at Reno and paid the $10,000 in cash. They were anxious to carry out their agreement as honorable men, even if they had a hazy recollection of the reasons prompting the deal. They had a code of their own. Soon after, Hayes and Monette wanted $10,000 more to develop the mine. Smith and Benedict returned to Chicago and tried to dispose of their interest, at the very moment when rich ore had been struck in the lease. They failed in their effort to sell and were forced into a fortune. Each of them made over a million dollars. Of the others, Mr. Monette is now a big banker at Los Angeles, while Mr. Hayes retired from business and Lovelock, the new district recently named after the champion pugilist. It is a dangerous baptism: champions have their day. We hope Willard may outlive its namesake.

When purchasing new equipment many firms specify something like the following: All angular moving parts or projections must be avoided so far as possible. If impossible to avoid their use, all gears, cams, eccentrics, setscrews, bolts, sprockets, chains, belts, feathers, splines, keyways, cranks, connecting rods, or other dangerous revolving or moving parts actuated by power, must be so guarded and protected as to render contact, intentional or otherwise, between them and the person or clothing of the attendant as nearly impossible as the work to be performed will permit. All guards must be so constructed and built up as to be readily removable without the use of special tools, allowing ready access to the working parts. It must be the aim of the builder to produce a machine that shall be as safe to handle and operate as human ingenuity can devise.

Notes From South America

By MARK R. LAMB

When the London metal-markets were paralyzed, the copper and silver mines of Chile suffered the same fate. Now that the price of copper is good, every copper miner is trying to get another start, but lack of ships to carry his ores and bars, and high freight-rates combine to hold him back. Even such ships as have contracts are accepting 20 tons when 100 are offered. Besides the ships sunk and withdrawn as transports, and those interned, others have been taken from this coast run to ply between New York and Europe at the high rates prevailing.

The copper smelters are running as slowly as possible in order to make their supplies of coke last as long as they can. Coke has now reached a prohibitive price, as none is coming from England or Australia, and American coke manufacturers have not yet found the market.

There have been violent fluctuations in the exchange-value of the Chilean peso lately, and as gold mining here is dependent for its highest profits upon a low exchange-rate, the gold miner is joining hands with the agriculturist to force exchange down.

The retrenchment and economizing forced on the country by the curtailment of export of nitrate is an important factor in the raising of the rate of exchange. It is freely prophesied that the peso, which is now worth 8 pence, will go to 18 pence (par) if the War continues much longer. Personally, I want the peso to increase in value so that my customers can buy more and to decrease in value so that my salary will go farther.

The economic point of view in Chile is changing rapidly. Formerly it was necessary to have an automobile, or at least a fine carriage and pair. Now it is absolutely the fashion to talk of straightened finances, and it is a lucky salesman who can find anyone even interested in automobiles.

Formerly there was no propaganda in favor of home industries, now the leading men of the country take pride in wearing Chilean cloth, which is like any other cloth and is at the same time pure wool and cheaper.

Wages for the laborer fell seriously at the "drop of the hat," this being an important saving for the mining companies, but hard on the laborer.

A reasonable freight-rate to the States would start a mining boom. Of course, the copper miners know that the price of copper is high because the production in the States is curtailed, but they also know that the production in Chile is comparatively small and therefore will not effect the world's market-price. If there were only a few American ships!

It is announced that Chuquicamata will be formally started on May 15 by his excellency, Don Ramon Luco, President of Chile, who will press the button in the capital at Santiago. It is expected that the plant will be running nicely in 30 days thereafter, and the ultimate capacity of this unit is quoted as 600,000 lb. of copper daily. The average man has difficulty in grasping these figures and wonders where such a quantity of copper can be absorbed.

With the present price of quicksilver there has been an increased interest in the two extensive deposits of cinnabar north of Santiago, near Ovalle, and if the price holds up long enough to make a proper start, the owners will make money. One engineer is getting together several small lots of quicksilver from old amalgamation plants in Chile, Bolivia, and Peru, and expects to ship a few tons to the States.

Three small gold mines are producing at present. The Miles mine of Sr. Felipe Herrera, near Ovalle, produces 8 ounces of gold daily with a Tremain stamp, and the Las Vacas mill, with 10 gravity stamps and a cyanide plant, is averaging 15 oz. fine gold. Don Luís Charme, of Santiago, has a Tremain on order to reduce 800 tons of hand-sorted gold ore.

Condoriaco is not operating, on account of differences between the lessees and the owners. The ore can be

COPPER READY FOR SHIPMENT FROM CHILE.

sorted to a high-grade in gold and silver. The highest grade was shipped and the lowest grade treated by stamping, concentration, and cyaniding.

The French company operating copper smelters at Naltagua and Catemu has lately lined its small acid converters with basic brick. In spite of the very small size of the converters, the manager, Mr. Lehmann, is getting excellent results and is making a big saving in cost, as compared with previous practice.

GOLD RECOVERY on the Rand has increased from 60% in 1890 to a maximum of 96% in 1914. The chief contributing factors were: introduction of slime treatment in 1894, advent of the tube-mill in 1904, improvements in classification from 1907 to 1910, and the vacuum-filter in 1909. At the same time a large number of mechanical and metallurgical details have helped the better recovery. The cost decreased during that period. At the Modder B. the total charge from the crusher to the residue dump is only 68.6c. per ton milled.

BLADES in impulse steam-turbines occasionally work loose and drop out, or are knocked out by some means. The single-stage machine revolves at a high speed, and when blades are lost vibrations are set up in the shaft. These wheels must be perfectly balanced, the loss of a single blade causing noticeable shaft vibrations.

Technical Reminiscences—II

By ALBERT R. LEDOUX

Not many years after the opening of our laboratory in New York City, in 1880, our growing business made it advisable to establish a sampling-plant for ores and metals at the port of New York. We had been doing the best we could by handling shipments on the railroad-docks and by carting bars to be drilled at various machine-shops. The important question was where to erect this plant.

At that time there was a freight pool with headquarters at Chicago. Shippers of ore and other products could not control the routing, the pool dividing the freight arbitrarily between several lines, regardless of the conditions stipulated in the original bill of lading. The receivers of the material at this end, whether they were smelters or exporters, did not care over what line the material came east, as all the bills of lading called for free lighterage within the limits of the port of New York. We made careful inquiry of each railroad, as to whether it would be interested in helping us to secure this east-bound freight for its line, should we select a site alongside. The representative of the New York Central said the matter did not interest them in the least. The Pennsylvania Railroad people were most courteous and offered us a site on the Jersey meadows, at a fair rental, and agreed to stop all cars the contents of which we were to sample. The Erie Railroad exhibited such extraordinary liberality and such a grasp of possibilities that we decided to take our chance with them. They instructed their real-estate agent to go with me and look over all the land they had in and near Jersey City, and said that I might take my choice of a site. I selected an unoccupied building that they owned upon their line back of Jersey City. It was equipped with an engine and boiler, and could be made over into a sampling-works without much expense; but when I reported my decision to Mr. George H. Valliant, of the Erie, he said: "I would not advise you to locate at that point because it is not accessible to any railroad except our own. There is a better site just outside of the Erie tunnel, within a stone's throw of the Lackawanna and of a branch of the Pennsylvania. We propose to treat you fairly, but if at some future time some other administration succeeding the present determines to take advantage of you, you would then be sufficiently near to these other roads either to run in short switches or to cart material." They therefore gave us a lease of this tract at the nominal rental of $10 per annum.

At that time, they were re-building their railroad station in Jersey City. They presented us with all the timbers coming out of the old structure that we could use, and ordered their boss carpenters to erect our building with the railroad's own labor, charging us only for the actual time of supervision and wages; so our building cost us very much less than had we built it entirely from lumber purchased and paid a contractor's profit.

In the lease, the railroad bound itself to stop all cars coming over its line, when notified that we wished to sample the contents, and agreed to send empty cars for the material when it was ready to proceed to the docks for lighterage. Furthermore, when I stated to them that in some cases the material might have to lie some time at our works, if it had been sent forward unsold or must await satisfactory freight arrangements for export to Europe, they added a clause to the lease placing no limit upon this detention of freight, if the cars were emptied and released. How this worked in one important case will be told later in this article.

As soon as we were established, shippers who had sold their product upon our sampling and assay, brought pressure upon the pool at Chicago to route over the Erie Railroad all products destined to be sampled by us in transit, compensating the other members of the pool, as far as possible, by giving them their equivalent in other freight. The result was that the Erie became the chief copper-carrier from Buffalo and Chicago to New York, not only of materials that we were to sample, but others; even Lake copper came chiefly over the Erie, because the agents of the pool got into the habit of considering the Erie *the* copper carrier, and did not always take the trouble to see whether my firm was to handle it all or not.

When the other railroads awoke to the fact that they were losing this copper freight, some of them made offers of large cash payments to us if we would change to their line on the expiration of our lease; but for thirty years our works were confined to the Erie, although we supplemented them by a plant on the Southern Pacific docks, where we could sample copper bars from Arizona or elsewhere in the Southwest, which come into New York by boat from Galveston or New Orleans.

A large part of the furnace material handled by us went abroad, and at first our certificates of sampling and assay in New York served only as a check on the final sampling in Europe, especially at Swansea. The sampling over there, while usually accurate, took a great deal of time, being done entirely by hand, not even crushers being employed, and the method of settlement was complicated in the extreme.

To begin with, the settlement sheets did not account for the product by the ton of 2000 pounds, nor yet by the ton of 2240 pounds, but by the units per so-called 'miners' ton' of 2352 pounds. There were charges for 'master porterage,' dock dues, town dues, and an arbi-

trary 'draft' of 3½ pounds was deducted from every hundredweight. Furthermore, there were many conventional charges and deductions from the settlement price; in addition, payment was made upon 'produce' by Cornish assay. This Cornish assay was an attempt to imitate the smelting process in the laboratory. The difference between the buyers and sellers—assuming that the British buyer re-sold to a smelter—were often great, and the two Cornish assayers 'agreed' upon the produce, for which the American shipper was ultimately paid, after delays of from 60 to 90 days. Nearly all the shippers endeavored to persuade the English buyers to accept American assays, but without result, until Mr. W. A. Clark sent to James Lewis & Son, of Liverpool, who were very anxious to get hold of 3000 tons of his matte, a cable that was epoch-making for the trade. He had offers here for his material, and said in his cable: "I will no longer submit to the robbery of English terms and conditions. I will sell for so much cash f.o.b. New York on Ledoux's certificate of weight and assay." James Lewis & Son had the courage to accept this proposition, and for the first time, probably, in the history of American ore or crude-metal exports, credit was opened in New York for the total payment, and Senator Clark received cash at so many cents per pound of fine copper contents against delivery to the New York bank of our certificates of weight, sampling, and assaying. The outcome when the matte arrived in Liverpool was satisfactory, and from that time on James Lewis & Son bought freely on those terms.*

I made a trip to Great Britain endeavoring to persuade some of the other British buyers to purchase on American assays. A meeting of the Swansea Smelters Association instructed their chairman, then Sir Hussey Vivian, later Lord Swansea, to say to me that they were perfectly satisfied with their method of doing business, which had not been changed for several hundred years, and that I need never expect any of the Swansea buyers to recognize American assays.

Later the Boltons, and some of the other smelters and refiners near Liverpool, followed the lead of James Lewis & Son, but Swansea was immovable. Then came an episode that changed the situation:

Billy McDermott, of Butte, sold to a New York firm 500 tons of rich copper ore and agreed to accept payment in New York on our sampling. The material went to Portland, Oregon, by train and came to New York by ship. We were obliged to sample it on the dock. McDermott came to New York to get his money. He had given the buyers an estimate of the copper contents of the shipment. We divided it into lots of 25 tons each, as nearly as possible, and sampled it by hand, reporting our assays as fast as completed. As soon as each lot was sampled, it was put on a tramp steamer, having been re-sold at Swansea. When we had reported most of our assays and had nearly finished the sampling, we were astonished to be served with an injunction, issued by a New York court, restraining us from completing the assays, ordering us to give into the custody of the Court the samples hitherto taken, and to show cause why this injunction should not be made permanent.

My lawyer inspected the affidavit upon which the injunction was granted, and I called on the people who made it. We found that they imagined that, either through negligence on the part of my firm, or through interference on the part of the seller, who had witnessed some of the sampling, the assays that we had reported were much higher than the contents of the ore.

Very soon after the service of the papers, a lawyer representing the buyers, who had obtained the injunction, called upon me and said that we would, of course, be paid for the assaying and sampling if we let the matter take its course, that our assays were really higher than the seller expected, and that they would settle in a way satisfactory to him; and that would end the matter. I referred him to our lawyer, and on behalf of his clients he offered our lawyer $500 to advise us to let the matter drift. Of course, these proposals were refused. Our capital was our reputation, and our reputation had been attacked in the affidavit. In the meantime, the material all reached the tramp steamer, which sailed for England.

I called upon the buyers with our lawyer, and informed them that I would push the case to the utmost legal limit; that I would make their action public, and confidently expected damages for this assault upon our integrity and upon our business. I made an alternative proposition, which was that we should send an expert assayer by fast steamer to Swansea; that when the material arrived, it should be sampled by methods satisfactory to us, and to be agreed upon by our representative and the sampler of the British buyers, and that a third assayer of prominence and not interested in smelting should be selected by the two assayers; that the sample should be assayed jointly by the electrolytic method of assay; that if the results showed there was material error in our New York sampling or assaying, whatever the cause, I would drop the matter and stand the expense; but if, on the other hand, the European sampling confirmed our own, the seller, Mr. McDermott, should receive pay on the American basis, and all our expenses in connection with the investigation should be paid by the buyers, who should acknowledge that their statements filed with the Court were erroneous. This was accepted; so we dispatched our chief assayer and sampler to Swansea to arrive before the cargo.

Fortunately for us, the controversy became public, and when the ore got there representatives from the smelters watched the work. They were entirely satisfied, and had explained to them the advantages of previous crushing, where possible, and of mechanical sampling.

The ore was divided between works at Liverpool, Swansea, and another place. The samples were assayed by the electrolytic method at the Royal School of Mines

*See 'Modern Copper Smelting,' by Edward D. Peters, 7th Edition, for difference in returns by electrolytic and Cornish assays.

by our representative, working jointly with one of the instructors in that institution. They were then assayed at the same place by our representative by the Cornish method, his work being directed and supervised by the authorities. Our representative then repeated the work in Cristoe's laboratory, both by the electrolytic and Cornish methods of assay. The results of the electrolytic determination confirmed our original assays in New York, whereas the Cornish assays showed about 1.3 units less. The American buyers paid our bills for expenses and services, admitting that our original assays had been correct; but the foreign smelters began to say to one another, "These Americans do know how to sample and assay." Shortly thereafter Sir Hussey Vivian himself signed a contract for a large tonnage of Anaconda matte to be paid for in New York on our sampling and the electrolytic assay less 1.30. This influenced German buyers competing for American products to make the same concession, after an independent investigation.

The custom of deducting 1.3 from the electrolytic or other wet assay seems to have originated in this country in very early days. It was prevalent at Baltimore as far back as 1872, but it had not obtained the sanction of trade custom in Great Britain, so far as I can learn, prior to the episode above described.

This gave us the beginning of almost a monopoly of sampling ore, matte, and copper bars for export, in spite of the fact that there were, as there still are, other laboratories in New York honorable, progressive, and equally experienced.

While we thus broke through the prejudices of Great Britain and Germany, we had as yet comparatively little business with the French. Our entry into that field came about by another one of the 'accidents' that —as stated in a previous article—have so markedly influenced my professional career. I was about to sail for Europe in 1887, when the active manager of a New York metal house, chiefly handling Swedish and other European irons and steels, called with a letter of introduction to Monsieur E. Secretan, the active head of the great French house, the Société des Métaux. This gentleman said they had been for some years the agents of that company in America; that Mr. Secretan had plans of some kind on foot which they did not as yet fully understand; and that he was asking questions about copper and American production which they could not always answer. He would be obliged if I would call upon Mr. Secretan in Paris with this letter of introduction, and give him such information as I might have.

I was exceedingly busy when in Paris and deferred my call until the day before I was to leave. Had Mr. Secretan been out, I would have left a note with an expression of regret at not finding him, and would have felt that I had performed my full duty. He happened to be in, and questioned me for over an hour on the product of the different American copper districts, on the qualities of the various brands on the American market, and wound up by saying that he was about to inaugurate a great change in the copper world; that Paris was to replace London as the arbiter of copper prices; that it would result in his having almost absolute control of nearly the entire American production; and that he had ample funds guaranteed to carry it through. He said that his present American agents were conservative and loyal, but that they had far more experience with iron and steel than they had with copper. To illustrate what he meant, he said that he had recently cabled for a price for a certain number of tons of copper, guaranteed equal to English 'best select.' His agents ascertained that 'best select' copper was a grade fit for the making of rolled brass; but the word "brass" alone had apparently impressed his agents, who had contracted with the Baltimore Copper Company for the shipment, under the solemn guarantee that the copper would "make brass." Assuming that the copper would be of 'best select' grade, Mr. Secretan had paid a high price for it, only to find that it was of a casting quality, but of course could be used in "making brass," though the product could not be rolled.

He urged me to take the agency of his company for America, and said he would guarantee me a far greater profit than I could possibly expect to make out of the business of consulting engineering, or sampling and running a laboratory. Of course, this was a great temptation, but my reply was that Mr. Secretan had overlooked one thing: that I owed the pleasure of his acquaintance to a letter of introduction from his present agents; that I could not possibly use this introduction as a means of supplanting them in the agency. This embarrassed Mr. Secretan very much. He assured me that he was going to change his agents anyway, and that if I did not take the agency, someone else would. I said that my mind was made up and that I could not discuss the matter further. He shrugged his shoulders and we parted.

The next evening but one I was called upon in London by the late Theodore Morrison, who said that he had been summoned by telegraph to meet Secretan—I think at Amiens; that they had talked half the night over the question of the American agency; that he, Morrison, while appreciating my sensitiveness, begged me to reconsider my declination, and said that possibly a little of my hesitation was due to a lack of full knowledge of the details of foreign business and international exchange; that he had a son who was in his office and who was thoroughly familiar with all these questions; that if I would accept the agency, he would place him in my New York office, and that I might feel entirely safe. I again declined to consider the proposition, although Morrison still further opened my eyes to the magnitude of the attempt which Secretan was making.

Not long after my return to New York, I was called upon by a representative of Secretan's agents, who told me quite frankly that Secretan had continued the agency with them upon the implied condition or expression of the wish that I should be retained to advise them in matters concerning which he or they might wish to con-

sult me; and that he had stipulated that in all the contracts where copper material, sold in or exported from New York, had to be sampled and assayed to arrive at its value, Ledoux & Company's assays and sampling should govern, and that payments would be made in New York, cash, against our certificates. Of course, I most gladly entered into this arrangement.

Copper mattes, ores, etc., began to pour into our sampling-works until we had to enlarge them and sometimes run them by night, and the business became really enormous—as long as it lasted. The world knows that Monsieur Secretan failed to carry through his great corner, largely because he had to purchase material from unexpected sources, and also because of the weakening of the financiers who were backing him.

Soon matte began to accumulate in our works; there were no shipping orders. We were instructed to hold it by representatives of the bankers who had made advances upon it. Seven thousand tons of matte was thus stored by us for seven years! We did not know who held our storage certificates, nor who owned the matte.

The corner having failed, the French government, which would have applauded Secretan had he succeeded in making Paris the chief market for copper instead of London, had put him in jail for restraint of trade, a director of one of the French banks that had financed him had committed suicide, and the owners of the copper matte did not dare show themselves.

At the end of seven years, our warehouse certificates were surrendered to us by a New York banker, covered with endorsements and transfers, and we were told to ship the matte to the order of Cassell's bank in London—and now comes in again the Erie railroad:

That matte had been delivered to us under the lease or working agreement by which the Erie was bound to deliver it to us for sampling and to send empty cars to transport it to its destination "when notified" by us. We simply sent to the Erie freight-agent the original arrival-notices endorsed with instructions to carry it to the docks and lighter it to the ocean steamers, and the original bill of lading contract was complied with by the Erie without any extra charge, although seven years had elapsed!

I met Secretan once more before his death, when I was sent to make a report upon the Elmore process as carried out at his works at Dives. He was a patriotic Frenchman in spite of his adversities, confidently believing that the world would have been benefited had he been able to carry through his ideas. He complained that not only had the heathen in China substituted copper-plated iron idols for their bronze gods, compelling him to buy the latter by the shipload, rather than to have this metal get into the hands of rivals; not only had many tramp steamers that had been carrying copper as ballast instead of pig-iron (which copper they had bought at 10c. per pound) unloaded it on him when it got up to 17c.; not only had thrifty housewives sold their old copper pots and pans; but that some of the largest producers of the world violated the spirit of their contracts with him. One of them, in particular, bound itself to limit its production, as did some others, by not 'raising' more than so many tons of ore during the term of the contract, but neglected to state that it had thousands of tons already 'raised' and on the dumps, which they rushed through furnaces the product of which he, Secretan, had to buy.

While, of course, some of the producers who sold to Secretan were friends of other assayers to whom they naturally would have given their business, yet the advantage of getting cash in New York was too great to be overlooked, and after the failure of the Secretan syndicate, many of the producers whose acquaintance and friendship we made at that time stayed with us.

Since those days the tides of commerce have changed. We handle little ore or matte or unrefined metals for export today, although the volume of Western American furnace material, flowing to the Atlantic seaboard for refining, goes largely abroad in refined forms, but the ends of the earth are sending their ores and furnace materials here, just now increased by over 50,000 tons of zinc ore from Australia.

American Smelting & Refining. The report for 1914 is notable on account of the following information given:

Men employed, excluding Mexico	12,179
Total wages and salaries paid, excluding Mexico	$10,212,591
Average wages per employee per 8-hour day	$2.33
Ore mined, tons	1,266,702
Coal mined, tons	257,942
Charge smelted, tons	4,171,258
Bullion refined, tons	588,718
Coke produced, tons	129,650
Coal used, tons	544,619
Coke used, tons	447,761
Oil used, barrels	976,528
Gas used, cubic feet	7,430,300
Gold refined, ounces	2,540,911
Silver refined, ounces	77,604,483
Lead refined, tons	316,591
Copper refined, pounds	529,686,000
Metal products manufactured, pounds	40,122,817
Metal production and other income:	
Gold	$ 52,515,549
Silver	42,690,226
Lead	24,551,632
Copper	71,712,527
Other metals	2,431,410
Value of products of Company's mines	3,135,809
Value of manufactured products	2,665,958
Miscellaneous income	1,222,514
Total volume of year's business	$200,925,625
Net earnings available for dividends	9,031,565
Net earnings to volume of business, per cent	+4.49

The directors hope that the foregoing information will be of special interest to the stockholders.

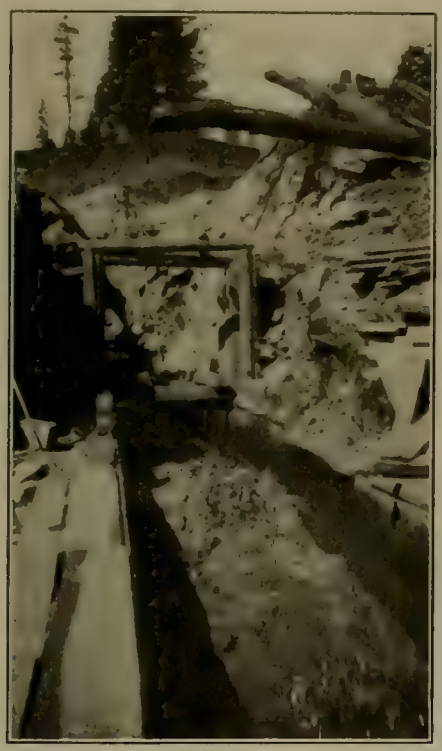
When the American Smelting & Refining Company was organized its business was confined almost entirely to the purchase and smelting of lead-silver ore, refining of gold, silver, and lead, and selling the same. Copper was not sold until 1908. The annual output of copper in America was then 50,000,000 lb. In 1914 it was 529,686,000 pounds.

The Metallurgy of Alluvial Mining

By JOHN M. NICOL

INTRODUCTORY. The purpose of this article is not so much to review the present state of the art as to furnish a critical examination of the principles involved, with a view to suggesting devices that might be more efficient than the ordinary arrangement of sluice-boxes, undercurrents, and gold-saving tables.

Alluvial deposits consist of the detritus resulting from erosion and represent a natural concentration of the more resistant minerals, metals, and gems. These take many varieties of form: blanket deposits from veins; talus deposits partly concentrated by alluvial action, known as *mantas* in Central and South America; recent alluvium in streams; bench placers; old river-channels or 'deep leads'; sea-beach deposits, recent and old.



RACING WATER IN A SLUICE, ILLUSTRATING CONDITIONS UNDER WHICH GOLD IS SUPPOSED TO BE SAVED.

These 'placers,' as they were formerly called by the Western miner, may be worked by a variety of methods, including hand methods for shallow surface deposits, drift-mining for the old buried deep leads, hydraulic mining, elevating, pump-sluicing, and dredging for the large bodies of low-grade gravel. Whatever the metal to be saved or the method used in mining, the metallurgical principles discussed in this article are applicable, although my immediate purpose is to deal mainly with the saving of gold in hydraulic and dredge mining. As a rule, care is taken only to save the chief metal, mineral, or gem, with a consequent neglect to win the possible by-products, which, judging by my own observations, would in many cases be of much value.

PRODUCTS OF PLACERS. In a bulletin of the U. S. Geological Survey, dealing with the so-called 'black sands' of the Pacific slope, on page 54, a list of minerals is given as having been detected during the course of the investigation. Omitting quartz, as normally present, the minerals, in order of frequency are:

Minerals.	Specific gravity. From	To
Magnetite	5.16	5.18
Gold (native)	15.6	19.3
Ilmenite	4.5	5
Garnet	3.15	4.3
Zircon		4.7
Hematite	4.9	5.3
Chromite	4.3	4.6
Platinum (including arsenides)	14	19
Mercury		13.6
Amalgam	13.75	14.1
Feldspar	2.5	2.9
Epidote	3.2	3.5
Olivine	3.2	3.6
Pyrite (chalcopyrite, arsenopyrite, pyrrhotite)	4.9	6.2
Monazite	4.9	5.3
Limonite	3.6	4
Iridosmium	19.3	21.12
Rutile	4.18	4.25
Pyroxene	3.2	3.6
Apatite	3.17	3.23
Titanite	3.4	3.65
Manganese ores	3	4.82
Copper	8.8	8.9
Cinnabar	8	8.2
Cassiterite	6.8	7.1
Tremolite	2.9	3.1
Tourmaline	2.98	3.2
Lead (shot, etc.)		11.37
Wolframite	7.2	7.5
Siderite	3.83	3.88
Corundum	3.95	4.10
Josephinite (awaruite)		8.1
Topaz	3.4	3.65
Scheelite	5.9	6.1
Molybdenite	4.7	4.8
Fluorite	3	3.25
Columbite and tantalite	5.3	7.3

On page 5 of the same publication the following statement is made: "Of the minerals found, the following are evidently saleable wherever found."

Amalgam	Josephinite (alloy of iron and nickel)
Cassiterite (tin)	Lead (bullets, shot, etc.)
Cinnabar	Mercury
Columbite and tantalite	Platiniridium
Corundum (gems)	Palladium (with platinum)
Gold	Platinum
Iridium	Sperrylite
Iridosmium	

Many of the metals of the platinum group and other rare minerals exist in appreciable quantity only in placers.

Unfortunately it is difficult to obtain accurate data concerning the demand for these products, but we may place those most commonly found in the following order of commercial importance: Gold, cassiterite, platinum, gems, iridium, thorium (monazite sand), garnet, and abrasive sand.

Of the rarer metals and minerals found in placers, by far the greater number are only in demand for collections and for experimental purposes. The demand has never been sufficient to stimulate the commercial side of research to a point that would insure means being found to save them as a by-product during the routine work of standard practice. Conversely, the rejection of many of these valuable minerals and metals is also due to the fact that they have not been produced in sufficient quantity to admit of the development of a market that would give them commercial value when used in the arts and manufactures. If demand creates the supply, it is also true that a supply is often a prior requisite for the development of a demand.

The Present State of the Art. The losses that occur in the metallurgical end of placer mining when using the present standard methods are an unknown and unproved quantity. This is largely due to the difficulties of sampling. It must be remembered that, roughly speaking, a drill-sample will only represent something like 1 part in 200,000 to 1 part in 1,000,000 of the body of material to be worked, while in sampling a mine the sample is probably from 1 part in 5200 to 1 part in 10,000.* The sampling of tailing is even more difficult. The difference of opinion on the subject is an added proof of the well known difficulties of correct sampling and of the great variation of the personal equation in this work.

Leaving to one side the question of gem placers, the whole art as at present practised consists of washing and disintegrating the material that has been mined, and passing it (either with or without prior screening of the coarse material) with water, over some form of riffled surface; either sluice-boxes with riffles, or tables covered with canvas or cocoa-matting and expanded metal riffles.

The losses that occur have been discussed by D'Arcy Weatherbe, who says: "In any case, the gold is so excessively fine, particularly at Oroville, that much of it is lost even under the most favorable conditions possible, with the present gold-saving devices. The extent of this loss is not known, as the small amount of research work has given no results of any value. This is one of the features of dredging that surprises the mill-man and metallurgist. * * * A clean-up of the 20th undercurrent of the Spring Valley Hydraulic Co. at Cherokee, Butte county, California, yielded $2600. This gold was taken from material that had been sluiced over 2½ miles of sluices and over 19 other undercurrents, and even then the Chinese were working the tailing below the point; moreover, the gold-saving system of this company was supposed to be the most complete in the state."

Losses occurring in placer mining are due to five grave defects, as follows:

1. The method of saving always aims at making a clear and final separation of the precious metals in a one-stage process.

2. While the mining and sluicing operations are nearly always continuous, the actual removal or saving of precious metals and concentrates is intermittent; there are no means of continuously clearing the riffles as on a table-concentrator used in stamp-mills.

3. The saving of gold or other substance to be saved is entirely dependent upon the classifying action or 'boil' of strong and irregular ascending currents set up by the riffles; the water flowing in the sluices being kept in a sufficiently violent state of agitation to prevent the settlement of anything except gold, platinum, or other metals having a high settling factor; if the boil is not kept strong enough the riffles 'pack' and everything slides over. When the 'boil' is maintained to the point of the riffles being kept clear (the ideal condition of the practical placer miner) all light, flaky, or spongy gold and platinum or any associated minerals that may be valuable for their own, or included precious metal, content, are continuously 'boiled' out from the first to the last riffle, and sent to the tailing-dump.

4. No consideration is given to the possible commercial value of these associated minerals that might be concentrated and saved, or to losses in precious metals occurring as inclusions in heavy concentratable particles, which are now invariably discharged with the tailing.

5. There is no accurate method of assaying the heading and tailing in placer mining, owing to the exceedingly low actual metal-content. The value of that content therefore has to be gauged by a mechanical separation of a large sample; and there is no known convenient method or appliance available for the separation of the by-products.

The losses occurring are, according to my own observations, much more serious than is usually admitted. The losses are especially high in associated and included particles of precious metals existing as concentratable grains of heavy mineral; for reasons given above, it is essential to force this product into the tailing, so as to keep the riffles clean enough to save the gold at all.

In Bulletin No. 45, State Mining Bureau of California, the following statement is made on page 8: "In general the valuable black sand may be described as consisting of hard minerals ranging in specific gravity from 3 to 7, mingled with small percentages of metals and metallic minerals reaching from 7 to 20 in specific gravity. Most of the value will be found in the sand below one-eighth inch diameter of its grain."

And on page 7, referring to the quantity of black sand available, the statement is made that: "In their original condition they form but a small percentage of the grav-

*'Dredging for Gold in California,' by D'Arcy Weatherbe.

els, varying from 0.25c. up to, but seldom exceeding, 2c."

The work that was carried out by David T. Day and R. H. Richards, as was summarized in a bulletin of the U. S. Geological Survey, entitled 'Black Sands of the Pacific Slope, 1907,' was primarily defective in one particular feature. When the original invitation was given for 4-lb. samples, it should have been stipulated that in every case the pounds of black sand or concentratable material per ton of gravel in place must be given, and the relative position of the sample taken, and other data.

In one placer mine that I examined I found in every clean up of the sluices a great quantity of coarse grains of soft red hematite varying from pin heads up to one-quarter inch, and occasionally fragments up to an inch. I collected a fairly large sample and after carefully removing every trace of free gold and black sand, the residue assayed 25.20 oz. in gold and 1.5 oz. in platinum. A concentrate of the screened under-size of 20-mesh made from the tailing of a clean-up from the same mine,

AN UNDERCURRENT, ILLUSTRATING VOLUME OF WATER AND THE 'BOIL' UNDER WHICH GOLD IS SUPPOSED TO BE SAVED.

so that the value of the product could be calculated back into value per cubic yard of average gravel in the mine. Without these details, the work was practically valueless. Nevertheless, from rather unreliable data given under 'Remarks,' we note that the proportion of 'black sand' varies from 1 lb. per 20 cu. yd. of gravel to as high as 650 lb. per ton of gravel. An average of 37 samples from widely scattered points gave approximately 35 lb. of heavy black sand per cubic yard of gravel.

It seems incredible, but owners of mines will not spend the money necessary to prove this crucial point, that is, the proportion and value of concentratable heavy minerals found in the placers; they devote their time and attention solely to free gold that can be caught by known 'riffle' methods.

after carefully removing all free gold and platinum, assayed, gold 19.38 oz., platinum 6.5 oz., osmium-iridium 5.6 oz. per ton of concentrate.

This was clearly in 'included' value. This material had a reducible value of over 35c. per pound, and if therefore there was only one pound per cubic yard of gravel that could be saved, it would more than double the value of the mine; as the free-gold value of the gravel only averaged 18 to 25c. per yard.

My purpose in again raising this vexed problem of 'black sand' is to show clearly that the art of metallurgy in placer mining is defective, and that there is a possibility of saving several metals from the heavy concentrate. I prefer the term 'heavy concentrate' to 'black

sand,' because there are numerous other heavy associated minerals that are not by any means always black, and that may be well worth saving.

STATEMENT OF THE PROBLEM. A clear understanding of the problem that we have to face is essential before we attempt to solve it. Let us take the case of an ordinary gold placer using sluice-box methods of saving.

Let us assume that a cubic yard of gravel weighs approximately 1½ tons; and the precious-metal content is approximately 22½c. of free gold, 875 fine, or worth $18.08 per ounce Troy. Assuming also that by careful hand-concentration tests, it was found that there was 10 lb. of heavy concentrate per cubic yard. Taking no notice of the possible value of the by-products or of the 'included gold' in this heavy concentrate, the problem as gauged by standard methods would be as follows:

In one operation to separate and save six grains Troy of gold, out of a mass of 10 lb. (70,000 Troy grains) of heavy concentrate and the accompanying 2990 lb. of gravel and sand. In other words, to save 6 grains out of 21,000,000 grains. And this at a cost not to exceed 5c. for mining, metallurgical, overhead, and all other charges. It is evident that, owing to the great tonnage handled in placer operations, any saving in cost, or increase in amount of saleable products—counted even in fractions of a cent per yard—is worthy of careful consideration.

There are two principal avenues for the loss of gold:

(*a*) Owing to the necessity, in the one-stage sluice-box method of gold-saving, of maintaining the velocity and supporting power of the current, and the 'boil' or ascending currents in the riffles, in such a state of activity as to prevent the settlement of black sand, and other heavy concentrate, there is no doubt that a great deal of spongy, flaky, rusty, and fine gold, whose settling factors approximate that of the 'heavy concentrate' is carried forward and never has a chance to settle either in the first or the last sluice-box.

(*b*) All of the 'included' gold in fragments of other heavy minerals is also lost for the reason that the heavy concentrate is deliberately boiled out and carried forward.

A great deal of time and ingenuity have been expended in designing riffles and special appliances to keep the riffles clear, overlooking the fact that this must also cause the loss of much fine gold.

Therefore I arrive at the following conclusion: Any form of riffle that does not 'boil' will pack, and all material will pass over and no gold will be caught. Any form of riffle that 'boils' effectively will keep itself clear and in an efficient state to catch gold, but at the expense of practically all of the 'heavy concentrate' and of a certain amount of fine gold, and of nearly all of the spongy or flaky gold, whose settling factor approximates the heavy concentrate, and also of all of the included gold in the heavy concentrate.

The above conclusion applies in varying degree to all fixed riffle-surfaces, sluice-boxes, undercurrents, and canvas tables.

SUGGESTIONS FOR THE SOLUTION OF THE PROBLEM:

1. To use the ordinary sluice-box mainly as a washing, disintegrating, and transporting appliance; and as a metallurgical appliance merely to save the coarse and easily caught gold. Short sections of these main sluices to be in duplicate, and parallel so as to admit of frequent 'clean-ups.'

2. To screen and eliminate, at as early a stage as possible, all coarse material (say about ¾ in.) after it has been thoroughly disintegrated and washed.

3. To eliminate entirely the fixed-riffle undercurrent, expanded metal, canvas table, etc., and to avoid any attempt to make a one-stage separation of the fine gold.

4. To dewater the undersize product of the screens, by some form of simple spitzkasten.

5. To use some form of concentrating device in which the riffles move continuously at right angles to the direction of the flow of sand, with an adjustable travel, so that all of the concentratable heavy particles can be caught, together with the fine gold, and separated afterward by more refined methods. In other words, get away from the 'boil' in the riffles, catch everything that is heavy, and separate the free gold afterward.

6. Use a second-stage screen, send all the dewatered oversize to picking-belt conveyor, and by this means either to the dump or to a crusher, for further treatment, according to its assay-value.

7. Dewater and dry all the fine concentrate, the undersize from the screen. The amount of this concentrate that would require drying, in most placer mines, would not be excessive. At 50 lb. per yard in the 2000 yd. per day mine it would amount to 50 tons. This is a large amount; usually it would be only a few tons per day.

8. Use magnetic separators of special design to remove all magnetic material, generally the true 'black sand.'

9. Add water to the non-magnetic residue and pass over refined concentrating tables, capable of making several separations, preferably at least five. The No. 1 and 2 concentrates of these tables would contain most of the gold and platinum, and so they would represent a very reduced volume of the original gravel, and would probably be high-grade; they might be treated either by smelting in crucibles, or by pan-amalgamation, using sodium amalgam for the separation of the platinum; or they might be sold direct to the refiners.

10. The treatment of the other by-products would depend on what was found.

(To be Continued)

HYDROTHERMAL METAMORPHISM is frequently so profound as to change materially the chemical and mineralogical composition of large areas of rocks. It is only rarely, however, that this process can actually be seen occurring at the present time, under conditions which permit the changes to be traced through their various steps. It is still more exceptional to find recognizable cases where this alteration has gone to so complete a stage that the end products consist of residual soils, essentially in the ultimate stage of decay.

Secondary Sulphide Enrichment of Copper Ores

By ARTHUR L. DAY

*Since about the year 1900 the problem of the secondary enrichment of ores has been growing in interest, and certain phases of it have been studied as opportunity offered, both in the laboratory and in the field. In 1911, L. C. Graton, of Harvard University, planned a much more comprehensive study than has been undertaken hitherto, of one particular phase of this problem, namely, the secondary sulphide enrichment of copper ores. He was fortunately able to enlist the interest and the co-operation of the copper-mining companies, which secured for him special privileges to examine all the principal copper-sulphide mining districts of North America.

This fact of itself is of more than passing interest, for although co-operation between science and industry has been much cultivated in other countries, notably in Germany, and without recorded exception has resulted in great advantages to both participants, but little open co-operation of this character has been attempted in the United States. There would seem to be no reason why American science and industry might not enjoy similar benefits where their common interests are involved.

Recognizing the necessity for laboratory studies on the conditions of formation of the copper-sulphide minerals, the means for identifying them, and the alterations to which they are subject, Mr. Graton proposed to this laboratory that such investigations be undertaken here in direct collaboration with those who might be chosen to undertake the systematic field investigation which he proposed to begin. After some consideration of the scope of the plan proposed, which was rather too large for the resources at our disposal for such a purpose, but in full appreciation of the advantages which such co-operation might offer, the invitation was accepted. In fact, at the moment when the invitation was received, laboratory work on the stability of the sulphides of copper and the relations between them was already in progress, following upon similar work upon the sulphides of iron, of cadmium, and of mercury, the successful results of which enabled us to proceed with full confidence in the outcome of the larger plan now proposed. The difficulty in the matter of resources was happily removed by an allotment from the funds at the disposal of Mr. Graton.

Thus the systematic study of one of the larger problems of geology, a problem of interest equally from the scientific and the economic viewpoints, was begun early in 1912 under the most favorable conditions and has been conducted with vigor and success since that time. Some details of the plan as at first proposed were contained in the annual report of this laboratory for 1913. The present status of the investigation, or rather of the laboratory portion of it, follows.

*From the annual report of the Director of the Geophysical Laboratory of the Carnegie Institution.

WHAT IS SECONDARY ENRICHMENT? It is now generally conceded that when the sulphides of an orebody oxidize at the surface of the ground and pass into the soluble form, they are carried down by percolating waters and re-precipitated on the surface of the still unoxidized sulphides below. The chemical reactions involved in this process and the physical conditions which favor them have been heretofore only matters of conjecture. The laboratory problem involves the elucidation of these processes, as well as the somewhat broader problem of the stability relations between copper and the copper and iron sulphides: chalcocite Cu_2S, covellite CuS, chalcopyrite $CuFeS_2$, and bornite Cu_2FeS_4; it involves the synthesis of these sulphides under known conditions, including, of course, the conditions of natural formation where known and the most important alterations which are found to occur.

The most obvious manner of attack is to start from the pure chemical elements copper and sulphur, and from these to endeavor to make, in the laboratory and under measured conditions, the compounds of these, or, in a word, to study the relations between pure copper and pure sulphur over a sufficient temperature range to include all the natural combinations of these two substances which are known. Heating these two elements together results first of all in the formation of the simple 1:1 compound CuS, corresponding to the mineral covellite, which then appears stable up to about 360°C. Beyond this temperature (in H_2S at atmospheric pressure) it begins to lose S, but microscopic examination shows that the mass remains homogeneous, which may be interpreted to mean that the covellite has lost its stability and yielded place to a lower sulphide of copper carrying sulphur in solution. Continued heating drives out this dissolved sulphur gradually, until in vacuo at 1127°C. the charge melts as Cu_2S, corresponding to the natural mineral chalcocite. The progress of this reaction has been checked by observation at several intermediate temperatures, at each of which the charge is exposed until no further change occurs there, after which the product is examined. The results are tabulated below:

Temperature, °C.	Dissolved sulphur, %	Specific gravity (25°).	Color.	Product.
410	2.89	5.562	Light	$Cu_2S(S)_x$
485	2.32	5.638	Darker	$Cu_2S(S)_x$
700	1.75	5.666	Still darker	$Cu_2S(S)_x$
1050	1.66	5.675	Do	$Cu_2S(S)_x$
1060	1.66	Melting temperature in H_2S (1 atm.)		$Cu_2S(S)_x$
1127	0	Melting temperature in vacuo		Cu_2S

The change in the measured properties is thus shown

to be a continuous one, and the sulphur in solution is found to lower the melting temperature of chalcocite, as might be expected. The relation of these intermediate solutions to chalcocite and covellite is in every way analogous to the relations of the various pyrrhotites, $FeS.S_x$, to ferrous sulphide and pyrite, and since the pyrrhotites are common in nature, chalcocite solutions might also be expected. Nevertheless, the field evidence shows that whereas the pyrrhotites are found more commonly in nature than ferrous sulphide, Cu_2S is certainly more common alone than with excess sulphur in solution.

Thus far, chalcocite alone has not been obtained in the wet way from cupric solutions, but mixtures of the covellite result. When covellite is heated with an excess of alkali sulphide, a part of it is changed into chalcocite with formation of polysulphide, while when polysulphide is heated with chalcocite, part of the latter becomes covellite. The reaction $Cu_2S + Na_2S_2 = 2CuS + Na_2S$ is therefore reversible. At this point the investigation was interrupted until a method could be worked out for the determination of covellite and chalcocite, each in the presence of the other, and this has now been successfully accomplished.

Simultaneously with the above investigation of the relations between sulphur and copper, a similar study of the system copper, iron, and sulphur was undertaken, and, although more complicated than the first, is also well advanced. Chalcopyrite and bornite have both been successfully prepared in the laboratory and a method for their determination is available. Also the composition of pure bornite has been found not to be Cu_3FeS_3 as commonly stated in the books, but Cu_5FeS_4.

Conjointly with these experiments on the formation of the copper-sulphide minerals and their relations, direct experiments have been in progress for some time on the changes which actually take place during the processes of secondary sulphide enrichment. In nature we find indications that the solutions from the oxidized sulphide zone have produced a series of changes in the sulphides beneath them, as follows:

Pyrite changes to chalcopyrite..... $FeS_2 \rightarrow CuFeS_2$
Chalcopyrite changes to bornite..... $CuFeS_2 \rightarrow Cu_5FeS_4$
Bornite changes to covellite..... $Cu_5FeS_4 \rightarrow CuS$
Covellite changes to chalcocite..... $CuS \rightarrow Cu_2S$
Chalcocite (rarely) changes to copper. $Cu_2S \rightarrow Cu$

After more than a year of work, we now know that all these changes can also be effected in the laboratory by the action of copper-sulphate solutions on the sulphides, and will therefore be accessible to detailed study. Most of these changes are very slow at low temperatures and more rapid at higher ones. The laboratory work has therefore been done for the most part at 200°C., but the same reactions have been found to occur at 100°C., and indications of the same reactions or some of them were also found at 30 C. The conditions of deposition in nature are therefore also accessible and the results comparable with those of the laboratory. Moreover, these reactions have been worked out in a quantitative way, that is, the quantities of all the products formed have been carefully determined. The ratios of the iron dissolved and of the sulphuric acid which is formed to the copper precipitated have been determined in all the cases. In some of the cases chemical separations of the products can also be made. Thus the following changes have been established:

Pyrite to chalcocite..... $FeS_2 \rightarrow Cu_2S$
Covellite to chalcocite..... $CuS \rightarrow Cu_2S$
Chalcopyrite to chalcocite..... $CuFeS_2 \rightarrow Cu_2S$
Pyrrhotite to chalcopyrite..... $FeS(S)_x \rightarrow CuFeS_2$
Bornite to chalcocite and covellite. $Cu_5FeS_4 \rightarrow CuS + Cu_2S$

Color changes and incomplete chemical investigations indicate also:

Pyrite to chalcopyrite ..... $FeS_2 \rightarrow CuFeS_2$
Pyrite to bornite..... $FeS_2 \rightarrow Cu_5FeS_4$

Again, the change at ordinary temperatures from pyrite to covellite and chalcocite, $FeS_2 \rightarrow Cu_2S$ and CuS, has been quantitatively worked out and at 300°C. we have found the change $Cu_2S \rightarrow Cu$. All these changes involve an increase of copper in the product, that is, an enrichment.

Thus far, the conditions which determine any particular one of these changes at 200°C. can only be stated in general terms; thus, for example, the higher the concentration of copper solutions and the longer the time and the greater the surface of sulphide exposed, the farther the change will go. A large surface of pyrite and a dilute copper solution gives at first considerable chalcopyrite, but eventually all becomes chalcocite. Certainly none of the intermediate copper sulphides between pyrite and native copper can be regarded as stable in the presence of copper sulphate solutions. Since sulphuric acid is one of the products formed in the oxidation zone whenever pyrite, marcasite, or pyrrhotite is present, we have studied the effect of copper-sulphate solutions on the common sulphides in the presence of acid as well as in neutral solutions. In one instance (the change from pyrite to chalcocite), acid has been found to retard the precipitation of copper; that is, the enrichment process. Now, mine waters have been proved to be less acid the lower the level. The acid is neutralized by various minerals, like the carbonates, feldspars, and others, with which the solutions come in contact. Therefore we should expect that enrichment would go on more rapidly at some distance below the surface, the distance depending on local conditions.

In these various ways the problem is leading to a series of reactions bounded by definite conditions which admit of laboratory study and precise definition. This problem will be pursued actively during the coming year.

DECOMPOSITION of any rock is accomplished by the removal of the more soluble bases, and a concentration of the relatively insoluble oxides of iron, aluminum, and silicon. By reason of its somewhat greater solubility, silica is much more subject to removal than iron and alumina. The two important residual end-products of weathering are sand and clay.

CONCENTRATES

Readers of the MINING AND SCIENTIFIC PRESS are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

NICKEL added to steel up to 3.5% increases its strength and elastic limit.

FELSITE is a general term applied to light-colored fine-grained igneous rocks, chiefly altered rhyolites.

CRUSTIFICATION is a banded structure produced by successive deposition of different layers on the walls of a vein or other ore-opening.

FIFTY SAMPLES of mine-water from mines producing sulphide ore throughout the world showed that 22 were acid, 14 neutral, and 14 alkaline.

LUBRICATION is necessary to diminish friction and conserve power. A shaft should not come in contact with a bearing, it should revolve on a thin layer of oil.

SPONGE PLATINUM recovered in refining over 3,000,000 oz. of gold bullion in U. S. mints in 1912-1913 amounted to 1666.94 oz. Palladium saved was 28.25 ounces.

POROUS STONE and brick may be made non-porous by the use of some fatty or oily varnish which will sink into it. These applications must be renewed from time to time.

PROBABLY nine out of ten ore deposits have some visible relation to a body of igneous rock. In general, a region free from igneous rocks is not characterized by ore.

GREENSTONE is a general name applied to certain igneous rocks, generally fine-grained, of a dark-green color. The term is used when no accurate determination is possible.

QUICKSILVER VERMILION is the amorphous mercury sulphide, which is normally black, but when made with sulphur in the presence of an alkaline solution it becomes bright red.

DRAG is the name given to fragments of ore torn from a lode by a fault. Such fragments are scattered along the line of the fault and are usually enclosed within crushed or brecciated pieces of the rock traversed by that fault. Secondary mineralization along the fault may obscure the true character of the 'drag' in which case the difference in associated minerals may prove suggestive.

MANGANESE STEEL is brittle when slowly cooled. On heating to nearly a white heat and plunging into water, it becomes tough and ductile, a reversal of the ordinary condition.

METALLIFEROUS VEINS have been formed at every period of the earth's history, but a large proportion of the richer concentrations have been made after the later periods of volcanic activity.

COLLOIDAL SELENIUM can be prepared by dissolving freshly-prepared $SeBr_4$ in a hydrobromic acid. This gives a clear brown solution that on dilution gives colloidal selenium.

THE ATOMIC WEIGHT of lead has been under investigation at Harvard for several years. Baxter, Thorvaldson, and Grover's experiments on lead bromide and lead chloride prove lead to average 207.19.

BISMUTHINITE is the sulphide, and bismuthite the carbonate, of bismuth. Bismite is the oxide; also called bismuth ochre. The first of these characterizes the rich sulphide ore found in the deeper workings at Goldfield, Nevada.

SULPHURIC ACID production is second on the list of products known as chemicals; fertilizers are first, being about double the tonnage of the acid. In making fertilizers, 52% of the sulphuric acid manufactured is consumed. In oil refining, 11.7% is used.

WHEREVER WATER has to be cooled for condensers, transformers, or water-jackets, a spray system, properly designed, is considered by some engineers to be the most efficient to operate. It also costs much less to install than any other system of cooling water, and where there is an existing pond, the cost is limited to the spray nozzles and piping. In a spray system, the hot water is cooled by spraying it into the air so that when it falls

into a basin or pond, its temperature is sufficiently reduced to permit of it being used over again. Cooling towers are used in many countries. They are also efficient. They are inexpensive to erect.

IMPURITIES in zinc that affect rolling into sheets are lead, iron, and oxygen. Up to 1.5% of lead and 0.125% iron does not interfere with rolling. Oxygen may occur as zinc oxide. Cadmium is not harmful up to 1.5%. Copper, tin, and arsenic render spelter hard and brittle.

CHILE SALTPETRE sold for $14.50 per hundredweight (112 lb.) in Moscow during March, as compared to a normal price of $2.85. At the petition of manufacturers of chemicals and explosives the import duty has been removed. Means of increasing imports are being discussed.

LIMESTONE containing appreciable quantities of impurities sufficient to give the calcined product hydraulic properties, but insufficient to take up all the lime present, makes, when burned, hydraulic lime. This is an intermediate product between ordinary lime and natural cement.

SALT in sea-water amounts to about 3%; in Great Salt Lake, 9.7%; in the Dead Sea, 10%; and in some gold mines in Western Australia, 10 to 25%. As regards the last it is a coincidence that the majority of the properties which yield a large quantity of salt water, do not produce much gold.

PUMPING-STATION at the 18th level of the Old Dominion copper mine, Arizona, is 15 ft. high, 20 ft. wide, and 55 ft. long. The roof is supported by steel columns. A motor-driven Aldrich pump, of 1200-gal. per minute capacity, is at work. In 1914 this mine produced 1,349,210,000 gal. of water.

FUEL is a substance whose combustion in atmospheric oxygen can be utilized as a source of heat energy for commercial or domestic purposes. Fuels are most conveniently considered as divided into three natural divisions, namely, solid, liquid, and gaseous. The two elements which contribute most to the heating power of fuel are carbon and hydrogen.

THE IDEA that veins in granite are short-lived is a common fallacy. 'Granite' is a term open to various interpretations. It can be stated that the mines of Butte, for example, are in rock of granitoid character, so also are the tin mines of Cornwall. The edges of granite areas, in contact with eruptive rocks, are particularly susceptible to mineral impregnation.

GOLD REFINING in Australian mints is done by the Miller chlorine process. Gas is passed into molten metal. In America the electrolytic method prevails. The latter is considerably slower than the former. In Europe sulphuric acid is used. The quantity of gold annually refined by these processes is £10,000,000, £15,000,000, and £70,000,000 respectively. The advantages of the existing methods are sufficiently nearly balanced at present for the preference shown to one or other of them to depend largely on local conditions.

TURBO-GENERATORS should be connected with a filter of some type to supply clean air for the generators. In Germany this is a feature of all plants. Air passages are liable to get clogged. The capacity of the machine is reduced. This often results in burning out coils. In some plants the generators are cleaned with compressed air. This is not good practice. A machine cannot be stopped for cleaning.

WATER from regions of old rocks like granite is low in mineral content. That from limestone areas is hard. Alkali country gives water a high sodium and potassium content. Swampy water is highly colored. Water flowing through easily disintegrated material like clay is muddy. Drainage from basins with small rainfall is more highly mineralized than that from more humid areas. Ground water is usually higher in mineral than surface water of the same locality. The former is clear, the latter dirty. All of these points should be studied by mining and metallurgical engineers. Good water is a necessity in all mining operations.

ORE from the Youanme mine, Western Australia, contains gold-bearing quartz and iron pyrite, with 0.21% antimony and 0.96% arsenic. Wet crushing, amalgamation, and cyanidation; concentration after crushing, grinding, and slime treatment; concentration by flotation; bromo-cyanide and Gitsham processes; and preliminary caustic soda treatment all failed to give good results. The following process was finally adopted: jaw-crusher, revolving cylindrical drier, No. 8 Krupp ball-mill, Edwards duplex roasting furnace, pulp mixer, fine grinding, filtering, and zinc-dust precipitation. The recovery is 84%, at a cost of $2.16 per ton. The residue assays $1.68 per ton. Cyanide consumption is 1 lb. per ton.

ZINC is used in boilers to prevent scale formation and pitting. Recently there was exported from the United States 400,000 lb. of pure zinc, in the form of plates ½ in. thick, 4 in. wide, and 6 in. long. They had a ½-in. hole bored through the centre. They were to be used in boilers as follows: A steel rod is introduced through the side of a boiler. The plates, together with steel or iron washers, are strung on the rod in alternate layers, so that there is constant contact between the zinc and the iron all the way across the boiler. When the boiler is in use, this arrangement of the two metals constitutes an electric couple. A galvanic current of electricity is set up inside the boiler which, it is claimed, effectively prevents not only foaming of the boiler, but also the deposition of scale. In this way the use of various materials known as boiler compounds is eliminated, and the boiler is kept in good, clean condition for an indefinite period. Aluminum plates act in the same way.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

MIAMI, ARIZONA

NEW SMELTER IN OPERATION.—CAPACITY.—COST.—ROASTING PLANT.—BEDDING BINS.—LIME SUPPLY.

The new smelter of the International Smelting & Refining Co. has started. It has a capacity of 250 tons of copper per day. It was erected primarily to treat concentrate from the Inspiration and Miami mills nearby. It will also reduce custom ore from mines in the Miami, Ray, and Superior districts. This is important for the district. The plant has cost approximately $2,200,000. Estimates were $2,000,000. Improvements in smelting practice caused the increase. L. R. Wallace is in charge.

One of the most interesting features of the equipment is the roasting plant used for ores and concentrates. Its arrangement shows the probable manufacture of sulphuric acid in the future. This would be for leaching purposes. Although it is for roasting, only enough heat is being applied to dry the

VIEW FROM MOONSHINE HILL, MIAMI. NEW INSPIRATION MILL, INTERNATIONAL SMELTER, POWER-PLANT, AND GULCH ON LEFT THAT WILL HOLD 90,000,000 TONS OF TAILING AND SLAG.

material for smelting. Furnaces are of the super-imposed hearth type, familiar to metallurgists. They are fired with oil. This fuel is generally used throughout the smelter. At present the oil is being fed mixed with steam, but as soon as the compressed-air supply is ready, steam will be used only in coils in the bottom of the oil tanks to keep the fuel easy to handle. The oil is received at the plant in a tank holding about 200 bbl. Then it is pumped into a main supply tank of 30,000-gal. capacity, and it then flows into eight measuring tanks, holding 200 bbl. each. These make possible an accurate control of the oil supply, showing exactly the amount being used for any given time.

A scale-hopper weighs each charge as it enters the converter. Three bedding-bins are used to hold the mixture of ore and flux before entering the plant, the material being brought to the bins by a conveyor and mixed by traveling distributers. At present, concentrates, sulphide ore from Bisbee, lime, and iron, are being mixed in the central bin. The mixture is being made low grade to avoid possibility of burning out the bottom of the reverberatories in starting. After the furnaces are partly filled, the charges will be of higher value. At one end of the converter floor is a large grizzly surmounted by a travelling pile-driver. It is for breaking old shells from the converters. The broken material drops into cars and is re-smelted.

At present the International company is buying lime from the Old Dominion, at Globe, four miles away. It has a quarry and crusher on the Copper Hill railway. In the event of the lime required reaching an amount which would make it more economical to quarry its own flux, the smelting company will build a line to its large limestone deposit about a mile northwest of the plant.

No. 1 reverberatory furnace was charged with roasted concentrate on May 17. Waste heat from the reverberatories will generate steam in Stirling boilers in the usual way. The converting department is ready to receive matte. The Cottrell electrolytic dust-saving process is working in connection with the Wedge roasting furnaces. This system is fairly well understood by metallurgists, and needs no further description. Another installation is being fitted in the converter flue.

At the Warrior 60 men are working. Ore shipments to El Paso and Hayden average 5 to 7% copper.——Patrick P. Sullivan, well known at Globe, and associates in 22 claims adjoining the Warrior and Inspiration, are preparing for churn-drilling. They expect to cut the Warrior ore dipping west between the dacite hanging wall and schist foot-wall.——Encouraging results are reported from the Cole-Goodwin.——The Savage claims, one mile west of the Gibson, are considered among the best prospects of the Miami district. Adits have exposed a strong vein. The Miami Development company and Stoll & Jones have bonded the property.

GOLDFIELD, NEVADA

ROUND MOUNTAIN.—JUMBO EXTENSION, ATLANTA, SANDSTORM, KENDALL, ORO, SILVER PICK, COMBINATION FRACTION, AND KEWANAS.

The annual meeting of the Round Mountain Mining Co. was held in Goldfield on May 17. James R. Davis was again elected president and manager, Louis D. Gordon vice-president, H. G. Mayer secretary and treasurer, with W. H. Webber and W. C. Erb additional directors. Mr. Davis reported good progress in laying the pipe-line from Jett cañon to the mine, eight miles, to supply water for sluicing. This will commence between June 1 and 15. The company's mill is working as usual. A new orebody has been opened on the 800-ft. level.

Equipment for the Velvet shaft of the Jumbo Extension company is being installed. It includes a double-drum electric-hoist, 100-hp. motor, Cameron Pump, and air connection. Air will be supplied from the 16-drill compressor at the Polverde shaft. Sinking will begin within the next 10 days. This shaft will be sunk as quickly as possible to 1017 ft. Then connection will be made with the deepest workings from the Polverde shaft, 500 ft. distant. In new workings, southwest of the 1017-ft. level rises, No. 524 drift and 507 cross-cut have exposed ore of uniformly high grade along the latite-shale contact for a length of 400 ft. The contact area both above and below this point, which is at a depth of 884 ft., is all virgin ground. This work follows the surface of the shale almost due east. As the contact ore-channel is shown to extend slightly east of south, along the dip of the shale, it is apparent that the area of enrichment is considerable. All work has been confined to development for some time past. Occasional shipments are made to

relieve congestion in the bins. A rise is being driven from the south drift at 1017 ft. to reach the shale contact. This drift has continued for over 100 ft. in the large fissure that extends into the shale. On the 790-ft. level a cross-cut far to the east, near the Velvet shaft, has exposed large quantities of $6 to $12 ore. This is apparently in the main Velvet vein, in the latite, well above the shale. A special shareholders' meeting was held at Phoenix, Arizona on May 20 to ratify the agreement with the Reorganized Booth Mining Co., and to increase the capital of the Jumbo Extension, in order that 300,000 shares might be transferred to the Booth company in payment for the cession of apex rights.

The Atlanta company is shipping at the rate of 50 tons daily. Shipments are usually made every other day, to effect a saving in sampling and handling the product at the mine. The average value is from $27 to $30 per ton. Stoping is in progress from the incline cross-cut in ore, 115 ft. above the 1750-ft. level, and extending toward the adjoining Grizzly Bear ground on its pitch to the north. From a point 50 ft. higher in the air-rise, another cross-cut will be driven to the stope for air. This will be done at intervals of 50 ft. At a point in the air rise, 80 ft. below the 1400-ft. level, seams of ore were exposed, assaying 3½ oz. gold. Work will soon begin at this depth. From the main stope a drift, known as 1013, is being advanced south, on the vein, to connect with rises 1011-A and 1012-A, over 200 ft. south. Both are in good ore. A rise has just been started 300 ft. south of the new workings, on a body of $27 ore exposed over a year ago in the first work on the 1750-ft. level. The main cross-cut, from which the newer workings have been opened, in its progress from the hanging to the foot-wall, cut the vein diagonally. It was in profitable ore for 107 ft. The company's engineers are already considering the practicability of an oil-flotation plant. Ore now being shipped contains from 5 to 8% copper.

Sinking has been resumed by the Sandstorm-Kendall company at a depth of 550 ft. An electric-hoist has been installed at the collar of the winze on the 500-ft. level. This replaces the windlass used to sink 50 ft., following the incline of the vein. This incline will be followed, with the purpose of finally reaching the point of contact between this vein and the shale. The vein is regarded by engineers as one of great promise. It produced a good tonnage of rich ore nearer the surface. Tests of the company's placer ground, which were delayed by storms, will now proceed, for the purpose of determining whether better results can be obtained by washing, or by screening and washing combined.

The Goldfield Oro is now working on the 800-ft. level where strong seams of ore have been exposed lately. The ground is broken, and has given considerable trouble at 700 and 800 ft. ——Silver Pick Con. is extending a cross-cut west from the new station at 700-ft., to reach a large vein that was cut on the 500-ft. level.——Combination Fraction lessees have cut a seam of high-grade ore. They are rising to develop the vein. ——At the Kewanas development continues at 840 ft. along the latite-shale contact, in a fissure that penetrates the shale.

TORONTO, ONTARIO

Dome Mines Co.—Hollinger and Acme.—Huronia.—McIntyre.—Dome Lake.—Nickel.

At a meeting of the directors of the Dome Mines, held in New York on April 30, it was decided to issue 50,000 shares of treasury stock at par, *pro rata* to shareholders of record June 26. At the present price of the shares this will be equivalent to a dividend of 40c. per share. The authorized capital of the company is $5,000,000. The new shares will bring the issued capital up to $4,000,000. The money raised will be used to finance new development, and to provide for a number of new buildings. It is expected that a large proportion of the total amount will be held in reserve to pay for new additions to the mill. These will probably be built this year. The annual meeting of the company will be held in Toronto on May 25. The report is expected to show a profit of over $1 per ton during the past year. It is also expected that at this meeting some definite program regarding the future dividend policy will be announced. The property is in excellent condition. The recent discoveries on No. 6 level, in addition to the favorable developments on No. 4 and 5 levels, have greatly improved the outlook.

Hollinger shares continue to make new high records with monotonous regularity. This advance, aside from the excellent results from the property, is largely based on the expectation that Hollinger shareholders will participate in the flotation of the Acme company on an attractive basis. So far however, nothing definite has been done regarding the issue of Acme shares. When these eventually are offered, it is probable that the Hollinger and the Acme will be consolidated. At the Hollinger the new central shaft is down 425 ft. A station is being cut at that depth. It is to be sunk to 1200 ft. The winze below 800 ft. is down 100 ft. Early in June development of No. 1 vein at 925 ft. will be started. Results at 800 ft. are good.

It is understood that the Canadian Mines and Finance Co., which controls the above, has taken an option on the Huronia mine near Kirkland Lake. This property, owned by Montreal people, is equipped with a plant and a small mill. After operating the latter for several months, the company was forced to stop operations on account of a lack of funds. About $400,000 has been spent to date. The property is now being examined and sampled and if the results are satisfactory, work will be started June 1.

The McIntyre mill is treating about 300 tons per day. Gross profits for April are expected to be $40,000. This will be sufficient to clear the deficit and leave a surplus. The financial statement of the company for the year ending March 31, 1915 shows current assets of $102,782. This includes $1840 cash, and $46,791 bullion. Current liabilities, including a bank overdraft of $57,507, are $114,704 leaving a deficit on current account of $12,000.

The Dome Lake mine was closed down on May 1 to permit of necessary repairs to the mill and also to an adjustment in the wage scale. All the men were discharged. It is expected that the majority will be re-employed at a lower rate of wages to conform to the wage-scale that is in effect at the other mines of the district. This step was considered necessary to avoid the provisions of the Lemieux Act, which requires a notice of 30 days before any cut in wages can go into effect. Economies will be effected in all departments. It is hoped that when these changes are made the property will be able to make a profit of about $4000 per month. As the ore reserves are small, and the company owes the Hudson Bay Mines, the controlling company, about $80,000 for money advanced, the prospects for the shareholders cannot be considered very encouraging.

Results on the Vipond continue to be satisfactory. It has been decided to increase the capacity of the plant to 120 tons per day.——The North Thompson, which adjoins the Vipond is to be re-opened. A contract has been let for the sinking of a 300-ft. shaft.

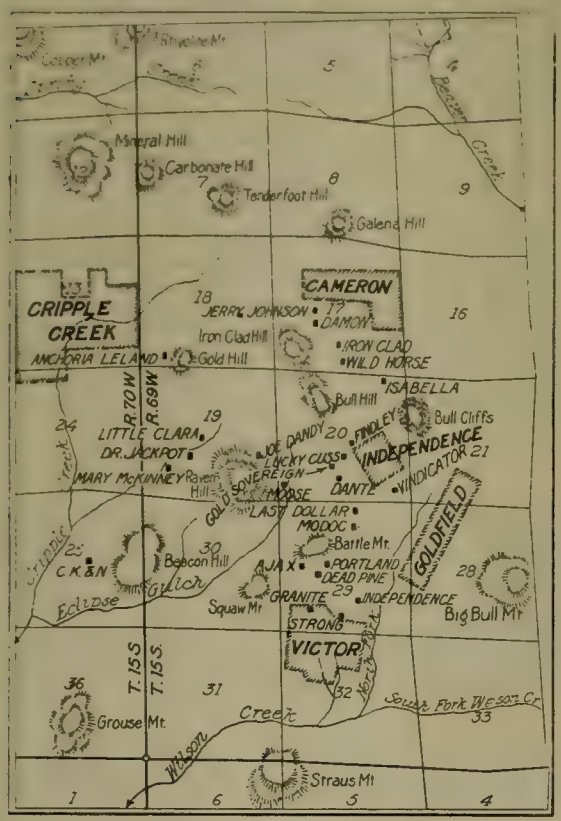
Directors of the International Nickel Co. have declared the regular quarterly dividend of 2½% and an extra bonus of 2½% payable June 1. The heavy demand for nickel to be used in the manufacture of munitions of war, as well as for industrial purposes, has resulted in the heaviest sales in the history of the company. The large supplies of refined nickel on hand at the refinery at New Jersey have all been used. In order to cope with requirements the company will install another blast-furnace. A new five-compartment shaft is being sunk at the Creighton mine. New hoisting equipment will also be installed and a new rock-crusher and sorting-house built.

The Huronia mine in Gauthier township is to be developed by L. H. and N. A. Timmins, who are also interested in the Hollinger. The workings are being sampled.

CRIPPLE CREEK, COLORADO

PROPERTY CONSOLIDATIONS—STRATTON'S AND PORTLAND.—ISABELLA LESSEES.—MINING DUMPS.

Topics of interest in this district during the past week were mergers and rumors of mergers. It is now stated that A. E. Carlton proposes a merger of the Vindicator, United Gold Mines, Findley, and others, to form a new company and keep the mining company separate from the milling or Golden Cycle Reduction Co. This is regarded as improbable, as the Vindicator, which recently bought the Golden Cycle mine, is pretty well satisfied at present. Mr. Carlton's holdings in the Vindicator are hardly large enough to change the policy of the company. A more probable combination would be to separate the Golden Cycle Mining & Reduction Co. into its component parts, namely, the Golden Cycle mill, the United Gold



CRIPPLE CREEK DISTRICT.

Mines, Trail, Findley, and other mines. Meanwhile rumors are numerous, and nearly every property in the district has been merged with some other in popular discussion.

The Stratton's Independence mine has been sold to the Portland Gold Mining Co. as a going concern for the sum of $300,000. The further allowance for stores on hand, etc., will bring the total close up to $375,000. This is a wise move on the part of Stratton's Independence, for with the big dumps exhausted and only a small showing of ore in the mine the company could not hope to exist much longer. The Portland company will be enabled to mill its dump at the No. 1 shaft through the Independence mill and save an expensive double handling on this material. The Portland mill was built on the top of Battle mountain, so that crude ore and supplies have to be pulled up to it and tailing pulled away from it. The disposition of the tailing has reached a critical stage with them, so much so that it would not be surprising to see the mill taken down and added to the Independence mill. Incidentally, the Portland company will now be able to take care of low-grade custom ore here in the district and save—as against the Golden Cycle Co.—the haul to Colorado City. Indeed, a great many possibilities are now before the Portland company. The Independence company maintains its existence and will proceed at once to acquire new property, according to the will of the shareholders as expressed at the meeting held in London on May 17.

Clark Mitchell, superintendent of the Isabella, recently made public a commendable report on the general conditions at this important property. He has succeeded, in face of great odds, in putting this property back on the list of large producers, and is entitled to great credit. He says, in part: "Forty-five sets of lessees are now operating, several of them meeting with splendid success. Just recently a very important find was made at the 14th level of the Lee shaft, on company account, in a region where very little development has ever been done. There is every indication that we have something new and big, better, in fact, than we had on the Isabella in years."

With the coming of warm weather great activity is apparent on the various dumps of the large mines. It is surprising the amount and grade of the shipments from these sources in a summer. About 150 men are already at work and the next few weeks will see that number doubled.

BOSTON

COPPER AND ZINC DIVIDENDS.—WEST VIRGINIA MINING CO.—JUNEAU STOCKS.—NORTH BUTTE.

Meetings of several copper companies in the latter part of May for dividend action have aroused interest. People are wondering what the increased prices of copper and zinc will do in the way of distributions to stockholders. It seems to be a certainty that Butte & Superior will increase its regular dividend rate, or else yield to the pressure for a large extra disbursement. The directors will probably feel compelled to distribute some of the company's great profits. Utah Copper is earning about $15 per share, yet it sticks to the $3 annual rate. This, however, it maintained through the latter part of 1914, a period which caused even Calumet & Hecla to pass payments in its 50-year dividend history. The position of the 'porphyries' is strong. Their handling has been conservative. It is possible that Chino will restore the 75c. quarterly rate, and Ray Consolidated will resume its interrupted dividend payments of 37½c. per quarter. Some surprise was expressed at the failure of the Granby directors to resume dividends at the meeting this month. Granby is in position to pay larger dividends than ever before. While the copper and zinc company managements are looking for at least two or three years of high prices, they are proceeding, as a rule, with great caution in the matter of increasing regular dividend rates.

William Osborne, United States marshall of the southern district of West Virginia, was recently here in connection with the re-organization of the company that operates the Surprise, Lone Pine, and Pearl mines in the Republic district, Washington. These properties have been taken over by the West Virginia Mining Co., capitalized at $1,000,000. This is to be reduced at once to $250,000. New machinery has been shipped. About 40 men are at work at the mines. These properties have been frequently discussed in the *Press*.

The Juneau, Alaska, district is assuming increased importance for Boston traders. Alaska Juneau, now on the Boston and New York Curbs, is to be listed soon on both Exchanges.

Some talk is occasionally heard of Anaconda absorbing North Butte on a share-for-share basis. The two stocks are selling at the same level in the market. The dissolution and disappearance of Amalgamated will be the signal for many new developments of importance in the Butte district. The Amalgamated's report for 16 months has been issued.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press.

ALASKA

The new mining law passed by the Territorial Legislature and approved April 20 repeals all conflicting sections in the law of April 30, 1913. Among some of the new provisions are the following: No association placer claim shall exceed 40 acres. For every individual or association placer claim $100 worth of labor shall be performed during each calendar year, including year of location. No individual placer claim in future shall exceed 1320 ft. in length, and no association claim shall exceed in length 2640 ft. Claims may not be staked by power of attorney in future, unless that power has been recorded in the recording office of the district where the claim is staked, and before the staking of the claim. [This clause probably is the outcome of the disputes in the Chisana district in 1914, power of attorney being the deciding point.—EDITOR.] No one shall locate or cause to be located more than two placer claims for himself in any one recording district within one calendar month. Assessment work must be recorded within 90 days after the close of the calendar year in which the work was done. Otherwise the location shall be deemed abandoned.

A new wall map of Alaska has just been issued by the U. S. Geological Survey. The map is on a scale of 23.7 miles to 1 inch (1:1,500,000) and measures 55 by 82 in. It may be purchased for 80c. per copy. According to the Department of Commerce, Alaska has produced gold, fish, fur, copper, and other materials worth over $500,000,000 since 1867. A small population, now 65,000, has been responsible for this great output. Products sent to the United States from the Territory in 1914 totaled $44,000,000, while shipments to Alaska were $21,610,860. Trade with foreign countries amounted to about $1,663,000.

JUNEAU

On May 12 sinking was started at the Treadwell main shaft. It is 1878 ft. deep, and will be sunk 500 ft. more. On May 28 the Alaska Mexican, Alaska Treadwell, and Alaska United companies distributed 20c., $1, and 40c. per share respectively. It is reported that Robert A. Kinzie, formerly with the companies on Douglas island, is returning to Juneau to take charge of the Noble properties at Mt. Juneau. It is thought that the Ebner mine may be included in the consolidation proposed.

ARIZONA

GREENLEE COUNTY

The pumping plant of the Morenci Water Co. is described by W. L. Du Moulin in the April *Bulletin* of the American Society of Civil Engineers. The works are about six miles southwest of Morenci, on the Eagle river. Besides supplying water for the town, the Arizona and Detroit copper companies draw their needs from the system. The population is 6000. The mills have capacities of 3000 and 1300 tons per day, respectively. There is also a 350-ton smelter. The surrounding country is almost a desert. Water is pumped in one lift of five miles against a head of 1525 ft. The plant, which is valued at $675,000, has a capacity of 4,500,000 gal. per 24 hours.

MOHAVE COUNTY

(Special Correspondence)—A number of mining transactions involving a good amount of money have taken place lately. The largest was that of the Pioneer Consolidated Mines Co. It divided its 328 acres into four groups. The Pioneer claims were sold to Colorado people, headed by Whitney Newton. The property was examined by Howard Bancroft. The Pioneer company retains the Minneapolis, Snowball, and Harold claims. A 10-stamp mill and general equipment is on the Pioneer property included in the deal. The shaft is to be sunk from 400 to 600 ft. At 100 ft. is a 293-ft. shoot averaging $8.50 per ton; at 400 ft. is 250 ft. of $12 ore.——The Straight, Hardy, Cash Entry, Moonlight, and Sunlight claims have been acquired by F. Crosley and J. O. A. Carper of Cripple Creek, and other Colorado men. The second and third mentioned are under option.——The Last Chance, Lazy Boy, and Gray Eagle properties have been optioned to Los Angeles people. The Gilt Edge was sold to New York people.

The United Eastern Mining Co. has decided to erect a treatment plant. Seeley Mudd, of Los Angeles, is a director.

Oatman, May 18.

Last week the Amster interests closed their option on the majority of shares in the Union Basin Mining Co., which owns the Golconda zinc mine. A good smelter contract is in force.

YAVAPAI COUNTY

On May 18 the new smelter of the United Verde Copper Co. at Clarkdale was blown-in. The plant has a daily capacity of 3000 tons, double that of the old smelter nearby. The mines and works are controlled by Senator W. A. Clark. Charles W. Clark is general manager, and Robert E. Tally superintendent.

Twenty stamps, two tube-mills, concentrators, and a cyanide plant of 150-ton capacity are being erected at the Copper Chief mine. Electric power will be supplied by a line going to Jerome.

CALIFORNIA

CALAVERAS COUNTY

In addition to equipping the Calaveras mill to treat 100 tons per day, 15 tons of high-grade copper ore daily is being shipped to smelters.——At 200-ft. depth in the Nassau copper mine some rich ore was cut last week.——Rich gold ore is being extracted from the Economic at Esmeralda.——At Reynolds ferry, G. Oneto and others of Angels are driving an 1800-ft. tunnel to divert the Stanislaus river from its course. It is in 1200 ft. The dry bed will then be washed.

KERN COUNTY

According to W. M. Mills, chemist and assayer at the High School at Bakersfield, extensive tests show that platinum exists in the black sand of the upper Kern river, and in the Antrim vein of the Long Tom mine. The metal occurs as an arsenide of platinum.

NEVADA COUNTY

Seventy-five tons of machinery has arrived at the Brunswick. More is on the road. Construction includes a steel head-frame, 20-stamp mill, classifiers, and vanners. A small cyanide plant for concentrate is being considered. Dividend No. 8, of 6c. per share, equal to $24,000 will be paid by the Brunswick on June 15.——On May 21 the mill, head-frame, hoist, and other plant at the California mine was destroyed by fire. The plant will probably be rebuilt, according to the manager, G. C. Cunningham.——The Ragon Flat mine, west of Nevada City, is to be shut down indefinitely.——Work is to be resumed at the Major gravel mine in a few days. J. M. Proctor is in charge.——A carload of copper ore from a property in the Rough and Ready district has been sent to the Selby smelter. L. Williams controls the mine. A good tonnage has been opened.

PLUMAS COUNTY

The Engels Copper Mining Co., which operates in Lights

cation, near Taylorsville, has issued a report for the period ended April 30, 1915. It contains the following information:

At present there are six machine drills working in the mine. Another air compressor has been bought. A favorable diamond-drilling contract has been let. Holes are to be bored in the property now worked. Further drilling will be done later on in the Superior and other claims controlled. The capacity of the mill is to be increased during the summer.

During the first four months of 1915 the mill produced 1447 tons of concentrate. Of this 563 has reached the smelter, leaving 884 tons on hand and in transit. Early in June the latter should be at the smelter. The concentrate averages 36% copper and $5.50 per ton gold and silver.

A 75-hp. Holt caterpillar engine and three Mack trucks are used for hauling supplies and concentrate. Three 5-ton trucks are also to be used. The combined haulage should move about 40 tons of product per day.

There is plenty of water on hand for the hydro-electric plant. Spring rains promise enough for the summer.

The financial results are as follows: total debt, $104,728; value of 796 tons of dry concentrate on hand and in transit, $105 per ton, $83,575; net debt April 30, $21,153; estimated yield in May, 400 tons at $105, $42,000; operating expenses in May, $20,000; credit balance, $846.

The manager, Elmer E. Paxton, states that the company should be on a paying basis within two or three months, after setting aside money for development. Edmund Juessen and Henry Hanson have been appointed operating engineer and mill superintendent respectively.

Seneca, which is 16 miles from Greenville, and 3 miles from the Great Western Power Co.'s dam at Nevis, is the busiest district in this country at present.——Denver people, who have the Seneca Consolidated under bond, made their first payment of $20,000 this week. Machine-drills and pumps are to be ordered. Ten stamps are crushing. Twenty-five men are employed, in charge of J. J. Riley and E. E. Brandt.——All the gravel mines on the north fork of the Feather river are working. These are operated by syndicates employing from one to 15 men. The Cameron placer mine is owned by Utah people. It is one of the best on the river. A 300-ft. adit is being driven to open the channel at a lower level.——Oakland people control the Glacier.——Rich gravel is being extracted from the Scott.

San Bernardino County

At the Oro Belle mine, under option to the Tonopah Belmont company of Nevada, 12 miners have been repairing the shaft. Drifts are to be started at 600, 700, and 800 ft. Good ore is showing at 100 ft. Treatment will offer no difficulties.

Santa Clara County.

It is reported that the Pacific Chemical Co. will erect a plant at Agnew, costing $100,000 to manufacture potash. Residue from the adjoining Western Grain and Sugar Products Co. will form the source of raw material.

Shasta County

The Victor Power & Development Co., operating the Midas at Harrison gulch, has started work on its hydro-electric plant. This will replace steam power.

Siskiyou County

(Special Correspondence.)—The Rollin Mining Co., of San Francisco, has unwatered the Daggett shaft of the Black Bear mine. It is re-timbering the old workings. Near the shaft a drift has cut a 7-ft. vein. The property is equipped with a 16-stamp mill and good plant. Production will commence shortly.——Hydraulicking has been resumed at the Walker & Fippin mine, near Callahan. The property consists of a large porphyry dike, easily worked with giants. Frank Fippin is superintendent.——Several nuggets have been recovered recently from the John Peterson hydraulic mine at Eddy's gulch, on the Salmon river. The largest is valued at $250. Several others were worth from $5 to $20. John Peterson is manager.

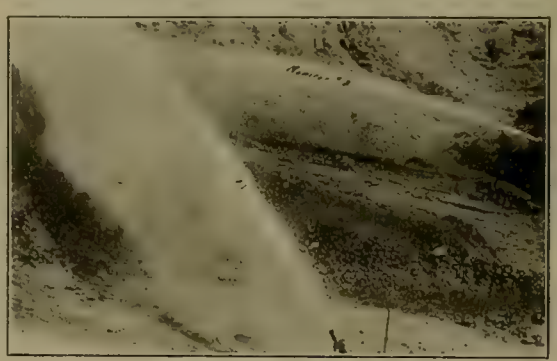
——Work has been resumed at the Homestake mine, near Yreka, with a small force. Plans are being made for the building of a small mill. Considerable ore is blocked out, together with over 300 tons on the dumps. John Boyle is superintendent. R. S. Taylor, of Yreka, is managing owner.——The Victory Gold Mines Co., composed largely of Los Angeles people, has purchased a mill for its U. S. A.-North Pole group. The plant has a capacity of 50 tons per day. Ore will be amalgamated and concentrated. It is expected to start treatment in July. John Nefroney is manager.——A large nugget, of an estimated value of $750, was recently found in the Messner mine, at Fox creek.——George Baker and sons have sluiced off the earth from their quartz claims at Indian creek and are preparing for development. Good ore has been found near the surface, and outcrops of several veins have been exposed.——The 1915 session of the Northern California-Southern Oregon Mining Congress will be held at Etna Mills, July 1 and 2. G. F. Hellmuth, M. H. Balfrey, Walter Day, E. W. Bathurst, and A. Dannenbrink constitute the committee of arrangements.

Etna Mills, May 24.

Trinity County

Five feet of ore has been opened in the Oriole mine on Indian creek. Weaverville people are interested.——A large tonnage of ore has been opened in the Democrat mine, two miles from Weaverville. Development is done by means of adits.

Recent heavy rain and a fall of snow will supply plenty of water for the season's hydraulicking. Lagrange is working full time. Trinity Consolidated is sluicing its Hupp, Union Hill, and other claims.



GIANTS AT THE LAGRANGE MINE, TRINITY COUNTY. THE INLET PIPES ARE 18-IN. DIAMETER, DISCHARGE PIPE 21½ FT. LONG, AND NOZZLE 8-IN. DIAMETER. THE HEAD IS 600 FT., AND WATER USED 2300 TO 2400 MINER'S INCHES.

Owners of the Headlight mine at Carrville plan resumption of work. The mill will probably be remodeled to treat sulphide ore in the summer.

Yuba County

A large dredge is to be built for the Marigold Gold Dredging Co. by the Union Iron Works, San Francisco. The boat will dig at Marigold, near Marysville.——Marysville people have organized the Lafayette Drift Gravel Mining Co. with a capital of $50,000. It will work a property in Plumas county.

COLORADO

Gilpin County

The Iron City mill at Black Hawk is being overhauled. Its capacity will be doubled, 50 to 100 tons per day. A large quantity of ore awaits treatment.——Fifteen lots of ore are ready to go through the Carr mill. Twelve 'cords' (9 tons per cord) of ore from the Castle Rock mine were treated last week

in this plant. It yielded 20½ oz. gold and 28 tons of concentrate.——Machine-drills are to be used in the Barnes mine, Quartz hill. J. C. Jensen is manager.——Development at the Missouri and West Baker mines is highly encouraging.

LAKE COUNTY (LEADVILLE)

The St. Louis-Colorado Mining Co. has been organized with a capital of 500,000 shares at $1 par value. The property is in the Lackawanna district, in the southwest part of the county. Work will commence early in June. Dorsey W. Almond is general manager.

An arrangement has been made between the Yak Mining, Milling & Tunnel Co. and the Big Five Operating Co. whereby the latter may drive a cross-cut adit from the Yak to the Big Four shaft. The adit will be about 700 ft. It will open the Big Four to a depth of 1000 ft. A rise will connect the adit with the shaft.

The Fortune mine, worked through the Yak tunnel, is now shipping ore to the local smelter. New machinery is to be ordered. James McNeece is in charge.

OURAY COUNTY

Rich silver ore has been opened in the Agnes vein of the Mountain Top mine. A rise on the main vein is in $20 ore. Construction of the new mill will start before long.

TELLER COUNTY (CRIPPLE CREEK)

(Special Correspondence.)—The Last Dollar mine, operated on lease and bond by Page and Rapp, will now be worked by the latter, the former having disposed of his interest to Rapp. This old mine has one of the deepest shafts here about. It was a fair producer some years ago. Its dump of 150,000 tons of $3 ore goes with the lease. A small mill may be erected to treat the dump and low-grade ore from the mine. A recent discovery on the 1200-ft. level is yielding shipments averaging around $70 per ton.

The Ajax is about to resume operations at the mine, this time on the leasing plan, probably on the 'split-check' basis. When production warrants it the mill will probably be started. Many applications for leases have been made. A considerable number of men will soon be at work.

The recent development in the Blue Bird is opening well. It now seems as though a persistent vein has been cut. In addition to the work of the company, about ten sets of lessees are at work. A fair tonnage of good-grade ore is being mined.

The Trail discovery is still causing excitement. The walls of the vein have not yet been found. Shipments are worth from $23 to $80 per ton.——The adjoining Dexter is also producing a fair tonnage of $30 ore.

Victor, May 22.

IDAHO

SHOSHONE COUNTY (COEUR D'ALENE)

Profits of all companies operating in the Coeur d'Alene in 1914 were approximately $5,981,683, according to reports to the county assessor. According to P. L. Eberhardt, of Spokane, all of the mines in the Coeur d'Alene are being worked. More men are employed than ever before. The Nine Mile district, where are the Interstate-Callahan and Success zinc mines, is the most active area. The former's two-mile aerial tramway is ready. The Marsh company is overhauling its mill. The Stanley antimony mine should be shipping ore soon. The Tuscumbia mine and Idora mill are ready. The Gertie's lower adit is half finished. Near Mullan the Silver Cable has opened a large body of high-grade zinc ore. In the Stevens Peak district the Reindeer-Queen company has a good tonnage of copper ore. A mill is under consideration. It is reported that the National copper mine and mill is to resume operation.

The Federal Mining Co. has declared its quarterly dividend of $1 per share, equal to $120,000.——The Interstate-Callahan company is to distribute an extra dividend of 75c. in addition to the regular 25c. The total will be $460,000.

Rich copper ore has been cut in No. 2 adit of the Carney mine, near Mullan. The vein is in 1500 ft., and 700 ft. below the surface. About 3000 ft. of work has been done on the property, results being encouraging.

MISSOURI

The value of the mine output of silver, copper, lead, and zinc for the year 1914 was $25,874,864, against $29,604,890 in 1913, according to the U. S. Geological Survey. The falling off was due mainly to a decrease in sphalerite concentrate of more than 36,000 tons. The production of concentrate, of which all but 40 tons was derived from the Joplin region, amounted to 189,765 tons, valued at $7,351,726, a decrease of 36,085 tons in quantity and of $1,829,234 in value, compared with 1913. The output of zinc carbonate and silicate in 1914 was 19,648 tons, valued at $415,185, against 21,531 tons, valued at $483,463, in 1913. Over one-half of this kind of zinc ore was shipped from leases of the Granby Mining & Smelting Co. at Granby. The recoverable spelter content of the zinc concentrates (which averaged slightly higher in zinc in 1914 than in 1913) was 105,994 tons in 1914, against 124,963 in 1913. The total quantity of lead concentrate produced was 279,854 tons, or 24,132 tons more than in 1913. The mines operating in the disseminated lead district in southeastern Missouri produced 249,165 tons of galena concentrates averaging 67.6% lead. The Joplin region reported the sale of 30,494 tons of galena concentrate and 195 tons of lead carbonate concentrate, a much smaller yield of both classes of ore than in 1913. The estimated total quantity of ore, lead, zinc, and copper, treated in Missouri in 1913 was 11,492,300 tons, or about 800,000 tons less than in 1913. The decrease was due almost wholly to the lessened activity in the mines in the Joplin region. The average recovery of both concentrate and metal per ton of ore treated was slightly higher than the recoveries in the two previous years, reflecting to some extent the lower ore prices prevailing in 1914, as such prices made the operation of some mines unprofitable.

The yield of silver and copper was derived mainly from the dressing of lead concentrates from mines in southeastern Missouri. The production of silver amounted to 61,168 fine ounces valued at $33,826, an increase of 25,548 oz. compared with 1913. The production of copper in 1914 was 44,463 lb., valued at $5914. The only mine in Missouri reporting production of copper ore was the Swansea mine, in Ste. Genevieve county, which produced oxidized ore carrying copper and silver.

For the week ended May 8 the output of ore in the Missouri-Kansas-Oklahoma district was valued at $639,753. This is $100,000 more than in any previous week. For the 19 weeks of 1915 the total is $5,756,200 blende, $276,445 calamine, and $709,086 lead, a total of $6,741,731.

MONTANA

FERGUS COUNTY

(Special Correspondence.)—Plans are being made for the construction of a cyanide plant at the Spotted Horse mine at Maiden in the Judith mountains. This mine has produced several millions in gold since it was discovered in 1881, having been one of the largest producers in Montana. Recently it has been profitably worked by lessees. Examination has disclosed that large bodies of ore should continue to be discovered. The ore is found in a shoot or chimney along the contact of a sheet of porphyry and sedimentary limestone and shales, ranging in age from Cambrian to Carboniferous. Some very rich pockets of gold ore have been found in the Spotted Horse, and considerable $100 ore is blocked out. The production so far has come mostly from surface workings. The mine is developed to a depth of 585 feet.

A. S. Wright, who controls several prospects in the Judith and north Moccasin mountains, has returned from the East. He will at once start development at the Gold Acres claims adjoining the New Year property. The latter at one time was considered to have excellent prospects to develop into a profitable mine. A good cyanide plant was installed and a large

amount of work was done, but the property has been closed for some time. There is a possibility that further work will be resumed there also.

The Gold Links company owns valuable ground near Kendall. The recent discovery of ore in depth at the North Moccasin mine of the Barnes-King company will result in development being done on the property in the near future.

The Cottonwood Coal Co. is now erecting a $150,000 tipple and coal-washer at its town of Lehigh, near Windham. With the completion of the washers, its product will be the cleanest in Montana. The Great Northern railroad purchases the entire production. The output will continue to increase steadily. It is mining a coal bed 8 to 14 ft. thick, from a shaft over 200 ft. deep. Last year water gave considerable trouble. Pumps recently installed have proved capable of draining the mine. There are 190 men employed at present, and 75 more will soon be added, mostly carpenters and steel-workers.

Lewiston, Montana, May 7.

Silverbow County

Two cars of ore per day are sent from the Bullwhacker to the Washoe smelter. Another car will be added soon. This will go to the East Butte's Pittsmont plant.

NEVADA

Clark County

Over 100 cars of ore per month is being shipped from the Good Springs district. Every property is being worked, including the Ninety-Nine, Monte Cristo, Frederick, Anchor (has 200 tons of 70% lead ore), Pilgrim, Whale, Sultan (has 10 ft. of zinc ore), Hoodoo, Bonanza, Prairie Flower, Dusky Bell, and Keystone. The Yellow Pine employs between 80 and 100 men. It is producing 40% zinc ore. The Boss platinum mine is still finding ore in the deeper levels. The copper ore also contains platinum.

Elko County

According to a correspondent in *The Tonopah Miner*, charges at the custom mill at Midas are far too high. The ore is not refractory. Moisture amounts to from 5 to 9%. For $20 ore the charge is $8 per ton. Every $10 increase in value another $1 is added; $1 per ton is charged for sampling and assaying. Settlements are made on 87.5% of the assay-value. Carting to the mill costs from $1 to $2.50 per ton. At Rochester, a standard rate of $6 per ton is made. There is no reason why miners in this county should not be treated as well as in Humboldt county.

Esmeralda County

During April the Goldfield Consolidated mill treated 30,872 tons of ore, yielding a profit of $154,257. Costs totaled $5.38 per ton, including 17c. for construction. Development amounted to 3205 ft., at a cost of $6.20 per foot. Lessees produced 683 tons worth $36,825. Of this the company received $18,320, less transport and treatment charges.

Humboldt County

Under the name of the Rochester Consolidated Mines Co., the Rochester Mines and Rochester Weaver companies have been consolidated. The capital is 2,000,000 shares, of which 350,000 are in the treasury. A 100-ton mill is to be erected at the Nevada-Packard mine.

Lincoln County

Investigations are being made for the new mill of the Yuba Leasing & Development Co. of Pioche. B. I. Smith is manager, and Otto Wurtenweiler will design the plant.

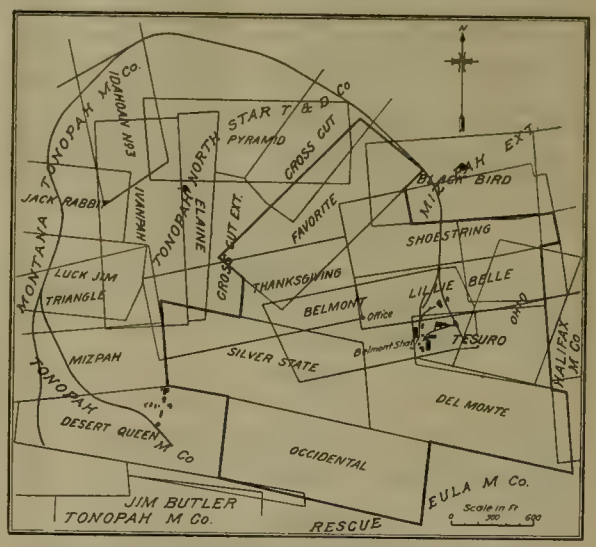
Nye County

Seven mines and lessees at Tonopah produced 10,548 tons of ore valued at $215,824 during the week ended May 22. Stope 555 in the West End is 12 to 14 ft. wide. The ore is the richest in the mine.

The report of the Tonopah Belmont Development Co. covers its financial year ended February 28, 1915. The report of the general superintendent, Frederick Bradshaw, contains the following information.

Between the 600 and 1500 ft. levels of the Belmont, development covered 24,630 ft. The total in this ground is 80,477 ft. There was no advance in the Desert Queen workings. The cost was $7.246 per foot, a decrease of 94c., and 68.3c. per ton of ore milled. There was mined a total of 228,328 tons. Of this, the 900 to 1400-ft. levels, inclusive, yielded 224,783 tons. The Belmont vein supplied 77,730; Shaft, 63,887; Occidental, 12,911; Favorite, 18,883; Mizpah fault, branch A, 4762; Mizpah fault, branch B, 14,487; Lillie Belle, 13,203; and Western, 20,585; while other veins furnished 3180 tons. From the 228,328 tons of crude ore there was sorted out 46,958 tons of waste. The latter assayed about $1.50 per ton. The resulting ore of 181,370 tons was worth about $16.74 per ton. Total mining costs were $4.313 per ton, 38.6c. less than in the previous year. Ore reserves, estimated as at March 1, 1915, consist of 226,921 tons of positive, 6355 tons of probable, and of 61,808 tons of possible ore, a total of 295,084 tons.

The mill superintendent, A. H. Jones, reported that the plant at Tonopah treated 181,424 tons of ore averaging 0.2236 oz. gold, and 22.3 oz. silver per ton. The recovery was 92.99%, slightly less than in 1913, on account of the ore being more refractory. Cost of treatment amounted to $2.564 per ton, a decrease of 48.5c. Metal production was 40,591 oz. gold, and 3,714,862 oz. silver. The plant at Millers, 12 miles from Tonopah, treated 44,692 tons of custom ore. This yielded 12,469 oz. gold, and 1,031,745 oz. silver. Profit from this work was $24,344. Costs were reduced from $4.034 to $3.766 per ton. This was the result of the new process. A saving of 80c. per ton will be made later. Extraction increased to 90.05% from 87.45%.



TONOPAH BELMONT CLAIMS SHOWN BY DARK LINES.

Like all other silver producers, the Belmont suffered from the low market price. Of the 3,714,862 oz. produced, only 2,068,763 oz. was sold. The balance is stored in San Francisco. Total receipts were $2,714,191. The net income was $1,456,698. Dividends totaled $1,462,504. At the beginning of the year the balance was $2,126,763; at the end it was $1,963,286. Quick assets are valued at $1,852,465. Dividends to date amount to $7,268,010.

The Dexter White Caps Mining Co. will hold a meeting at Tonopah on May 26 for re-organization. On March 31, cash in bank was $7.81; current assets $1106. Current liabilities were $18,827. From 1911 to 1914-15 inclusive the output was 19,909 tons valued at $381,054, an average of $19.14 per ton.

From April 1, 1906, to March 31, 1915, the net income was $45,867. Deducting $65,684, all charges, the deficit is $19,816.

The report of the Tonopah Mining Co. of Nevada for the year ended February 28, 1915, contains the following information:

Ore reserves are estimated at 102,056 tons averaging $14.94 per ton. All mining and hoisting is being done on day shift, excepting the Sand Grass work. Development amounted to 18,485 ft.; mining cost $4.10 per ton.

Changes were made in treatment. The filters did not make a satisfactory recovery of the dissolved metals. Sand did not give as good results as slime. By altering the filters their capacity was increased, and the highest recovery and lowest costs resulted. The mill treated 147,261 tons containing 2.6% moisture. It assayed 21.22 oz. silver and 0.246 oz. gold per ton. Treatment cost $2.96 per ton. Total costs were $8.51 per ton. Revenue from all sources was $2,308,740. Expenses, including $1,000,000 in dividends, totaled $2,514,473. On February 28, 1914, the surplus was $3,975,353; on that date of 1915 it was $3,860,244. Silver stored in San Francisco is valued at $609,162. The company has large interests in Colorado and Nicaragua. The former, Tonopah Placers Co., made a profit of $200,347 from dredging gold worth $467,204.

Storey County

At the Comstock lode, the Con. Virginia and Ophir, jointly with the Pumping Association, have been repairing the southwest air-way on the 1465-ft. level of the Ophir incline shaft. At 2500 ft. the station has been repaired. The main north drift from this point is to be started. In the Ophir central adit workings, the north drift shows 6 ft. of $12 ore.——At 2300, 2500, and 2700 ft. the Mexican is doing interesting work.——At 2500 ft. the Sierra Nevada and Union Con. have installed a hoist and cage at the winze station. The latter is in porphyry and quartz in the west cross-cut at 2650 ft.——The C. & C. shaft pumps are working well.——The Yellow Jacket mill received 977 tons of dump ore last week.

White Pine County

Safety First of the Nevada Consolidated Copper Co. for April shows that at Copper Flat there were nine disabling accidents, minor mishaps at the Ruth, none at the concentrating plant, and three at the smelter.

OREGON

Baker County

After being closed for 10 months the Ben Harrison has resumed work at full time; from 40 to 60 men are employed.——Good reports come from the Imperial at Cable Cove. The mill is operating again.

UTAH

The relation of ore deposits to different types of intrusive bodies in Utah is discussed by B. S. Butler in *Economic Geology* for March. He summarizes as follows: The larger intrusive bodies of Utah are of two types, laccoliths and stocks. The laccoliths occur in the sandy and shaly sediments in the southeastern part of the state, the stocks in the quartzites and limestones in the western part of the state. The stocks may be sub-divided into those truncated near the apex and those truncated at greater depth. The deeper truncated stocks are uniformly more silicious. The apically-truncated stocks are monzonitic to dioritic in composition, the deeper truncated stocks have the composition of granodiorite to granite. The ore deposits associated with the laccoliths and deeper truncated stocks have been of comparatively slight commercial importance, while associated with the apically-truncated stocks are deposits of great value.

The Murray, Midvale, and Tooele lead-silver smelters are working full blast, the first time in many years. The total daily capacity is about 6500 tons. Besides Utah ores, some comes from Colorado, California, and Montana. The smelting companies want carbonate and silicious ores. They have plenty of sulphides.

Beaver County

In the Leonora mine, Star district, 6 ft. of hematite ore has been cut in the east adit. This is promising, as silver-lead and zinc ores in the property have been associated with it. The superintendent, A. C. Nebeker, states that either gasoline or electrically-driven machinery is to be installed.

Salt Lake County

High-grade ore has been opened at 700 ft. in the Darnell claim of the Utah Apex company. The Parvenu shaft is down 1300 ft. Cross-cutting about 900 ft. for the vein has been started. The quarter ended March 31 showed a net profit of $51,106.

On April 11 the Utah Metal & Tunnel Co. cut a new orebody; one car daily is now being shipped to the Murray smelter. It contains 0.24 oz. gold, 11 oz. silver, 32% lead, 1.5% copper, and 18% iron. A large tonnage is being opened.

Three lots of ore from the Wasatch mine returned 22.42 oz. silver, 26.73% lead; 66.70 oz. silver, 11.25% lead, 11.205% copper; and 25.65 oz. silver, 6.25% copper respectively. They netted $17.70, $63.66, and $25.85 per ton. Some rich silver-copper ore was cut on May 21.——The Alta Con. is laying a 5000-ft. air-pipe from the Wasatch plant.

Summit County

The Park City Mills Co.'s plant is now in full operation, treating low-grade ore from the American Flag mine. The Holt-Dern furnace is working satisfactorily.

Washington County

It is reported in Salt Lake City that gold ore has been discovered near Quail Springs in the new Goldstrike district. An automobile road is to be constructed from St. George to Goldstrike, 33 miles. The latter place has telephone communication.

WASHINGTON

Ferry County

The West Virginia company, operating the Lone Pine and Surprise properties at Republic, is installing a 200-hp. compressor, Diesel engine, and electric hoist this month. The company has been using the San Poil compressor up to the present time. About 30 men are employed. This company is referred to in the Boston letter of this issue.

Stevens County

The first unit of the United Copper Co.'s mill at Chewelah will be ready about June 1. With the old plant the daily capacity is 200 tons. Oil flotation is part of the process. A month later the second unit should be finished. The 50 stamps will crush 350 tons per day. Diamond-drilling below 1000 ft. justifies the expenditure on plant. Costs will be reduced. Eighty-five men are employed. E. A. Wolfe and Roy Wethered are mine and mill superintendents respectively.

CANADA

British Columbia

Since sluicing started near Vernon on April 20, the Union Hydraulic company has moved 80,000 cu. yd. The ground averages 20c. per yard. Costs should not exceed 3.5c. The first clean-up will be made on June 15. R. H. Hanauer is general manager.

The report of the British Columbia Copper Co. for 1914 states that mining and smelting at Greenwood was suspended in August on account of the metal market. Development of the Copper Mountain property was continued at a reduced rate. The latter work disclosed 6,200,000 tons of 1.82% ore. Also 750,000 tons averaging 1.54%. The Mother Lode, Napoleon, Queen Victoria, and Lone Star mines yielded 178,049, 5332, 7920, and 1988 tons of ore respectively, a total of 193,289 tons. Development cost $183,204. Metal shipments realized $899,851. The year resulted in a loss of $39,765.

The general manager of the Canada Copper Corporation, Oscar Lachmund, reported as follows for 1914:

Development in the Mother Lode mine amounted to 2576 ft.,

also 4852 ft. of diamond-drilling. This work cost 8.7c. per ton of ore and $5.96 per foot, and 6.4c. per ton and $2.37 per foot respectively. Sorting cost 1.55c. per ton. The total underground charge was $6.18 per ton. Construction was charged against operation. Hand sorting increased the costs above normal. Reserves are estimated at 315,000 tons. Reserves in the Napoleon, Lone Star, and Emma amount to 273,000 tons. Prospecting was done at other claims.

The Greenwood plant smelted 299,928 tons of company and custom ore. Metals produced were 4,116,190 lb. copper, 14,442 oz. gold, and 63,501 oz. silver. The furnaces were in blast for eight months, less one week.

At Copper mountain, 130 miles west of Greenwood, prospecting consisted of 18,315 ft. of trenching (some trenches 35 ft. deep, owing to overburden), and 28,134 ft. of drilling. Estimates place the ore at 4,523,763 tons of 'reasonably assured' and 1,675,000 tons of 'probable' ore. 'Outlying' deposits contain 405,170 and 345,000 tons respectively.

ONTARIO

A winze is being sunk from the 500-ft. level of the Porcupine Crown. At 300 ft., 800 ft. from the shaft, there is 40 in. of $30 ore. The shoot on this level is 1030 ft. long. At 400 ft., 790 ft. has been opened so far. Diamond-drilling is under way at 500 ft., prospecting beyond the fault.

In April the Dome mill treated 23,630 tons of ore averaging $4.01 per ton. The annual report of the company shows that ore reserves total 2,782,811 tons assaying $4.15 per ton. These are above No. 5 level. The mill treated 248,550 tons worth $4.25 per ton. The revenue was $1,055,496; and operating profit $315,179. Net assets total $441,028.

On May 15, buildings and shaft-house at No. 1 of the Chambers-Ferland were destroyed by fire.

KOREA

(Special Correspondence.)—A recent cable to San Francisco from the Suan Concession states that an extensive ore deposit has been partly developed near the Suan mill. The superficial area is about 5,000,000 sq. ft., the depth varying from 3 to 70 ft. Metal contents are approximately 50c. gold and 1.5% copper.

San Francisco, May 12.

PHILIPPINE ISLANDS

According to 'Press Bulletin 39' of the Bureau of Science at Manila, dated March 31, the engineers of the division of mines have returned from an examination of the iron ore in Surigao province. Analyses of 250 samples will be published as soon as they are finished. Test-holes were drilled over an area of 100 square kilometres, totaling 650 metres in depth. The deposit is similar to the Mayari ore near Nipe bay, Cuba. It is a great surface blanket of iron-bearing clay, that has resulted from the weathering and decomposition of the original rock. At Surigao this rock was principally mineral serpentine. Water-power and natural harbors are near the deposit.

Schools and Societies

The SPOKANE MINING MEN'S CLUB is arranging for an automobile excursion to the Chewelah copper district in June.

Materials of engineering construction will receive special attention in the proceedings and discussions of the INTERNATIONAL ENGINEERING CONGRESS to be held in San Francisco, September 20-25, 1915.

The third annual joint field meet of the U. S. BUREAU OF MINES, AMERICAN MINE SAFETY ASSOCIATION, and CALIFORNIA METAL PRODUCERS ASSOCIATION will be held at the Panama-Pacific Exposition on September 23 and 24. First-aid and mine-rescue demonstrations will be held. Committees include well known mining men.

PERSONAL

C. W. MERRILL is at New York.

J. A. AGNEW is expected at Denver.

HORACE WINCHELL is at Salt Lake City.

JOHN M. NICOL has gone to Trinity county.

FRED. T. WILLIAMS is in northern Arizona.

ELWOOD MEAD has returned from Australia.

WILLIAM W. MEIN is returning to New York.

F. R. WEEKES, of New York, is in California.

D. C. JACKLING leaves today for Juneau, Alaska.

JAMES G. DOOLITTLE is here from Salt Lake City.

DAVID T. DAY has returned to Washington, D. C.

C. M. EYE has returned to Los Angeles from Arizona.

VICTOR G. HILLS, of Denver, was here during the week.

R. S. BAVERSTOCK has been examining a mine in Oregon.

W. S. APPLEBY has gone to British Columbia for a holiday.

J. POWER HUTCHINS has returned to Petrograd from London.

PHILIP ARGALL sails from Liverpool for New York on May 29.

S. J. WEISS has returned to London from the Malay States.

J. E. RYPINSKI has returned to Moscow, Pa., from San Mateo, Costa Rica.

R. B. BRINSMADE has been visiting the mining districts of Oaxaca, Mexico.

J. B. P. WEBSTER and WALTER G. PERKINS left London for Russia recently.

W. H. LOVELETT, A. M. PETERSON, and W. G. PATTISON are in London from the Congo.

H. V. WINCHELL has moved his office to 826 First National-Soo building, Minneapolis.

EUGENE P. KENNEDY has returned from Juneau and will remain in San Francisco for several months.

HENRY S. MUNROE was the guest of honor at a dinner given by the Chemists Club, New York, on May 28.

B. MAGNUS has resigned from the management of the Mt. Morgan mine, Queensland. A. A. BOYD is acting general manager.

CLINTON P. BERNARD was among those saved when the *Lusitania* went down. He was on his way from New York to Greenland.

SCOTT TURNER dislocated his shoulder in jumping from the *Lusitania* when she sank, and suffered minor injuries from which he is recovering.

RICHARD R. FREEMAN, JR., a Harvard graduate about to join the staff of the Russo-Asiatic Corporation in Siberia, was among those lost on the *Lusitania*.

Obituary

JOHN BIRKINBINE died at his home near Philadelphia on May 14, aged 71. He was widely known as an authority on iron enterprises and water-supply engineering. As a president of the American Institute of Mining Engineers and of the Franklin Institute, he won professional recognition of his honorable character.

JOHN TRAVERS, lately working at Johannesburg, Kern county, California, and formerly at Searchlight, Nevada, was found dead on the desert three miles from Searchlight. He had $300 about his person and was traveling with a horse and burro. From indications it is surmised that his horse got loose, that in endeavoring to catch the animal he was kicked in the forehead and then staggered forward, trying to reach help, but died before being able to attract attention. The burro came into Searchlight with the pack nearly off, and a party immediately went in search, fearing some such tragedy as had occurred, but when found the man was dead.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, May 27.

Antimony	35 —35¾
Electrolytic copper	19¼—19½
Pig lead	4.65
Quicksilver (flask)	$75.00
Spelter	16½—16¾
Tin	40 —41½
Zinc-dust, 100-kg. zinc-lined cases	20

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, May 27.—Copper is quiet and lower; lead is firm; the spelter market is excited and steadily rising.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
May	20	Apr. 14	16.03
"	21	" 21	16.85
"	22	" 28	17.93
"	23 Sunday	May 5	18.63
"	24	" 12	18.75
"	25	" 19	18.68
"	26	" 26	18.50

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	....
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	....	Nov.	11.75	....
June	13.60	....	Dec.	12.75	....

The American Brass Co. has withdrawn all its quotations on brass goods made by it. This action is the result of the high prices of copper and spelter, from which brass is manufactured. Brass plants in the Connecticut valley are operating 24 hours per day. Their stocks of copper are low. Some firms are depending on day to day deliveries. The first shipment, 230,000 lb., of mineral from the White Pine mine, Michigan, has been sent to the C. & A. smelter at Hubbell.

Exports from the United States during the week ended May 18 totaled 11,869,484 lb., valued at $1,879,651. France took 4,896,631 lb.; England, 3,758,763 lb.; Italy, 2,352,693 lb.; and Norway, 578,572 pounds.

Reports for the first quarter of 1915 are as follows:

	Chino.	Nevada.	Ray.	Utah.
Ore treated, tons	406,000	564,834	656,652	1,396,341
Copper, per cent	2.1851	1.49	1.667	1.4393
Copper, pounds	11,732,508	10,815,680	4,821,071	26,415,995
Profit	$835,193	$704,734	$777,759	$1,691,728
Dividends paid	$434,970	$499,864	.....	$1,218,368
Cost per pound, cents	6.88	8.97	8.843	7.289

The Ray directors announce that dividends will be resumed on June 30.

A useful 60-page brochure on copper has been published by Charles A. Stoneham & Co. of New York.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
May	20	Apr. 14	50.06
"	21	" 21	50.18
"	22	" 28	50.60
"	23 Sunday	May 5	50.33
"	24	" 12	50.06
"	25	" 19	49.93
"	26	" 26	49.77

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	....
Feb.	57.53	48 45	Aug.	54.35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58 52	50.25	Oct.	51.12	....
May	58.21	....	Nov.	49.12	....
June	56.43	....	Dec.	49.27	....

The silver market is considered lifeless. On May 22 about 200,000 oz. was sent to China from San Francisco. Last week 302,219 oz. went to London via New York from Cobalt. The first quarter of 1915 shows a decrease of 1,060,647 oz. in the silver output of Ontario, which means Cobalt. London reports small supplies from America. Indian Bazaars and Europe purchases are light. Eastern exports from London to May 6 totaled £2,109,000, against £2,766,000 last year. In their letter of May 6, Samuel Montagu & Co. have interesting remarks on the situation in China. Silver stocks at Shanghai on April 10 were £8,000,000, say 80,000,000 oz. London also holds £1,000,000, say 10,000,000 oz., on China account. The War has caused this lockup of capital. It is always necessary for Eastern banks trading with China to maintain an equipoise between their commitments in gold and their commitments in silver, otherwise speculation sets in.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Apr.	28	May 13	75.00
May	6	" 20	75.00
	70.00	" 27	75.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60.00	Aug.	80.00	....
Mch.	39.00	78.00	Sept.	76.25	....
Apr.	38.90	77.50	Oct.	53.00	....
May	39.00	....	Nov.	55.00	....
June	38.60	....	Dec.	53.10	....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
May	20	Apr. 14	4.20
"	21	" 21	4.20
"	22	" 28	4.23
"	23 Sunday	May 5	4.20
"	24	" 12	4.20
"	25	" 19	4.20
"	26	" 26	4.20

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	....
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	....	Nov.	3.68	....
June	3.90	....	Dec.	3.80	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
May	20	Apr. 14	9.12
"	21	" 21	9.37
"	22	" 28	11.04
"	23 Sunday	May 5	12.21
"	24	" 12	14.33
"	25	" 19	15.08
"	26	" 26	17.79

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	5.22	9.05	Aug.	4.45	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9.78	Oct.	4.75	....
May	4.91	....	Nov.	5.01	....
June	4.84	....	Dec.	5.40	....

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	....
Feb.	39.76	37.23	Aug.	50.20	....
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	....	Nov.	33.51	....
June	30.72	....	Dec.	33.60	....

Tin is quiet at 37 to 38 cents.

Eastern Metal Market

New York, May 21.

A cessation of demand from both foreign and domestic consumers of copper has led to offerings at lower prices. The market remains quiet. Lead is firm, but dull. Most of the interest centres in spelter, which again is soaring because of its scarcity. Even large consumers have been buying in a hand-to-mouth manner, as evidenced by their entering the market in quest of June and July deliveries. Makers of sheet zinc and of galvanized sheets have advanced their prices. Larger arrivals and a more general acceptance of Banca tin in place of Straits has brought a decline in tin quotations. Chinese and Japanese antimony have continued to advance. Aluminum is scarce and higher.

COPPER

Both the foreign and domestic demand for copper has slackened to such an extent in the past few days that prices can be considered only nominal at best. With the lack of interest on the part of consumers there developed a growing pressure to sell, and second-hands made offerings down to 18.50c. cash, though 18.62½c. was more commonly quoted by them. Some of the producers still assert that they are holding to 18.87½c., cash, or 19c., full terms, but copper in almost any quantity can be had at the lower prices. The inactivity is believed to be but temporary. There is much talk of England having made inquiries for a large quantity, but the report lacks confirmation. Exports continue to go forward at a good rate. Up to May 21, they totaled 24,078 tons. The quotations for Lake continue to vary greatly. Choice brands are quoted at 23c., good grades can be had at 21 to 22c. Metal containing a trace of arsenic can be had at 19c. The London quotations for standard copper and for electrolytic have been irregular, generally weaker.

Comparisons and deductions of interest can be made from the accompanying table of copper exports from the United States during the four months of this year, as compiled by C. Mayer, secretary of the New York Metal Exchange. The great falling off in exports to Germany and Holland are at once apparent. It is also noticeable how far short increased exports to other countries are of compensating for the loss. The increase of shipments to Italy from 6875 tons in 1914 to 16,658 tons in 1915, and also the shipment of 8297 tons to Norway and Sweden, help to make up the deficit, but they and the other increases were not sufficient to prevent a decrease of 61,573 tons in the four months. In some minds the heavy shipments of early 1914 give rise to suspicion that buying for war needs was in active progress before the impending conflict was considered a probability by the world at large. At that time the charge was repeatedly made that the metal was being stored in Europe for speculative purposes, but today it looks different.

Copper exports in four months of 1914 and 1915, in long tons:

	1915.	1914.
United Kingdom	30,177	26,221
France	33,412	27,361
Germany	.....	51,223
Holland	237	29,059
Belgium	.....	1,683
Austria	.....	7,774
Italy	16,658	6,875
Denmark	305	.....
Norway and Sweden	8,297	.....
Russia	851	.....
China and Japan	.....	1,590
Sundries	725	449
Total	90,662	152,235

Total exports of copper from the United States in 1914 were 360,229 tons, against 382,810 tons in 1913.

TIN

Larger and more regular arrivals and liberal offerings of Banca tin at comparatively low prices have served to bring prices down until May 21, 37.87½ was quoted. A great deal of Banca tin has arrived in recent weeks and consumers, particularly those who mix metals, have been turning to it. Makers of babbitt metal, solder, and type-metal who formerly used Straits tin, have purchased Banca. Apparently they are satisfied with the results obtained. A period of dullness was broken in the latter part of last week when between 500 and 600 tons changed hands. All positions, from spot and metal afloat to tin to be shipped from the East, were dealt in. The New York quotation May 13 was 39.25c. On successive days the following prices were quoted: 38.75, 38.62½, 39, 38.25, and 37.50c. The arrivals up to May 21 totaled 2255 tons. There was afloat on that day 3880 tons. Supplies are coming in with much greater freedom from English ports. On June 3, 745 tons are due to arrive on three vessels from Singapore, Penang and Batavia.

LEAD

Despite continued quiet the market remains firm. The New York quotation is unchanged at 4.20c. At St. Louis the price has hardened, and 4.12½c. is quoted. It is reported that the United States Government has negotiations under way with a large smelter for a considerable quantity of the metal, but no large deal has been closed so far as the trade knows. This, and the fact that export sales have been lighter, are the only feature of the week.

SPELTER

It again appears as if the spelter market might be running away. Quotations have advanced steadily in the past week. The prices given for May and June metal are almost entirely nominal, because of the acute scarcity of those positions. The market has been excited, not only here, but abroad. For December delivery, up to 15.25c. has been obtained, while spot, if it can be found, will bring 16.25 to 16.75c., for prime Western. The usual differential between St. Louis and New York is more or less ignored, and practically all quotations are for prompt shipment from the West, wherever early delivery is specified. Brass mill special is selling at premiums which cannot be accurately stated, as many of them are paid following private negotiation. For high grades 20c. has been paid. Large consumers have been in the market for June and July deliveries. This indicates that their supplies on hand will not carry them far ahead. One producer states that last week he was compelled to decline to quote on 8000 tons because of his sold-up condition. The London price advanced May 18, £4, or about $19.50. The market abroad has been erratic, with alternate periods of quiet and activity. Manufacturers of sheet zinc advanced the base price of their product, May 18 to 18.50c. f.o.b. mill in carload lots. This quotation is subject to an 8% discount. Makers of galvanized sheets also have advanced their prices and the entire market for zinc and the products it enters is strong.

ANTIMONY

There is little to say about this metal, more than has been said repeatedly recently. Cookson's and Hallett's are no longer quoted, and none is offered save when some consumer wants to realize on a few odd casks he may have, and then almost absurd prices are asked. One such would-be seller wanted 53c. f.o.b., Boston, but this was an extreme case. Offers from the East are reported as fewer. Chinese and Japanese are quoted at 34.50 to 35 cents.

COMPANY REPORTS

BUTTE & SUPERIOR COPPER COMPANY

Whatever this company's name may signify, the fact remains that it is a zinc producer, one of the most important in the United States. Its operations have been followed with great interest. The report for 1914 makes good reading. The statement of the president covers the profits made, dividends paid, average price of spelter, effect of the War on the market, bonds, smelting contracts, selling arrangements, and litigation connected with the mine and mill.

During the year the property was closed for 60 days on account of necessary repairs to the main shaft. Improvements were also made to the head-frame, skips, and mill. Other equipment was installed. Development amounted to 16,796 ft. The total to date is 55,671 ft. Stoping has been done to 120 ft. above the 700-ft. level. Ore above that level is probably exhausted. Not much development was done at 800 and 900 ft. Fair results were obtained at 1000, 1200, and 1500 ft. A good shoot of average ore exists at 1500 ft. Reserves are estimated as 1,030,000 tons, averaging 20% zinc and 7 oz. silver, practically the same as in 1913. Mining cost $3.21 per ton.

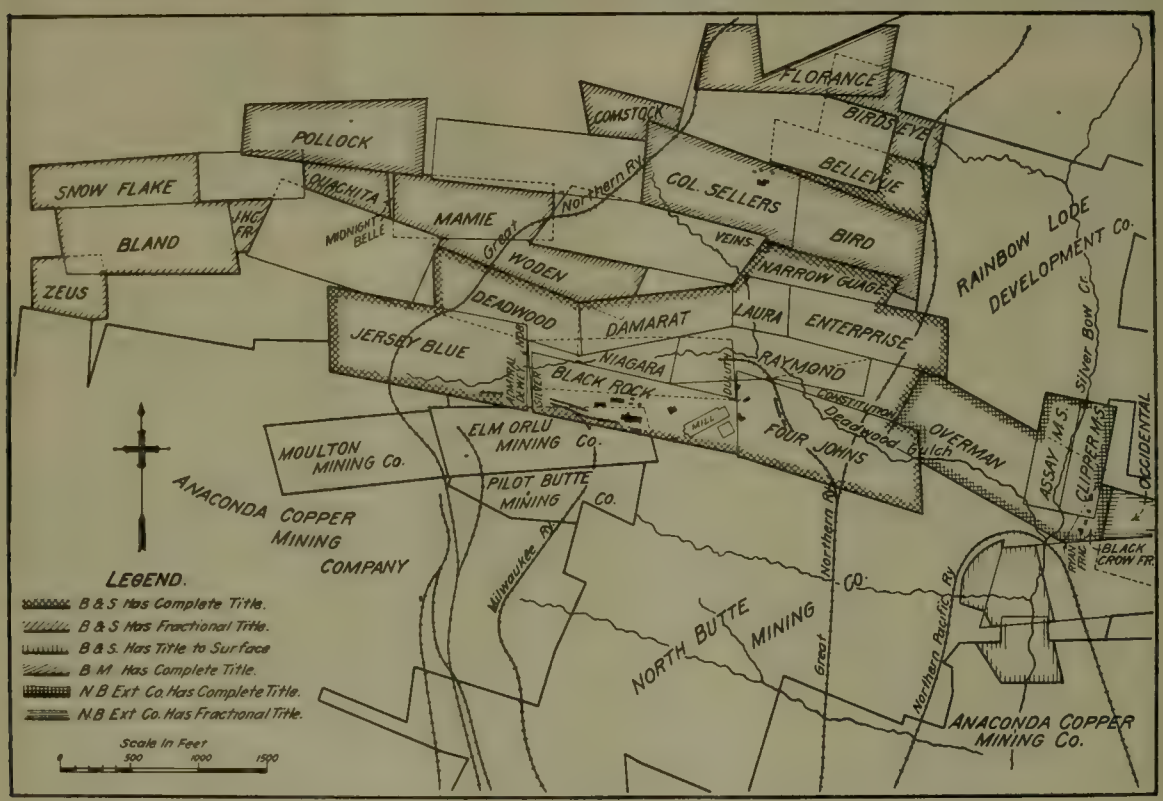
The mill treated 327,210 tons of ore, assaying 0.0196 oz. gold, 9.5315 oz. silver, 0.2105% copper, 1.3402% lead, and 18.573% zinc. The concentration and flotation plant produced 101,411 tons of zinc concentrate. This contained 5111 oz. gold, 2,578,759 oz. silver, 968,185 lb. copper, 4,941,850 lb. lead, and 107,828,679 lb. zinc. The 2972 tons of lead concentrate contained 213 oz. gold, 120,385 oz. silver, 17,708 lb. copper, 2,759,521 lb. lead, and 815,441 lb. zinc. The average recovery was 88.71%, against 86.43% in 1913. Treatment cost $2.12 per ton.

The revenue from metals was $3,238,414. All charges were $5.856 per ton. The net income was $1,417,128, against $942,988 in 1913. Dividends, $1.50 per share, totaled $611,909. The surplus at the beginning of the year was $1,215,520, at the end, $2,021,944.

AMERICAN ZINC, LEAD & SMELTING COMPANY

The report of this company for 1914 shows a profit of $186,158 before interest charges are deducted, against a loss of $91,656 in 1913, and profit of $400,300 in 1912. The net profit in 1914 was $77,692. No dividends were paid, but there is a surplus of $65,692, compared with a deficit of $394,630 in 1913. The president, H. S. Kimball, stated that the condition of the zinc industry during 1914 has been unsatisfactory. Throughout the entire year there was not a month in which the quotation for spelter at East St. Louis averaged as high as 5.5c. per pound, and the average for the year was 5.06c. He also discussed the spelter situation generally. This company's smelters have an annual capacity of 110,000 tons of concentrates, which should yield 50,000 tons of spelter, or 11% of the output of the United States. The property in Tennessee is treating 1480 tons of ore per day, and this is being increased to 1600 or 1800 tons. Plenty of ore is available. The Hillsboro smelter worked full time, the Dearing was closed, and the Caney worked at less than 20% capacity. With present conditions the company is able to make large profits.

Since the above was written the spelter market has risen considerably. This has benefited the A. Z. L. & S. Co. more than other zinc companies, on account of the results in 1914. All of its mines and smelters are working full time. At the beginning of 1915 the company was $1,000,000 in debt, and had $549,000 of bonds maturing in May.



CLAIMS OF BUTTE & SUPERIOR, BUTTE-MILWAUKEE, AND NORTH BUTTE EXTENSION COMPANIES.

BOOK REVIEWS

AMERICAN MINING LAW. By A. H. Ricketts. P. 553. Index. Panama-Pacific Exposition souvenir edition. Enlarged to May 1, 1915. Scientific Book Publishing Co., San Francisco, 1915. For sale by the *Mining and Scientific Press*. Price, $1.

The 32 chapters of this well known work contain brief abstracts of the various laws affecting mining in the United States. Seventeen pages consist of a table of several hundred cases cited under the different regulations. Recent decisions and departmental rulings appear in a chapter designated 'Continuation.'

RAILROAD FIELD MANUAL. By William G. Raymond. P. 386. Ill., index. John Wiley & Sons, Inc., New York, 1915. For sale by the *Mining and Scientific Press*. Price, $3.

Simple, compound, and vertical curves; the spiral; logarithms and trigonometric functions; location theories and tables; estimating and construction tables; turn-outs and cross-overs; azimuth, latitude, and time; tables for metric curves; miscellaneous tables; adjustment of instruments; and sexagesimal trigonometric functions comprise the 11 chapters of this work for civil engineers. The author is professor of civil engineering and dean of the college of applied science at the State University of Iowa, and experienced in railroad work. The book is for field use rather than for the office. After due consideration and consultation it was decided to use the decimal of a degree instead of minute and second. This is a new feature. Tables for solution of all problems in railroad construction are given, some not being in any other book.

MINING MANUAL AND MINING YEAR BOOK. By Walter R. Skinner. 961 pp., index. W. R. Skinner, London, 1915. For sale by the *Mining and Scientific Press*. Price, $6.

This valuable reference manual is so well known to the mining profession that it needs no review, but rather only a note to welcome its prompt annual appearance. As usual the chief feature of the book is its list of the principal mining companies of the world, 2450 being cited in this issue. For each company such details are given as the directors and other officials; date of establishment; seat of operations; description of the property, with the purchase consideration; plant erected or in course of erection; present working results; ore reserves; details of capital; assessments; dividends paid; and the financial position as disclosed by the accounts. The highest and lowest prices of the shares for the last four years is given, also the latest price. These are followed by a list of 5000 directors and 1000 secretaries of mining companies, also 900 mining and consulting engineers, mine managers, and agents. A glossary of mining terms is provided that will be helpful to those engineers and investors who speak only American and are apt to be puzzled by such terms as elvan, scrin, and swither. The present volume is especially serviceable since it shows the effect of the War upon British and other companies.

INDUSTRIAL CHEMISTRY. A manual for the student and manufacturer. Edited by Allen H. Rogers, in collaboration with 39 other chemical engineers. Second edition, revised and enlarged. 1005 pages. Illustrated. D. Van Nostrand Co., New York, 1915. For sale by the *Mining and Scientific Press*, price $5.

The first edition of this manual appeared in May 1912 and met with such a hearty reception that in preparing a second edition for the press the original chapters have not only been revised and expanded, but 10 new chapters have been added, increasing the size of the volume by 200 pages. As the book now consists of 49 chapters it would require too much space to list them, and it must suffice to say that practically the whole field of chemical technology is covered, each topic being treated by a specialist in that particular field of chemical engineering. This, of course, leads to some unevenness in treatment according to whether the author elects to write a concise review or a detailed discussion. Thus the 35 pages devoted to the petroleum industry seems modest in comparison with the 11 pages assigned to linseed oil alone, and 37 pages devoted to the essential oils. To some chapters a select bibliography of the topic is appended, and this procedure might well have been followed throughout, since it greatly increases the usefulness of a reference manual. Chemical technology is in a state of rapid progress, and the method followed of having the present status of each phase discussed by one who is on the firing-line of progress cannot be too highly recommended. The book will not only be highly useful to those engaged in the chemical industry, but as a manual of reference for the wider public which has frequent occasion to take into account present conditions in the conduct of business enterprises. It seems likely that the second edition will score an even greater success than the first, and we would recommend it to mining engineers and metallurgists who wish to keep informed of all the factors which bear on their own undertakings.

EXPLOSIVES: THEIR MANUFACTURE, PROPERTIES, TESTS, AND HISTORY. By Arthur Marshall. 623 pp. Ill. P. Blakiston's Sons & Co., Philadelphia, 1915. For sale by the *Mining and Scientific Press*. Price, $7.

No other comprehensive work on explosives has been published since Guttman's treatise of twenty years ago, although progress has been as rapid in this field as in other lines of chemical industry. The author of this volume therefore has an opportunity of which he has made good use, and the chapters dealing with the modern aspects of the manufacture and properties of explosives are excellent. Unfortunately he has introduced these with a series of chapters that might with profit have been omitted. Researches into Chinese and Egyptian history as to the invention of explosives are of interest to a few people, but most of those engaged in the industry are more concerned with the future than the past, and in any case it scarcely seems necessary to go back to the dawn of history in beginning the discussion of a subject. Descriptions of the properties and manufacture of sulphuric and nitric acids are easily accessible in standard treatises; the production of saltpeter, charcoal, and sulphur has also been amply discussed elsewhere. Fortunately the author has not relentlessly proceeded to describe the growing of cotton, the metallurgy of mercury, the manufacture of copper for caps, and similar by-ways of his subject. If such accessory material had been dismissed with a reference to the sources for detailed study, the unwieldy size of the book might have been obviated. But the painstaking effort which has led to the introduction of the material just mentioned has increased the value of the chapters dealing with topics of more imminent interest and the book is so full of useful detail that it is impossible to give any adequate summary in a brief space. It is interesting to note that although the book was written in India many of the illustrations and tables of data are taken from the publications of the U. S. Bureau of Mines, showing that the author is familiar with the world-wide aspects of his subject, in contrast with many European writers on technology, who seem to be under the impression that America is still inhabited only by savages. Appearing at a moment when the manufacture of explosives is at top speed the book should be extremely useful and should meet a cordial reception.

RECENT PUBLICATIONS

U. S. Bureau of Mines, Washington, D. C., 1915:

THE VAPOR PRESSURE OF ARSENIC TRIOXIDE. By H. V. Welch and L. H. Duschak. Technical Paper 81. P. 20. Ill., chart.

THE SMELTING OF COPPER ORES IN THE ELECTRIC FURNACE. By Dorsey A. Lyon and Robert M. Keeney. Bulletin 81. P. 80. Ill., index.

ABSTRACTS OF CURRENT DECISIONS ON MINES AND MINING DECEMBER 1913 TO SEPTEMBER 1914. By J. W. Thompson. Bulletin 90. Law serial 3. P. 176.

HOUSES FOR MINING TOWNS. By Joseph H. White. Bulletin 87. P. 64. Ill., plan, index. In these days of sociological interest for employees this publication is rather valuable.

PROBABLE EFFECT OF THE WAR IN EUROPE ON THE CERAMIC INDUSTRIES OF THE UNITED STATES. By A. S. Watts. Technical paper 99. Mineral Technology. P. 15. A discussion of the imports and utilization of domestic clays for pottery.

METALLURGICAL TREATMENT OF THE LOW-GRADE AND COMPLEX ORES OF UTAH. A preliminary report by D. A. Lyon, R. H. Bradford, S. S. Arentz, O. C. Ralston, and C. L. Larson. Technical Paper 90. P. 38. A résumé of this paper was given in the *Press* of May 8.

CONDENSATION OF GASOLINE FROM NATURAL GAS. By George A. Burrell, Frank M. Seibert, and G. G. Oberfell. Bulletin 88. 'Petroleum Technology 20.' P. 106. Ill., index. This report treats of a method of preventing some of the waste of the natural gas incidental to oil extraction. This process, the condensation of gasoline from natural gas, offers to the oil operator and others a profitable means of utilizing some of the oil-well gas now being wasted. In general, the oil-man considers casing-head gas as waste gas and its escape necessary in oil-well operations, to permit the maximum flow of oil into the well from the surrounding strata.

U. S. Geological Survey, Washington, 1915:

RESULTS OF SPIRIT LEVELING IN IDAHO, 1896 TO 1914 INCLUSIVE. Bulletin 567. P. 130. Ill., index.

THE COALVILLE COAL FIELD, UTAH. By Carroll H. Wegemann. Bulletin 581-E. P. 27. Ill., map, index.

THE CALCITE MARBLE AND DOLOMITE OF EASTERN VERMONT. By T. Nelson Dale. Bulletin 589. P. 67. Ill., map, index.

GEOLOGY AND COAL RESOURCES OF NORTH PARK, COLORADO. By A. L. Beekly. Bulletin 596. P. 121. Ill., maps, charts, index.

PRODUCTION OF SAND-LIME BRICK IN 1914. By Jefferson Middleton. Advance chapter from 'Mineral Resources of the United States. 1914.' P. 7.

TESTS OF WOOD PRESERVATIVES. By Howard F. Weiss and C. H. Teesdale. Bulletin 145. U. S. Department of Agriculture. P. 20. Illustrated. Washington, D. C., 1915.

RESULTS OF SPIRIT LEVELING IN MINNESOTA, 1897 TO 1914 INCLUSIVE. Bulletin 560. Work done in co-operation with the state of Minnesota from 1909 to 1914. P. 190. Ill., index.

SOME MINING DISTRICTS IN NORTHEASTERN CALIFORNIA AND NORTHWESTERN NEVADA. By James M. Hill. Bulletin 594. P. 200. Ill., maps, index. A résumé of this interesting book appeared in the *Press* of May 22.

MINERAL DEPOSITS OF THE SANTA RITA AND PATAGONIA MOUNTAINS, ARIZONA. By Frank C. Schader and James M. Hill. Bulletin 582. P. 373. Ill., maps, index. A résumé of this interesting book was published in the *Press* May 29.

RESULTS OF SPIRIT-LEVELING IN MARYLAND, 1896 TO 1911, INCLUSIVE. Bulletin 563. Work done in co-operation with the State through the Maryland Geological Survey. William Bullock Clark, state geologist. P. 78. Ill., index.

CONTRIBUTIONS TO ECONOMIC GEOLOGY, 1913. Short papers and preliminary reports. Part I, Metals and Non-Metals, Except Fuels. F. L. Ransome and Hoyt S. Gale in charge. Bulletin 580. P. 462. Ill., maps, index. As these papers appeared in pamphlet form, abstracts were made for the *Press*.

Water-Supply Papers:

GAZETTEER OF SURFACE WATERS OF IOWA. By W. G. Hoyt and H. J. Ryan. No. 345-I. P. 57. Index.

ST. LAWRENCE RIVER BASIN. By N. C. Grover, W. G. Hoyt, A. H. Horton, and C. C. Covert. No. 354. Prepared in co-operation with the states of Minnesota, New York, and Vermont. P. 136. Ill., index.

GROUND WATER FOR IRRIGATION IN THE SACRAMENTO VALLEY, CALIFORNIA. By Kirk Byron. No. 375-A. Prepared in co-operation with the department of engineering of the state of California. P. 49. Ill., maps.

Department of Mines, Ottawa, Canada, 1914:

BITUMINOUS SANDS OF NORTHERN ALBERTA. Preliminary report. By S. C. Ells. P. 92. Ill., 55 plates, map, charts, index.

SUMMARY REPORT OF THE MINES BRANCH FOR 1913. P. 214. Ill., plans, index. This is a very interesting report covering many subjects.

MINERAL PRODUCTION OF CANADA, 1914. Preliminary Report. Prepared by John McLeish. P. 24. Department of Mines, Ottawa. The total output was $128,475,499, compared with $145,634,812 in 1912.

PRELIMINARY CONCENTRATION TESTS ON CUYUNA ORES. By William R. Appleby and Edmund Newton. Bulletin 3. Minnesota School of Mines Experiment Station. P. 66. Ill., plans, charts. Minneapolis, 1915. This investigation is summarized as follows. (1) The physical character of the low-grade iron ore is exceedingly variable. (2) The grade of concentrate produced is generally low. (3) The grade of concentrate produced is usually proportional to the grade of crude ore. (4) Table treatment of log-washer tailing is not successful. (5) Phosphorus increases from crude ore to concentrate. (6) High costs of mining, royalty, etc., will limit beneficiation.

THE ARGUMENTS FOR AND AGAINST TRAIN-CREW LEGISLATION. P. 44. Published by the Bureau of Railway Economics, Washington, D. C., 1915. In 1912 there was a total of 455,396 trainmen of all grades employed in the United States. Casualties to trainmen in train operation and train accidents in 1914 were 1477 killed and 45,918 injured.

THE ELECTRO-DEPOSITION OF METALS. Papers on this subject presented on February 11, 1915, to the Lewis Institute, Chicago, include the following: 'The Advance of the Plating Industry,' by Carl Dittmar; 'Copper Cyanide Plating Solutions,' by Max G. Weber; and 'The Economy and Efficiency of Copper Cyanide,' by Charles H. Proctor.

PETROLEUM IN PAPUA (NEW GUINEA). By Arthur Wade. P. 48. Ill., maps. Government printer, Melbourne, Victoria, Australia, 1914. An investigation made for the Commonwealth Government. Surface indications of oil were found over an area of 1500 square miles.

THE ACCURATE MEASUREMENT OF THE REFRACTIVE INDICES OF MINUTE CRYSTAL GRAINS UNDER THE PETROGRAPHIC MICROSCOPE. By Fred E. Wright. P. 7. Reprint from the Journal of the Washington Academy of Sciences, February 19, 1915.

THE SUPPOSED OIL-BEARING AREAS OF SOUTH AUSTRALIA. By Arthur Wade. Bulletin 4. Geological Survey of South Australia. P. 54. Ill., maps. Adelaide, 1915. Possibilities of obtaining a commercial supply of oil are considered.

BIENNIAL REPORT of the state geologist, H. A. Buehler, of Missouri. P. 62. Illustrated. Bureau of Geology and Mines, Jefferson City, 1915. A résumé of this publication appeared in the *Press* of March 20.

New Machines and Devices

Information based on letters and catalogues from manufacturers

Filters at the Exposition

Metallurgists and chemical engineers will find an interesting exhibit at the Exposition in the Oliver filter, in the U. S. Bureau of Mines co-operative metallurgical exhibit in the Mines and Metallurgy building.

This machine is the smallest of the standard Oliver products. It has a drum 3 ft. diameter by 2-ft. face, with a capacity of 10 tons per 24 hours of dry flotation concentrate. This concentrate, from the Anaconda Copper company, is fed to the filter from a 4-ft. Dorr thickener. It has a consistence of one part water to one part solid. It is discharged as a $\frac{3}{4}$-in. cake containing 6% moisture. This is carried on a belt-conveyor to an agitator, where the cake is broken up and returned to the circuit. In practice this conveyor would discharge into a briquette-machine or hopper-car. A 25 to 28-in. vacuum is maintained by a $3\frac{1}{2}$ by $3\frac{1}{2}$-in. Root rotary wet vacuum-pump manufactured by P. H. & F. M. Roots Co., Connersville, Indiana. Air at 5-lb. pressure for release of cake and agitation purposes is furnished by a rotary compressor supplied by Baker-Hansen Manufacturing Co., of Oakland, California. A 1-in. Krogh Manufacturing Co. slime pump returns the pulp from the agitator to the Dorr thickener. A total of 3 hp. is used in the exhibit furnished by five Westinghouse motors, each direct connected to the various units.

The de-watering of flotation concentrate is of such great interest to metallurgists at present that the Oliver Continuous Filter Co. is demonstrating its machine in this field rather than in cyanide filtration, where it has long been established.

The Oliver company states that over 90% of the filters in flotation plants in operation and under construction has been supplied by it.

Dredges at the Exposition

Mining men will be much interested in the two working models of the 16-ft. Yuba No. 14 dredge at the Exposition at San Francisco. One of these is in the Palace of Mines, the other in the California State building. These models are part of the Yuba Construction Co.'s exhibit. Both of them are prac-

A YUBA DREDGE AT THE EXPOSITION.

tically the same. With the exception of the fact that housing is left off, they are almost exact replicas of No. 14. This is probably the largest and certainly the most modern gold dredge in the world. It has a steel hull, steel gold-saving tables, steel deck, digs 70 ft. under water, and has a monthly capacity of 300,000 cu. yd. The model is in general to a scale of 1 to 20, although the buckets are somewhat larger, being built to the scale of 1 in. to the foot. Images of men to scale on the deck of the model dredge give a comparative idea of the great size of No. 14. Some comparative data are interesting: On No. 14 the main drive motor is 400 hp., on the model it is $\frac{1}{4}$ hp. The boat in Yuba county weighs nearly 2000 tons, whereas the model weighs 1150 lb. It would take the model dredge nearly five years to handle the material that No. 14 can excavate in one day. The Yuba Construction Co. will be glad to send a booklet describing this model to anyone interested.

A New Drill-Sharpener

The Sullivan Machinery Co. is now offering to the mining world a new drill-sharpener, which is shown in the accompanying illustration, is a compact, substantial, and convenient machine for the rapid making and sharpening of rock-drill and hammer-drill bits of all kinds, and is also adapted to the making of steel shanks. The machine consists of a heavy

THE NEW DRILL-SHARPENER.

bed or frame carrying at one end the horizontal hammer, at the other a vertical standard, which, in turn, supports the vertical hammer.

In the frame, beneath the horizontal hammer, shown in drawing, there is a 12-in. air-cylinder which supplies the power for operating the vise, which is placed just behind the vertical standard, in which the dies are placed for gripping the steel while it is being upset to form the bit.

This vise consists of a heavy cap, forming a seat for the upper half of the die, to the two ends of which are attached heavy parallel steel columns. These columns are joined at their base by a cross-head. This is connected to the heavy cross-head block of the horizontal piston-rod by a massive toggle-joint. When air is admitted on the rod side of the piston, the travel of the piston toward the rear end of the cylinder pulls up the yoke or cross-head, opening the vise, and when admitted behind the piston, the toggle is forced down against the yoke, pushing it and the columns down, and closing the vise on the drill steel with tremendous power.

The valve motion in each is of the standard differential type, but the vertical piston is kept in a raised position, when not in use, by a pin, held against the lower end of the valve by a spring, which holds the valve off its seat, thus keeping the lower end of the cylinder full of live air. This control is con-

nected with the operator's foot lever, so that pressing down upon the lever allows the spool-valve to seat and starts the hammer.

This piston and rod of the vertical hammer are in one piece, as in the rock-drill; the upper forming die is keyed to the guide-weight, which in turn is attached to the piston rod by a taper joint.

To operate the machine, the smith presses down on the handle at the front of the machine. This admits air behind the 2-in. piston of the clamping cylinder, and closes the dies and vise. Continued pressure throws the traveler in the valve-chest farther to the rear, opening the port leading to the valve-chest of the hammer, which then starts reciprocating. When the bit has been upset enough, the operator raises the handle, shutting off air to the hammer first, then admitting air in front of the clamping cylinder piston to raise the yoke and open the dies.

The piston in the upsetting hammer cylinder is a floating hammer as in the standard hammer-drill manufactured by this company. The rod terminates in the front head in an anvil, and is blank at the other to receive the loose 'dolly.'

The exhaust air is led directly into the frame, from the side opposite the valve-chest. The vertical standard is a tight box and forms a conduit for the exhaust. From this, a diagonal hole connects with cored passages arranged so as to discharge the air forcibly on the faces of the vertical dies, thus keeping them clean of scale and chips.

A powerful blast of exhaust air also blows on the dies and vise jaws, keeping them free from dirt and scale.

A blow-gun and small hose are attached to the air-piping for keeping the other parts of the machine clean. The hammer cylinders are lubricated by regular automatic, differential pressure-lubricators, cast in the cylinders.

The sharpener is fitted with safety appliances which make it 'fool proof.' The valve-motion of the horizontal members is so arranged that the vise is operated before the upsetting hammer begins to run. In order to prevent the vertical hammer from starting while the horizontal members are working, a reach-rod and pin are provided which fall in front of a stop attached to the axle of the foot lever; thus, even if the operator should step on the lever inadvertently, the vertical hammer would not be released.

To permit the changing of dies, or for work in which the vertical hammer is not needed, a hole is bored in the guide weight and guide, and a pin, attached to a chain, is furnished to lock the guide-weight, in one or the other of two positions.

An indicator or tell-tale is provided to show the operator if the toggle and vise are properly adjusted.

In addition to making and sharpening bits and forming drill-shanks, the machine may be used for a variety of smithing work, such as forging bolts, and similar work. The vertical hammer is exceedingly powerful and rapid, and at the same time can be regulated to strike as gentle a blow as may be needed.

The machine impresses one by its compactness, simplicity, and workman-like appearance, as well as by its massiveness and solidity. The main frame or standard is a very heavy casting with a broad base and is arranged to be bolted to the floor or to timbers.

The entire weight of the machine is about two tons.

In sharpening or making bits, one heat is usually sufficient to complete the work. The steel is first placed in the clamping dies and held rigidly by the vise while it is upset. After a few blows, the bit is pulled back under the vertical dies, and the wings and corners drawn out and hammered to proper thickness and shape. Then the upsetting is complete in the clamping dies and the final gauge given by the dolly. The vertical hammer puts the last touches on the wings, and the drill is ready for tempering.

In making shanks, two heats are generally necessary.

The actual time required for making a new bit from blank stock is from 50 seconds to one minute.

It is to be noted that in the operation of this machine, the sharpening process consists solely of a hammering rather than a squeezing of the steel, which is claimed to be a decided improvement over some of the older type machines. This hammering method also makes it possible to keep the steel hot for a longer time than in machines which employ a molding or squeezing process.

Commercial Paragraphs

A dredge to cost $400,000 is being constructed by the UNION IRON WORKS, San Francisco, for the Marigold Gold Dredging Co., near Marysville, California.

In an 86-page illustrated catalogue, the KENNEDY-STROH CORPORATION, 120 Broadway, New York, describes its ore milling, cyaniding, and smelting machinery. This includes from crushers to bullion furnaces.

Auto-trucks of all designs for all purposes are described in brief and illustrated in a folder issued by the STERNBERG MOTOR TRUCK Co., of West Allis, Milwaukee, Illinois. Some costs of operation are given.

The ORENSTEIN-ARTHUR KOPPEL Co., makers of industrial and portable railway material, Koppel, Pennsylvania, announces that its associate Pacific Coast manager, A. A. Prausnitz, is touring the Hawaiian islands for the firm.

In Kansas City the WESTERN ELECTRIC Co. has moved into a new warehouse, opposite its old one. It is five stories high, 50 by 175 ft. in area, 52,000 sq. ft. of floor space, is fitted with a sprinkler system and is equipped for efficient work.

The annual meeting of the JOSEPH DIXON CRUCIBLE Co. was held at Jersey City on April 19. The old board of directors was re-elected. Officers are as follows: president, George T. Smith; vice-president, George E. Long; treasurer, J. H. Schermerhorn; secretary, Harry Dailey; and assistant to last two officials, Albert Norris.

In *The Excavating Engineer* for April is an interesting article on nitrate mining in Chile, by John G. Beck. Owing to the occurrence of the *caliche*, drag-line excavators of the BUCYRUS type are useful in mining. There are also described street excavation by a Bucyrus 14-B revolving shovel, steam-shovels at stock-piles, and excavation for the Cedar River dam, Iowa. This article is a reprint from the *Press* of April 3.

Laboratory apparatus working at the U. S. Bureau of Mines booth in the Palace of Mines and Metallurgy at the Exposition consists of the following: one each of 'Braun' improved No. 1 and No. 3 improved 'Chipmunk' crushers, type 'UA' pulverizer, and sample-grinder; one sample mixer; one No. 8 furnace; two Braun muffle-furnaces; one table cupel-machine; one electrolytic outfit; one Braun universal sampler; and 'Vesta,' 'Cary,' 'Braun industrial,' 'Marvel,' 'Vulcan gas,' and 'Braun gas' burners. The above was supplied by BRAUN-KNECHT-HEIMANN Co., San Francisco.

The METALLURGIC ENGINEERING Co., of Chicago, has changed its name to that of the SNYDER ELECTRIC FURNACE Co. The company is just completing the installation of a second 3-ton furnace for the Otis Elevator Co., Buffalo, New York. This furnace will have a basic lining, and will be ssed in the manufacture of refined steel castings. Also a furnace of 6-ton daily capacity of refined steel for the Niagara Electric Steel Corporation, North Tonawanda, New York. Other installations are being made by the Snyder company. Two interesting illustrated bulletins on electric-furnace operation and steel produced have just been issued, one of which should be filed for reference on the subject.

A 4-ton furnace has been sold to the DAIMLER MOTOR CAR Co., England. This makes the fifth furnace of this company sold to European people within the last two months.

Mining and Scientific Press

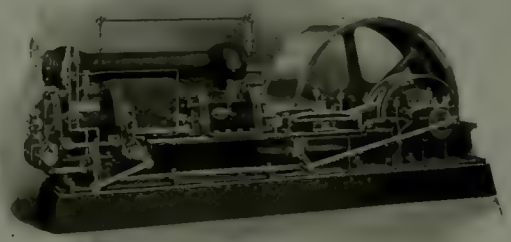
Edited by T. A. RICKARD

Volume 110 SAN FRANCISCO, JUNE 5, 1915 Number 23

CALIFORNIA STATE

MT. LASSEN is of interest to the miner as a manifestation of subterranean unrest. It links with the evidence of igneous action he has seen underground. However, it is a phenomenon, not a menace. The black cloud in this picture is not smoke, but steam. We discuss the subject inside.

NORWALK AIR COMPRESSORS



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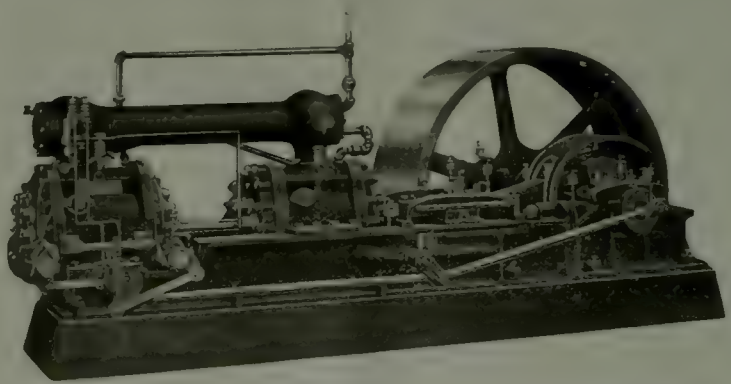

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Advertisers Index—Last Page
Buyers Directory—Page 28

TABLE OF CONTENTS

EDITORIAL Page.

NOTES 861

MARKETING LOW-GRADE ZINC ORE 861
The reason why low-grade ore cannot now be sold.

STRATTON'S INDEPENDENCE 862
Sale of famous property.

SAFETY IN CALIFORNIA MINES 863
Proposed rules governing the mining industry.

EXIT MARANON PLACERS 863
The end of a glittering romance.

MT. LASSEN 864
Facts about our volcano.

DISCUSSION

ASSAY OF ORE CONTAINING METALLICS.
By W. E. Cahill 865
The method used at the Treadwell mines for assaying concentrate containing free gold.

QUANTITATIVE BLOWPIPE ANALYSIS IN THE FIELD.
By E. C. Woodward 865
A well-known assayer points out that free gold can be more easily detected by panning than by blowpipe tests.

JAPAN AND CHINA.
By Kurt Pietrusky 866
A subscriber enters a polite demurrer.

UNDERCURRENTS.
By B. T. Ulrich 866
More useful hints from an operator of experience.

ARTICLES

OPPORTUNITIES IN CHINA.
By H. T. Liang 868
The undeveloped mineral resources of China offer the same opportunities for American capital that our own once offered to European capital. A well-known mine-owner and operator in central China suggests co-operation.

THE METALLURGY OF ALLUVIAL MINING—II.
By John M. Nicol 869
To recover more gold in alluvial mining, a device is suggested which permits continuous cleaning of the riffles. To get rid of the excess of water a dewatering device is proposed. The fine material collected in the sluices is to be concentrated on tables and the magnetic particles removed by magnetic concentrators. Recent devices for improving methods are discussed.

Page.

WET METHODS OF MERCURY EXTRACTION.
By E. Bryant Thornhill 873
Wet methods of recovering mercury have so far proved unsuccessful because of their high cost. It is proposed to dissolve the cinnabar in alkaline sulphides, precipitate with zinc hydrate, and regenerate the alkaline sulphide by the H_2S produced on dissolving the HgS precipitate with sulphuric acid.

SCALE OF OPERATIONS AT BROKEN HILL, NEW SOUTH WALES. 874
The effect of the War on these companies is shown by tables.

OPERATIONS OF THE YUKON GOLD COMPANY 874
The average length of the season at Dawson was 164 days, during which the dredge worked 87.2% of the possible time, 4,800,000 yd. was handled at a cost of 27.62c. and a yield of 54.21c. per yard. Net profit for the year, including the Iditarod and California dredges, was $1,184,819; dividends were $1,050,000.

PLATINUM IN SOUTHERN NEVADA.
By Adolph Knopf 876
The discovery of platinum and its related metals in lead-copper deposits occurring in limestone in southern Nevada, opens interesting possibilities as to the finding of similar deposits elsewhere. The deposits are described in detail by one of the geologists of the United States Geological Survey.

MILLING COSTS AT GOLDFIELD CONSOLIDATED 879
Of a total labor cost of $1.606 per ton labor amounted to 21.86%, supplies 56.60%, and power 21.54%.

DEPARTMENTS

CONCENTRATES 880

REVIEW OF MINING 882
Special correspondence from Manila, Philippine Islands; Cripple Creek, Colorado; Goldfield, Nevada; Toronto, Ontario; Quebec, Quebec.

THE MINING SUMMARY 885

PERSONAL 889

SCHOOLS AND SOCIETIES 889

THE MARKET PLACE:
Metal Prices 890
Eastern Metal Market 891
Current Prices of Ores, Minerals, Chemicals, Oils and Candles 892

COMPANY REPORTS 893
Chino Copper Company; Nevada Consolidated Copper Company; Ray Consolidated Company.

MINING DECISIONS 893

NEW MACHINES AND DEVICES:
Automatic Section-Insulator 894
Commercial Paragraphs 894

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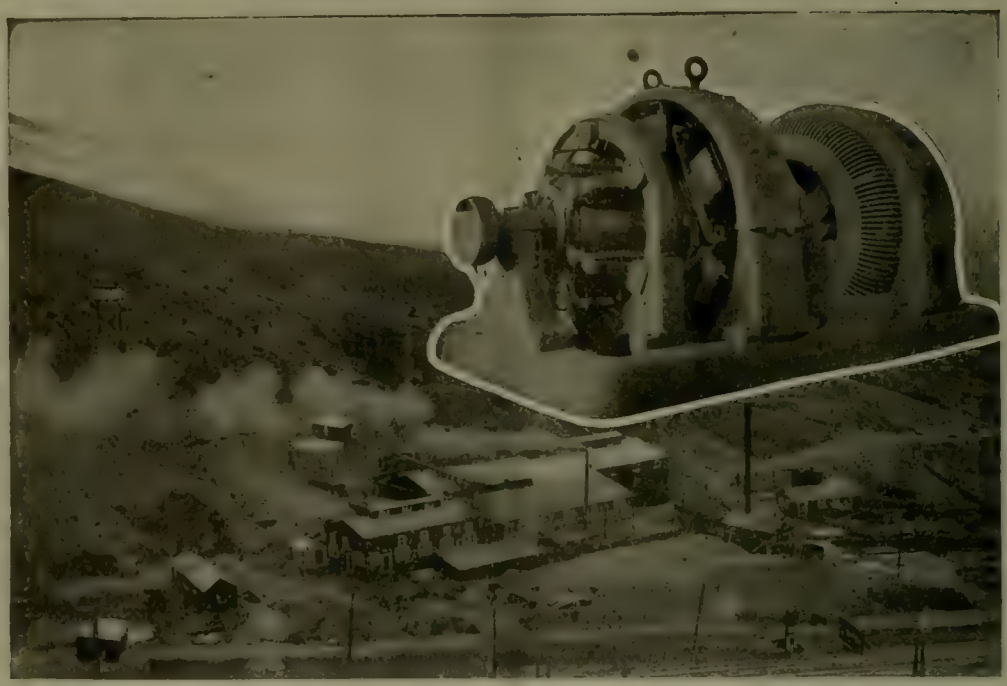

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Ore heretofore considered worthless is used, and 91% of the copper in solution is recovered in 20-minute cycles. The cost of electric power is published at 36 cents per ton.

Electric apparatus furnished by the General Electric Company is used throughout the property and has proved up in every way.

Our engineers will be glad to study your power problems and recommend suitable equipment without implied obligation on your part. Send today for our new bulletins showing the application of electric power to mine problems. State whether interested in hoisting, pumping or locomotives.

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MOTOR AGENCIES IN ALL LARGE CITIES AND TOWNS. 5460

EDITORIAL

T. A. RICKARD - - - - Editor THOMAS T. READ - Associate Editor

GENEROUS dividends declared by the big copper companies give expression to the favorable change in their fortunes during recent months. The distribution of profit indicates confidence on the part of the managements that the improved conditions for marketing their product is not temporary.

MERCURY, or quicksilver, to use the commercial name, is one of the metals appreciated by consumption in the manufacture of explosives employed in the War. We are able to publish a timely article, carefully written, by Mr. E. Bryant Thornhill, on a wet method of extracting mercury from its principal ore, the sulphide, cinnabar.

PLATINUM was the subject of recent discussion in these columns. We are glad to give publicity in this issue to an excellent description of the Boss Springs deposit in southern Nevada by Mr. Adolph Knopf, of the Geological Survey. The writing is a model of clear exposition. By his authoritative account of the geological environment, he will have afforded a useful guide for further exploratory work in search of this valuable metal and its equally valuable associates. It is interesting to note how one of the richest of these, the rare mineral plumbojarosite, assaying as much as $6000 per ton, looked like the ordinary 'black sand' of the placer miner. Incidentally, we note elsewhere in this issue that the Russian government will impose an export-duty of 30% on platinum from the Ural region, beginning on the 30th of the current month. This will tend to decrease shipments of the metal from the chief source of supply.

TALK of intervention in Mexico was revived on May 28 when the President, in an appeal to the Red Cross, referred to the "years of internal disturbances" that had reduced the Mexican people to the verge of starvation. At Washington it was said that our Government had become convinced of the inability of any of the contending parties to restore order. A parallel was drawn between the present position as regards Mexico and that existing immediately before intervention in Cuba 17 years ago. The President's appeal for funds and supplies to relieve the starving population in Mexico, published on May 29, synchronized with a statement sent to all the military leaders in Mexico urging a friendly solution of a problem becoming daily more acute. Undoubtedly this action by the President was stimulated by the fact that the Carranza generals had seized 600 tons of corn purchased by an international relief committee for the benefit of the Mexicans in distress, and by information concerning general conditions as collected by Mr. Du Val West, who has been making a careful investigation in Mexico for the President. At the time of our going to press, it is announced that the Government has served notice on the leaders of misrule in Mexico that unless they themselves adjust their differences, the United States will find means for restoring order in the republic. This is hoped to stimulate a rally of the best elements in the population and the formation of a coalition government, which would receive American support, including an embargo upon the supply of munitions of war to any other parties in Mexico. When next we write the position may have developed to the point of indicating whether this last effort of the President is likely to prove successful.

Marketing Low-Grade Zinc Ore

Zinc producers in Utah and Nevada are about to form an association to protect their interests, according to reports from Salt Lake City. Associations of men with a common interest can always be made to serve a useful purpose, and the proposal is therefore a commendable one; but if the principal aims of those active in bringing about the organization have been correctly reported by the daily press it may well be doubted if much can be done toward realizing them. It is said that since the price of zinc began to soar the smelters have refused to buy ore containing less than 40% zinc, and that the purpose of the organization is to enable every producer to sell all his zinc ore, including the low-grade material. Unfortunately no intimation has been made as to how this highly desirable state of affairs can be effected. The

reason why the smelters will not buy low-grade ore at the present time is as plain as a pikestaff: much more ore is available than the smelters can handle, for the high price of spelter is stimulating mining in this country to such a degree that, for example, the Australian concentrate, which ordinarily equals two-thirds of our domestic production, is being offered here without meeting much encouragement. The output of a zinc smelter depends upon the zinc content of the material smelted, since it is largely a matter of cubic capacity of the retorts. With higher-grade material the operating cost is distributed over a greater number of pounds of spelter produced and the profit correspondingly increased. With ore and concentrate offered in abundance it is only the simplest common sense to buy only the highest grade material, and it is in this way that the normal spelter output of 450,000 tons per annum in the United States has been raised to 600,000 tons, the rate at which the smelters are now operating. These, quite correctly, regard the present high price of spelter as abnormal, and are therefore making every effort to turn out as much metal as possible before the price goes down again. It is perfectly natural that producers of low-grade ore and concentrate should feel much chagrin that they are unable to sell their product during a period of high prices, but it is difficult to see what they are going to do about it, unless they have in mind the building of a smelter for themselves, a procedure that is seen to be impracticable on a moment's serious thought. Building a large smelter involves the spending of dollars in millions, not thousands, and it is necessary to be assured of a long period of profitable operation to return the capital invested before any real profit can be made. Before the War broke out the zinc-smelting capacity of the United States was considerably in excess of requirements; after peace is declared and international relations are resumed presumably the same conditions may obtain. The building of new smelters on the basis of a temporary demand therefore appears a foolish undertaking. The present high consumption of spelter is in the making of brass, therefore the ores and concentrates that are free from lead are most in demand. High-grade concentrate, such as the 51% product of the Butte & Superior is also well received; while the 46% concentrate of the Australian mines, which is also more difficult to treat, can be marketed here only in comparatively small amount. As to producers of ore and concentrate containing less than 40% zinc, we confess that we see no way in which they can hope to secure an assured market for their output under present conditions.

Speaking of zinc, we note that a bill has been introduced before the Federal Parliament of Australia to legalize the annulment of metal contracts with German firms, but this law, if passed, will affect only the mining companies registered in Australia, excluding therefore the Zinc Corporation and the Sulphide Corporation, both of which are English companies. To relieve them similar legislation is required at Westminster; and of that there is no sign. Moreover, many of the German metal agencies are in the names of companies registered in Australia and therefore entitled to legal protection. What may be the effect of the annulment of contracts with enemy-aliens remains to be proved. It is a knotty problem.

Stratton's Independence

The absorption of this property by its neighbor, the Portland, is a notable event in the history of Cripple Creek. Since W. S. Stratton located the Independence and Fourth of July claims on July 4, 1891, this bit of the earth's crust has yielded $23,500,000 besides at least $500,000 of high-grade ore that was stolen during the bonanza period; so that the total production has been fully $24,000,000. Out of this, $7,600,000 has been paid in dividends, without, however, including the profits of promoters, the gains of the tributers, or the money realized from stolen ore, making altogether at least $2,500,000 more. Finally, there is the $300,000 now received for the property from its new owners. Thus it returned about $10,500,000. The ratio of distributable profit would have been considerably larger if the mine had not been the victim of a scheme of promotion that involved a fiasco. Stratton himself was a millwright by trade; he was not much of a prospector, but a shrewd man; hence he was able to see his discovery develop into a great mine without losing his head. Fortunately for him, as the mine grew in value his valuation of it kept sufficiently ahead to prevent its sale, so that he retained possession of it until in 1899 a flamboyant promoter at Colorado Springs joined hands with an optimistic financier in London to float the mine in a company that was much over-capitalized. Under that burden the mine struggled manfully, producing a big tonnage of high-grade ore. When the bonanza had been depleted, the third stage in the history of the Independence began. This was marked by the erection of a large mill to treat the dumps at surface and the remnants of poorer ore underground. Undoubtedly this last stage of the enterprise, beginning in 1906, was the most creditable to all concerned. Anybody could have done big things with the orebodies uncovered both by Stratton and by the English company with which he made such a queer deal, but it took skill and care to extract further profit from the mine in its third phase. The fourth begins now, for the old mine will yet yield a further contribution to the world's wealth. On the whole, we conclude that Mr. Philip Argall's name will be the one most honorably linked with the record of this great mine, for he not only prolonged its productive activities but he applied a metallurgical skill to the reduction of its poorer and less docile ores that does credit to him and the profession to which he belongs. While the mine will merge its identity with the Portland, the history of which is equally remarkable, it is announced that the $300,000 in cash received from the sale will be employed to acquire a new property, in the search for which the present directorate will be advised by Mr. Argall. Thus the gold from the Independence will fructify elsewhere, giving vitality, let us hope, to a

worthy successor. Meanwhile the millions that have come out of it have been doing their work in many places, and the train of events that Stratton started on July 4, 1891, has affected men and markets far apart.

Safety in California Mines

The first public hearing to discuss the rules that the California Industrial Accident Commission has formulated to govern mining operations in this state will be held on June 11 at 10 a.m. in the offices of the Commission, 525 Market street, San Francisco. The draft of the rules to be considered has been prepared by Messrs. A. P. Anderson and G. W. Metcalfe, of the United States Smelting, Refining & Mining Co., N. S. Kelsey, manager of the Argonaut mine, and Arthur B. Foote, superintendent of the North Star mines, representing the operators, James Giambrino, secretary of Amador County Miners Union No. 135, J. C. Williams, secretary Grass Valley Miners Union No. 90, and A. M. Arandall, secretary Randsburg Miners Union No. 44, representing the mine workers; and H. M. Wolflin, representing the Industrial Accident Commission and the United States Bureau of Mines. Nowadays when unnecessary and undesirable legislation is too often forced on the public by politicians unfamiliar with the conditions governing industry, it is a pleasing novelty to have innovations formulated by those directly concerned and most familiar with actual conditions.

The rules, in their present form, provide for annual reports from mine operators to the Mine Safety Department of the Industrial Accident Commission; for the designation of agents on whom notices in connection with the rules may be served; for the keeping on hand of a supply of first-aid-to-the-injured material, and training of a first-aid corps at mines employing more than 50 men. Artificial-breathing apparatus for work in irrespirable gases, is required at mines employing more than 30 men. Mine-maps must be brought down to date yearly; fatal accidents and dangerous conditions must be reported immediately. The use of intoxicating liquor is prohibited in mines. There is a series of miscellaneous rules for underground men. These rules represent the best practices commonly found at modern mines. Boilers must be inspected, moving machinery guarded, abandoned shafts fenced, and working-shafts provided with gates. Some precaution as to sanitary conditions must be taken; good drinking-water furnished, and change-houses kept available for the men. Two mine-exits must be provided and outlets must not be covered by inflammable housing. Rules for ventilation and fire-inspection are given; also rules governing the use of lights and candles, of gasoline, oil, etc., underground. Sundry requirements are made for the elimination of rock-dust and regulations framed for the control of explosives. Rules are formulated governing hoisting operations. Telephones are required in mines, and a complete set of rules covering electrical installations are included. There is a provision that mine employees shall be made acquainted with the rules applying to them and shall agree to abide by such rules.

Suggestions and criticisms are invited from those engaged in mining, and all who can do so conveniently will do well to attend the hearing and take part in the perfecting of the regulations. It should be added that the Industrial Accident Commission is already empowered by law to make and inforce its regulations, and if operators and workers neglect to assist in devising a satisfactory set they can have no just cause of complaint later.

Exit Maranon Placers

The career of the Peru Gold Placers, Inc., which we discussed editorially in our issues of February 7 and April 11 of last year, has come to an inglorious end with the arrest of Raymond McCune, the promoter, on a charge of using the mails to defraud by the sale of $200,000 worth of stock in the enterprise. It is without jubilation that we find our first judgment of the venture completely confirmed. The whole affair has been a travesty on mining and is as regrettable as a divorce scandal involving people highly placed. It will be remembered that the persons involved in this case are Messrs. Alexis I. du Pont and John J. Raskob, of the du Pont de Nemours Powder Company; Henry H. Bowman, of the Springfield National Bank; David T. Marvel, former judge of the Delaware Supreme Court; Charles S. Miller, of Miller, Franklin & Company, efficiency engineers; Otto R. Hartman, of the Ascot Tobacco Company; William R. Basset, of Basset & Company, New York, officers and directors of the company. A number of well-known citizens of Wilmington and other cities, especially in New England, became shareholders in the enterprise, impelled by the prestige and business standing of the directors as well as by the lure of the "treasure house of the Incas."

It will be remembered that at that time we insisted that the statements made regarding the property were so incredible that they would require confirmation by an independent examination, even if made previously by an experienced and reputable engineer, while the knowledge and experience of Mr. McCune and his assistants was entirely too tenuous a thread upon which to hang such large assertions. We said then: "The whole matter as heretofore presented to the public is one of belief, not of proof. Furthermore, the basis for the belief as yet advanced is not convincing to men experienced in such matters. Indeed, capable engineers who have made examinations, and thorough ones, in the very district concerned, laugh at the claims made by the Peru Gold Placers company. We are disposed to believe that the directors are allowing their hopes to cloud their judgment, but others are not so charitable and protest that the whole matter is a thinly disguised scheme to milk the public. Certainly any director who cares for his reputation and who does not know better than to allow his name to be used as in this report, would do well to seek advice from some experienced as well as trusted friend." It may be asserted further that for a business

man of high standing, devoid of any personal knowledge of mining, to allow his name to be used to bolster an enterprise based on the report of an engineer of no standing is an exhibition of childish folly only mitigated by its frequency. The most deplorable feature of the affair is that the lesson will, probably, be lost on the public. All that will remain will be a stronger belief that mining enterprises are typically swindles. From time to time prospectors and mine-owners raise the plaint that it is unreasonably difficult to secure capital for financing mining enterprises. We submit that fiascos such as the Peru Gold Placers are among the most potent reasons why capitalists are wary of mining ventures, not because such ventures are necessarily more hazardous or less profitable than other forms of industrial enterprise, but because the meretricious romance of such schemes appears to bemuse the good sense of men ordinarily hard-headed. The one thing the banker and business man must learn is to take expert advice before he lends his name or his money to iridescent schemes.

Mt. Lassen

The volcanic activity of this mountain in northern California has caused the man in the street to wonder at one of Nature's infrequent manifestations of unrest. To the miner the eruption has suggested some connection between these superficial disturbances and those he sees recorded in the rocks into which he delves deeply in search for metallic wealth. As might be expected, the daily press has approached a scientific subject with its customary blatant ignorance and filled the minds of the public with catastrophic visions of a pseudo-scientific character. Mt. Lassen is interesting, but not alarming, except to those living on its flanks. To them, indeed, the awakening of subterranean forces long dormant has been calamitous, for their farms have been covered with 'ashes' and their water supplies choked with 'mud' emanating from the vent among the snowfields. The 'ashes,' the 'smoke,' and the 'fire' express popular notions rather than scientific facts. In childhood we learned that volcanoes were burning mountains that emitted smoke and molten rock. Less simply, they are the safety-valves for energies released by readjustments of the earth's crust, whereby the rock molten by pressure and interior heat escapes to the surface under propulsion of superheated steam. The 'smoke' is steam; the 'ash' is lava shattered by the explosive liberation of that steam; it is not the residue from cinders; and the 'fire' usually is either the reflection of molten lava—in the crater—upon the clouds of steam overhanging the orifice or it is the electric discharges originating from the intense friction caused by the passage of material hurled into the atmosphere. The 'mud' that threatens to overrun the ranches near Mt. Lassen is made by the falling of hot particles of shattered rock, the so-called 'ashes,' on the snow-banks, melting them and mingling with the resulting water. Fortunately at least one scientific account of the recent series of eruptions is available. We refer to that written by Professor Ruliff S. Holway and appearing in *The Popular Science Monthly* of March. According to this authority, Mt. Lassen is an old volcanic cone about 200 miles north of San Francisco, the summit attaining a height of 10,437 feet above the sea. It stands near the southern edge of a great Tertiary lava flow that covers portions of Oregon, Washington, Idaho, Nevada, as well as northeastern California. No precise record of its previous activities exists, but the Cinder Cone, in the same district, is believed to have emitted a flood of lava about 200 years ago, and reports extant among Indians, living in the region before the white settlers came, indicate that about 1850 Mt. Lassen itself had an eruption, similar to that which began a year ago and is still proceeding. The present outburst began on May 30, 1914; it was marked by volumes of steam, showers of fragmental rock, and the formation of a big chasm in the northwestern portions of the old crater. This chasm or vent was 400 ft. long at the end of June and is reported to have increased to 900 ft. in October last. Up to a late date no molten lava has been seen by any competent observer. The mountain happens to be in a National Forest reserve, so that it has been watched intelligently by members of the Forest Service, whose evidence has been carefully analyzed by Professor Holway, who himself ascended the mountain last week, on May 27, and reports that the bottom of the old crater has been pushed up by the pressure of lava underneath. The entire top of the peak has been changed and is now smothered under big stones, covered with dry powder and the steam-blown rock that constitutes the so-called 'ash.' Professor Holway fully recognizes the inability of science to foretell the behavior of a volcano, but he hazards the prediction that the changes now in progress will end in establishing a solfataric basin on the top of Mt. Lassen, much like the group of hot springs, boiling mud-pots, and geysers called Bumpass' Hell, a locality three miles from the peak itself. 'Geyser' is an Icelandic word for gusher, given to hot springs discharging violently at the surface, while 'solfatara' is an Italian word, derived from *solfo,* meaning sulphur. It designates the feebler phase of volcanic activity, associated with the escape of steam and other gases, including the sulphurous. Early in July, Mr. J. S. Diller, a distinguished geologist to whom this region is familiar ground, is to begin a study of Mt. Lassen's behavior. We shall await his report with keen interest. According to Professor A. S. Eakle, of the University of California, the 'ash' consists of fragments of an acid volcanic rock resembling rhyolite. Here the miner's attention will be caught, for rhyolite is a rock in which ore deposits are found not infrequently, for instance, at Tonopah. Indeed this late phase of volcanic action interests the miner by stimulating his imagination in conceiving the conditions under which the big extrusions and intrusions of igneous rock must have occurred in bygone geologic time. To those events the present violence of Mt. Lassen is of ladylike gentleness. We trust that its behavior will continue to exhibit polite restraint.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

Assay of Ore Containing Metallics

The Editor:

Sir—The concentrates from the ores on the Juneau side of Gastineau channel are remarkable for the gold that is carried in metallics. While it is not so noticeable in the iron concentrate, in the galena concentrate the metallics often carry more than one-half, and occasionally as much as three-quarters of the gold of the sample.

An idea of the importance of the metallics may be conveyed by the fact that one of them weighing two or three grams from a sample of 200 grams will often contain over 100 milligrams of gold. The weight of the metallics from a 200-gram sample varies from two to about twelve grams. The gold-content does not, however, bear any strict relation to the size of the metallic particle. The amount of metallics depends largely upon the wear of machinery during crushing.

When the metallics are small, direct fusion with the addition of silica to the flux is sufficient. As the weight of the metallic increases, the fusion becomes more imperfect and necessitates the breaking up of the iron by acids before fusion, which is too slow, or by using nails and adding an excess of sulphur.

In the routine work of the assay-office a large number of these samples have to be run every day. It was to facilitate this work that I devised a special method that not only insures perfect fusion of the metallics but also simplifies the mathematical calculation.

The pulp, screened through 120-mesh, is thoroughly rolled and two charges of one-half assay-ton each are weighed out. The metallics are then placed in the pan and pulp is added to bring the total of metallic and pulp up to one-half assay-ton. In adding the pulp it is tapped from a spatula to form a cone in the pan so that any excess may be removed from the top without disturbing the metallics. All fusions are made with nail flux with the addition of one nail, and require about 35 minutes in a hot muffle. The excess of sulphur present in the pulp added is sufficient to slag all the iron except where the weight of the metallics approaches one-half assay-ton. In that case it is best to divide the metallics and make two fusions.

By adding pulp to bring the total up to one-half assay-ton it is not necessary to weigh the metallics in order to make the calculation for its equivalent weight in pulp, as that is automatically done. The weight of gold in one-half assay-ton of pulp need only be subtracted from the amount of gold obtained from the one-half assay-ton of metallics and pulp, and the remainder is the metallic gold, to be distributed over the whole sample. This weight, divided by the number of assay-tons in the total sample gives the amount to be added to the assay-value of the pulp.

Example:

		Mg. Au
½ A. T. pulp A	4.48	
B	4.52	
½ A.T. metallic and pulp		94.50
Subtract value ½ A.T. pulp		4.50
To be distributed over whole sample		90.00

	Gm.
Weight of pulp	247
1 A.T. pulp and ½ A.T. metallic and pulp	45
Total weight of sample	292 = 10 A.T.

90.00 ÷ 10 = 9.00 mg. correction of metallics

4.48
4.52
9.00

18.00 oz. per ton; value of sample = $372

The silver value may be determined in the same way. This method has been in use at Treadwell for some time and has proved satisfactory.

W. E. Cahill.

Douglas, Alaska, April 28.

Quantitative Blowpipe Analysis in the Field

The Editor:

Sir—In your issue of May 8, George Delius writes on this subject. While the blowpipe, in the hands of one who knows how to use it, does very well for silver, I think it of little use for gold, on account of the small amount of material that can be treated and the exceedingly minute quantity of gold that even a fair grade of ore will yield from 100 milligrams.

One-ounce ore is very fair grade; this would contain only 0.0034 mg. of gold in 100 mg. of ore, or, in round numbers, one three-hundredths of a milligram. It is very difficult to handle and weigh a hundredth of a milligram under the most favorable circumstances, and the only safe way when it is required to make returns on exceedingly low-grade material—tailing, for example—is to take several assay-tons and combine the buttons.

Anyone who can use a pan has no trouble in finding gold in ore containing $4 to $5 per ton, and can make a close estimate of the amount. If sulphides are present, it may be necessary to roast the small residue of the panning, or if nitric acid is at hand, to heat it with that, especially if galena is present. Nitric acid or roasting

removes tellurium and leaves the gold in metallic form. The cases where gold will not show in a pan are so rare that they may be safely disregarded.

E. C. WOODWARD.

Colorado Springs, May 12.

Japan and China

The Editor:

Sir—Being an old reader of your paper, I am, perhaps, permitted to make the following friendly comment on your editorial, 'Japan and China.'

In these days when you cannot take up any paper or magazine without being reminded of the colossal struggle taking place all over the world, I always welcome the day when the *Mining and Scientific Press* makes its appearance in my mail. At least for a couple of hours I have something to read that occupies my mind without any direct reference to the War. It was only during the first weeks after the War had started that now and then, like a bomb from a Zeppelin, a contributor from the other side dropped in and told us "how the War looked at London," but fortunately the War ceased very soon to look very inviting at London to write about. Now you have published in a recent issue an editorial under the caption 'Japan and China.' This, according to its contents, ought to have been entitled 'Germany and Great Britain—China and Japan, a parallel,' and which actually is a continuation of those London letters.

Maybe many readers are greatly interested to know what London thinks about the War, but I for one would consider it a favor if you will kindly exclude in the future all one-sided references to this international catastrophe, if it were only to "let us have peace" in our technical journals on this side of the ocean, where, up to the present, thanks to our President, we have enjoyed peace. I trust you will find a little space in your journal for these lines.

KURT PIETRUSKY.

Chicago, May 12.

[We are glad to accord space to Mr. Pietrusky's views. One of the most difficult tasks in the world is the successful transfer of ideas from one mind to another, and we regret that in this instance the transfer seems to have been imperfect. There was no mention of Great Britain in the editorial in question, nor any thought of it in the mind of the writer. As to presenting the London viewpoint, it will interest Mr. Pietrusky to know that the editorial was not written by the author of the letters from London, but by the junior editor, whose knowledge of London is confined to a brief visit years ago, and who can scarcely be accused of bias toward Great Britain, being an American of Irish descent. What we attempted to make clear in our editorial was that sympathies confuse vision and obscure the fact that in international relations there are fundamental principles of right and wrong that are as coldly impersonal as a theorem in geometry. However, we appreciate the goodwill shown in Mr. Pietrusky's courteous comment, and take good note of his suggestion.—EDITOR.]

Undercurrents

The Editor:

Sir—Reading the article on undercurrent plants in your recent issue, it appears to me (though not criticizing Mr. Haley's article) that the undercurrent and the concentration of the fine sand from placer deposits is about the most neglected end of mining.

In the first place an undercurrent plant should be designed in proportion to the amount of cubic yards the plant is capable of handling and should be built so that the 'feed' can be regulated both from the main sluice and also over the tables.

I found the efficiency of recovery depended largely as to the amount of material run over the tables.

The general design I have found to be the most adaptable is to place a grizzly, as *A* in Fig. 1, at the end of the main sluice. This grizzly can be either of round or octagonal steel bars, spaced from ¼ to ⅜ inch apart and at least 12 ft. long. The grade of the grizzly should be about 1½ to 2 in. per foot. The heavy material rolls over this steeper grade and is picked up by the excess of water that is not used by the undercurrent, as is Fig. 2. The fine sediment falls into the concentrate-box and is thence fed into the long feed-box and over the different tables.

The excess water is a great asset where one has a long line of waste-boxes extending to the dump, as the whole undercurrent plant has to be placed on a firm foundation where a rise from a river could not harm it. The bottom of the concentrate-box should be lined with 16-gauge sheet-steel.

It is not necessary to go into details as to the size or dimensions of the concentrate and feed-boxes, etc., as they are governed by the amount of yardage handled.

The gravel issuing from the feed-box is regulated upon the tables, passing through a baffle-box that spreads it over the upper end of the tables evenly. These tables are 30 in. wide and 12 ft. long, similar to the tables on a dredge, and are set on a grade of 2 in. per foot, ¾ in. angle-irons are used on them, made up in 12 in. sections to the table.

The beauty of this system is that one never has to stop his entire plant to clean-up the undercurrent; simply shut the feed off from one table, clean it down, turn the feed on again and go to table No. 2, and so on. A flow-sheet of a plant of this kind would read as follows:

All material to main sluice, and after passing down main sluice, the fine through grizzly to concentrate-box, from concentrate-box to feed-box, from feed-box to the different tables.

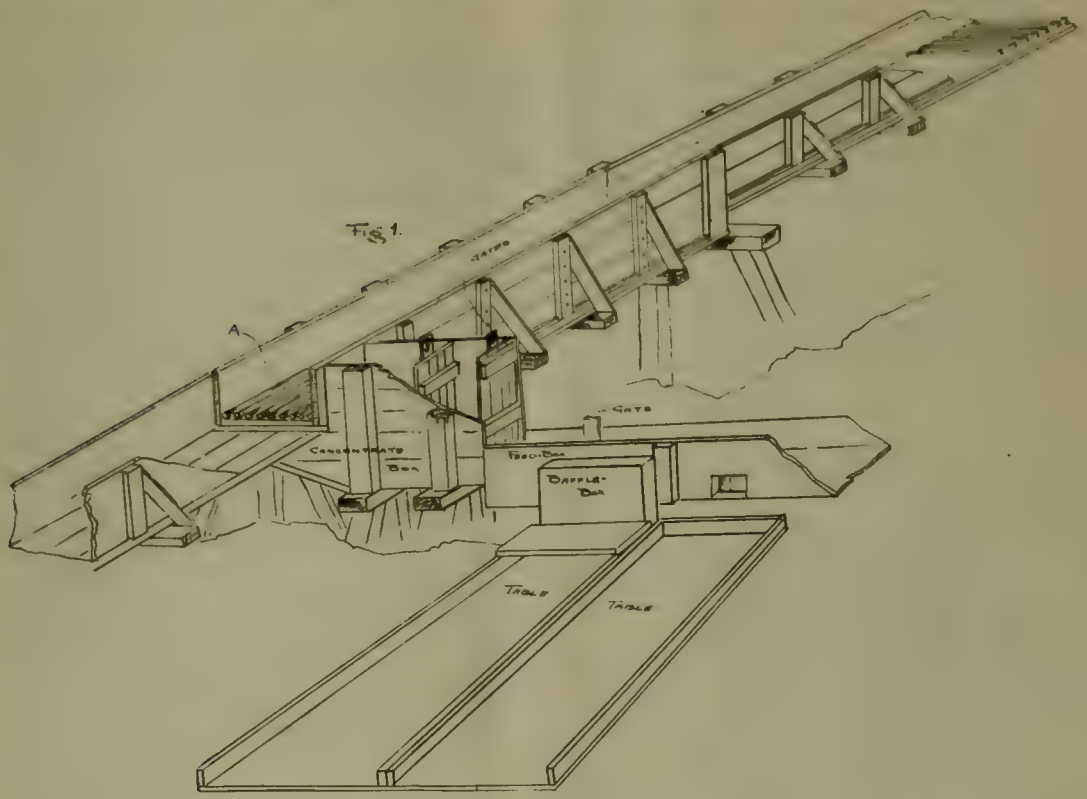
No consideration is given to block-riffles on a plant of this kind as it has been found that the tables should be cleaned-up at least once every 24 hours or more often in accordance with the yardage put through.

The idea of spilling the fine through a grizzly, over an undercurrent, without regulating the feed seems mighty poor practice.

The design of a plant is largely governed by the contour of the ground. There are times when one cannot get a gravity-flow from concentrate-box to the tables;

in a case of this kind the fine has to be elevated to the tables.

Mercury-traps can be placed at the upper end of the tables in the place of one section of riffles; where the gold is easily amalgamated, this cuts down a good deal of labor. A good concentration can be made on ordinary tables. This concentrate should be then re-concentrated over a table of special design and the product shipped to a refinery.



Pages could be written on the concentrating of placer sand and the design of undercurrent plants. I have wandered South to North in the world, and my opinion is that the average placer miner lets more gold go over his dump than is recovered in his sluice-boxes and hardly ever pays any attention to anything in his sand, except the free gold.

Seattle, May 5. B. T. Ulrich.

[The letters on this subject are most welcome. We have others ready to print. They should be read in conjunction with the thoughtful article by Mr. John M. Nicol, who shows clearly how sloppy are the conventional methods of gold-saving at placer mines. The large volume of water and the absence of classification render the effort to concentrate almost ludicrous. It is also time for alluvial miners to realize the fact that platinum and other valuable metals are usually associated with placer gold. These can be saved by some serious attempt to introduce concentration in stages. Undoubtedly, the alluvial miner, more particularly the dredge-man, has been living in a fool's paradise, deluding himself into an idea that he was making a high extraction because nobody could prove that he was not saving all the precious metal. He has been helped in his false feeling of security by the weird discrepancies between drill-hole results and shaft-sampling. These discrepancies have tended to remove the anxieties that might otherwise have filled his mind from his own inability to make his saving of gold tally with the estimates based either on drilling or shaft-sinking. Now the introduction of riffle-jigs and similar devices have already done enough to disturb the self-satisfaction of even the most complacent of those who apply water to the winning of gold.—Editor.]

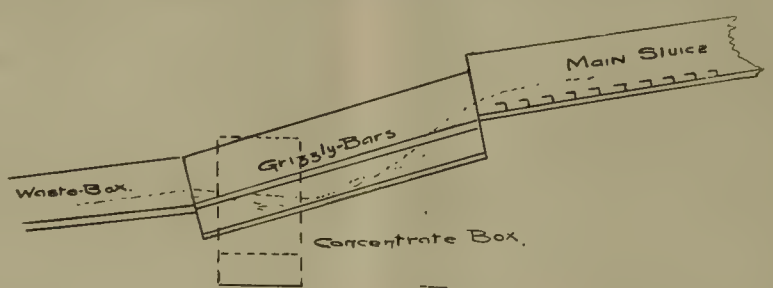


Fig. 2

Opportunities in China

By H. T. LIANG

*It seems almost a paradox to say that China is at once poor and rich. Nevertheless, it is true. China is poor, very poor, so far as hard cash is concerned, but it is rich, perhaps one of the richest countries in the world, when we begin to realize its unlimited natural resources. The natural resources of China in number and in kind will speak volumes. However, I wish to speak not so much on the general question of mining in China as on mining in Hunan, which is one of the provinces of central China.

Hunan is dotted with mines of every description: gold, silver, lead, zinc, antimony, tin, copper, iron, quicksilver, and coal. The numerous streams and canals throughout the province offer good transportation facilities. My own family was among the first to take an active interest in mining, for it has been in the business in Hunan for over twenty years.

I long had in my mind the ambition of becoming a mining engineer, and so in 1904, I came to this country for the necessary training. In the meantime, the mining of antimony at home began to assume great proportions, so that technical assistance was very much needed. In 1906, I went to the Royal School of Mines in London, and specialized in mining. Afterward, I studied under Herrenschmidt in Paris, and gained much knowledge and experience from him. The right of operating his patented smelting process in China was purchased for 100,000 francs. In 1908, upon my return to China, I at once organized an antimony mining and smelting company in Changsha, and the business has since been attended with much success. Almost all of our antimony products are imported into your great country through the office of the Wah Chang Mining Co. in New York city.

In addition, we have been operating a few lead and tin mines in Hunan, the ores of which are excellent and are easily transported to market. Nevertheless, as we are still in the experimental stage, we have not worked on a large scale. Consequently, our progress seems slow. But we have not been idle. Plans for rapid expansion have been made, and the prospect of great success seems assured. As soon as conditions in our country are a little more settled, we shall secure larger investments and more men of technical knowledge and experience for the much desired expansion.

The richness of our mines cannot be gainsaid. Let me illustrate by describing to you the Hunan Government lead mine at Shui Kou Shan, of which I have been in charge for about a year. Modern methods and machinery are used only for ore-dressing and in transporting the ores. Old Chinese methods are still being employed in breaking the rocks and in driving the drifts. Despite this fact, the mine yields high-grade lead ore amounting to about 60,000 tons per year. When we have installed up-to-date mining machinery, in a year or two, the output each year will, doubtless, increase several times. The width of the veins is over twenty metres. Foreign mining experts that have visited the place have one and all remarked that they have not seen veins of similar width at any other place in the world. This represents just one mine in Hunan, and there are many more and richer mines in the province. I hope some of you may visit Hunan in the course of time, and I shall be glad to show you what we have in the way of natural resources.

Our commission is now touring through your great country to see the notable advance which you have achieved in industry and in commerce, to seek your advice and co-operation in more than one way, and also to learn your system, methods, and spirit in transacting business. While doing this, I wish especially to investigate up-to-date mining machinery, some of which I hope to ship back to Hunan to improve and develop our mining enterprises. Further, I wish to have the privilege of conference with your leading mining men about the best mining technology, with a view to securing their best co-operation and assistance. I sincerely hope I shall have both opportunities and facilities of realizing these hopes.

The development of mining enterprise in America has been really phenomenal. It is true that your great country is rich in natural resources and you have a sufficient number of well-qualified men. But, in the early days there was one act from which your country reaped not a little benefit in developing your natural resources. That was your open invitation to capital and technical men from Europe, and they responded by coming to your country. China fully realizes the advantage of such a policy and has decided to follow your illustrious example. Already there are unmistakable indications that ere long foreign capital and foreign experts will be invited to help us in unearthing the natural resources that have been buried underground for so long.

I have made extensive trips especially through the provinces of Hunan and Yunnan and have found a number of mines which, if operated, will perhaps equal any rich mine in America. At the same time, I fully realize that without the co-operation of capitalists and mining experts from abroad, we can hardly hope to make such progress in mining as is desired and desirable. One of my great hopes in visiting America this time is to call your attention to the wonderful opportunities of mining in China today, and to urge that you do not allow them to slip. America sent invitations to financiers and mining experts in Europe and she has since profited by their response. Today China sends similar invitations to financiers and mining experts in your great country, and hopes that you will respond by coming to share with us our natural resources. Such a response will be heartily welcome, and will prove, I am sure, not only a source of great financial gain to you and to us, but also an added factor to strengthen the cordial relationship already existing between the two countries.

*An address before the Commercial Club of San Francisco.

The Metallurgy of Alluvial Mining—II

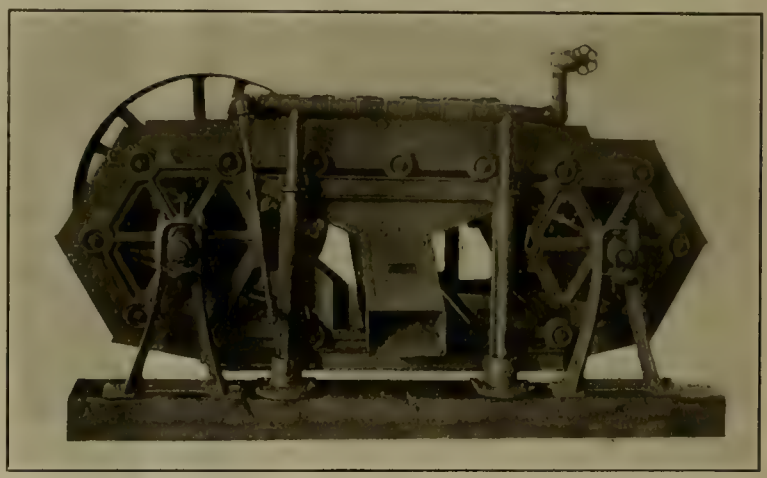
By JOHN M. NICOL

An Ideal Concentrating Plant for Placers. It is not my purpose to give the details of design of a complete plant, but, bearing in mind the principles that have been discussed in this article, to give a series of suggestions that any engineer can use and modify to meet the exigencies of any particular case, and also to describe three machines that I have designed particularly with a view to facilitating concentration work in placer mining operations.

As a rule in placer mining the available head-room for dumps is limited, and hence any metallurgical plant must be designed to use as little of this precious head-room as possible; and when head-room must be obtained for effective metallurgical operations, as small a proportion as possible of the material must be elevated to gain head.

Starting with the receiving sluice at the delivering end of mining operations, the arrangement suggested is as follows:

A short length of sluice should be built in duplicate, and the steepest admissible grade used, so that large boulders can be run through to assist in disintegration and washing. These sluices should be equipped with steel side-liners, and steel riffles having a strong boil, as in standard practice. As these sluices are in duplicate they can be cleaned-up at frequent intervals, without stopping mining operations.



A WET-SCREENING DEVICE FOR PLACERS.

At the end of these sluices a grizzly should be placed, with apertures of from ½ to ¾ inch, or even 1 in., according to local conditions. If head-room admits, the grizzly should be extra long and placed at a steep grade, so as to discharge oversize in a dewatered condition to dump, or to a stacker. If head-room does not admit of this arrangement, the grizzly must be inserted as an undercurrent, but in this case the riffles in the sluice must not be carried down close to the head of the undercurrent, preferably at least 20 ft. of smooth bottom at a lesser grade should be provided, so that the fine gold and 'heavy concentrate' have a chance to settle and travel along near the bottom, where they can be sucked through the undercurrent-grizzly. If an undercurrent-grizzly is used, the apertures will be smaller, say ¼, ⅜, or ½ inch, and if head-room is limited, the material passing through can fall into an under-pocket with side-hopper, and can be drawn off by a small hydraulic elevator or other suitable elevating appliance.

All of this undersize should then be passed over some form of 'roughing' or first-stage concentrating device, designed to catch all of the heavy material, and fitted with riffles arranged so as automatically to discharge the concentrate as fast as caught. Canvas or blanket tables, or cocoa-matting with expanded metal riffles (standard practice) fail utterly for this purpose, as the riffles do not discharge automatically and therefore rapidly choke, or else boil everything over, as already explained. I suggest the following design of machine: although it has not been tested in actual practice, it is simple and is in accord with the requirements of the case:*

The machine is to consist essentially of a large drum, say 5 to 6 ft. internal diameter, and say 20 ft. long; with open ends; the drum to be mounted on rollers and driven slowly round by outside gears. The inside would be fitted with cast-iron liners, with longitudinal angle-irons and low simple riffles spaced about 6 in. on the length of the drum. A smooth steel sluice would be suspended longitudinally down the centre of the drum. The drum would be mounted so as to be on a slight incline, and would have a free discharge-lip on the lower end and a safety-flange on the upper end. The speed of revolution would be slow, say about 4 to 6 per minute, so the power required for driving would be little.

The action would be as follows: The screened material would be fed at the upper end and discharged at the lower end of the drum. The heavy particles would settle and be caught in the riffles, which would be arranged to create the minimum of 'boil' possible. The concentrate would be caught by the longitudinal angle-

*Application for patents pending.

irons and carried around as the drum revolves, to be discharged into the smooth steel sluice, and clean riffles would be constantly presented to the flow of fine gravel and sand from the grizzly. Two or more of these drums could be mounted in parallel, according to the capacity required, and two or more in series according to the refinement of saving required.

As the sand from the undercurrents would have an excess of water, the following dewatering device could be placed between the grizzly and the drum. This device is a modification of a mill and is more or less of an improved copy of one built at the Old Channel mines in Oregon. It was used successfully for the dewatering of sand for a canvas-table sand-plant. The sketch is self-explanatory; it consists of a main sluice that receives the undersize from the grizzly or undercurrent; a cross-distribution sluice, with simple or shaped iron discharge-gates, to regulate the distribution-flow; a main spitzkasten having a hinged central baffle, with adjustable control, a series of V-shaped spigot-discharge doors; a longitudinal pipe with ascending jets and control-valve; a weir-discharge with adjustable lowering and raising edge and a discharge-sluice for the excess water and light sand. The size shown is for a mine handling a total of about 2000 yards of gravel per day.

This brings us down to the stage where we are saving everything heavy; but the volume has been reduced to probably less than 5% of the original gravel in place; hence, if the first rough concentrate contains practically all of the valuable particles, it is worth 20 times as much per cubic yard; and we can therefore afford to increase the cost of metallurgical operations to employ more refined methods for the remainder of the operations.

The material discharged from the drum-concentrator will be in a fairly dewatered condition, but will require screen-sizing to separate the coarse material, most of which will be worthless.

The coarse material could be passed conveniently over a conveyor picking-belt, to save occasional gems, lumps of cassiterite, and other minerals found in placers. What will be found is unknown until a plant of this kind has been tried, and will vary in every district. If this coarse material proved to be worthless, the conveyor could be arranged as a stacker, or used to return this material to the main sluice. If, on the contrary, it showed value by assay in included gold and platinum (which is highly probable), it could be crushed and the fine sent to the concentrating plant.

The successful screening of the great mass of mixed coarse and fine material resulting from placer mining is a difficult problem. Trommels are all right down to ¼-in. size with steel plates. But when a 20-mesh or finer screen is used, and coarse material has to be fed, the wear and tear and blinding of the screens is excessive. Bumping screens also failed. The most effective device that I have found so far consisted of a series of tray-screens linked together and forming a screening pan-conveyor. This admitted of the material being washed through the screen by jets. The distribution of the material in a thin sheet gave abundance of screening area, and avoidance of attrition on the screen-surface. Coarse wire could be used even with a comparatively fine mesh, insuring longer life.

The capacity varies, of course, but I should judge that a machine 3 ft. wide by 16 ft. long will screen about 300 tons per day to 20 mesh. This machine is not patented and any engineer is welcome to use the design or any modification of it to suit his own requirements. I designed and built the first machine about nine years ago.

The size of the screens used will depend, of course, on actual tests at the mine; it may be necessary to use two or more machines tandem, and send the different size products to different concentrators.

A number of preliminary experiments have been made, using table-machines to treat the fine from placers, and no doubt they could be used with success after a 'roughing down' process such as I have described. Their defect for this class of work is the high first cost in relation to capacity, and their lack of devices for making positive separations of four or five different products, such as is required in placer-mining operations. In view of this I designed a concentrator, which no doubt will be useful elsewhere, but was especially intended for concentration-separation work in handling the fine in placer mining. Patents were recently granted and although I have not had the opportunity to build and test a machine, I believe a description will not be amiss, and may interest those who have problems of this nature to face.

The machine consists of a traveling belt, moving at right angles to the direction of the flow of the sand. The sand is fed onto the upper edge and discharged at the lower edge. The belt travels on rollers, mounted on a frame, which in turn is mounted on rocking arms, the whole equipped with an oscillating mechanism much the same as an ordinary belt-machine. The surface of the belt is equipped with five or more flexible continuous riffles, supported by 'guide-flows' that admit of the adjustment of the height of the riffle at any part of the table.

The main feature, which gives great capacity, is that the surface of the table is moving continuously at right angles to the direction of the flow of the sand, and the concentrate is being discharged as fast as caught. The refinement of separation is due to the fact that the movement causing removal of the concentrate is independent of the oscillating movement causing settlement, and also that the height of the riffles is adjustable. These factors do not exist on other machines.

Whatever machine may be adopted, the fine material from the screens should be concentrated on some form of table or belt-concentrator, in which the riffles are being automatically cleaned. Judging by my own experience in such experiments as I have made, the resulting fine concentrate will probably arrange itself in bands, in something like the following order:

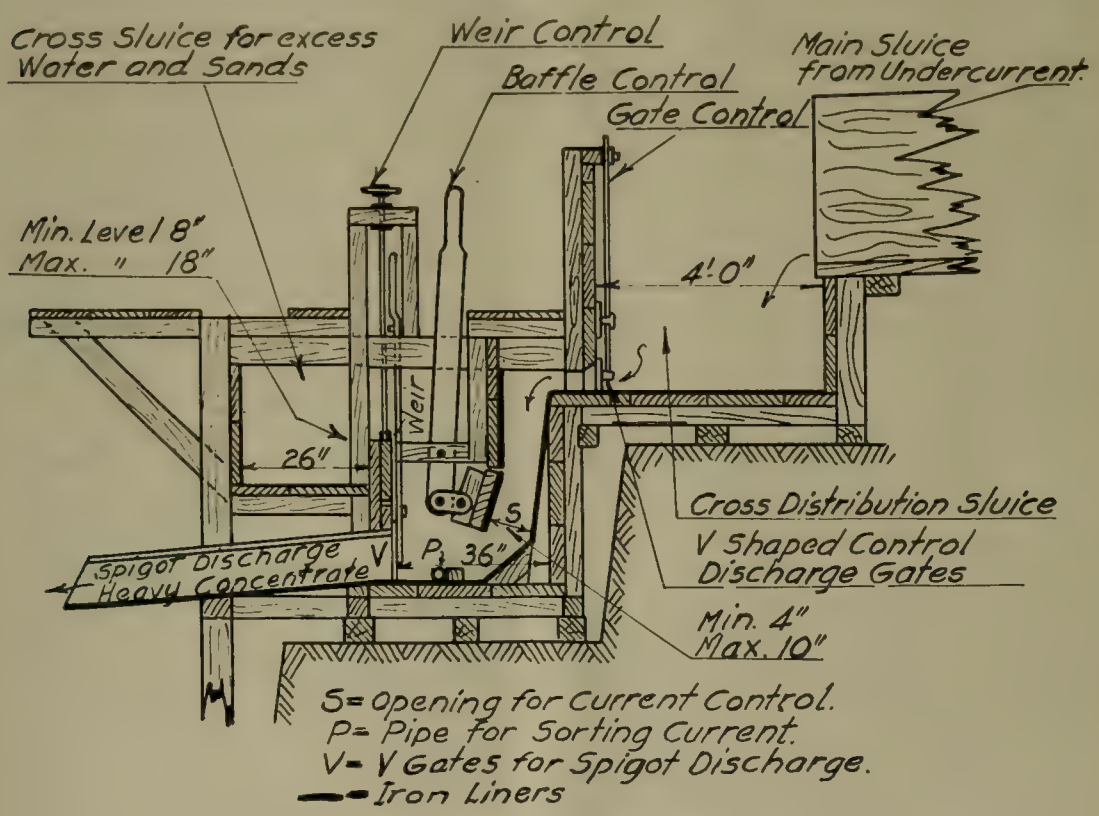
A band of very fine heavy magnetic black sand on the upper edge, or first riffle-discharge, according to the type of machine; this band will contain, in 'associated' par-

ticles practically all of the free gold, platinum, and iridosmium, and also the mercury and amalgam. It will merge into a lower band of coarser black sand, through which will be spotted particles of hematite and chromite, when these occur as gold-bearing particles; at some mines these grains are entirely absent. On the lower edge of this band and intermingled with what we might term the middling, fragments of heavy copper ores, cassiterite, and cinnabar will lie; also josephinite and occasionally wolframite. About this zone there is often a strong belt of garnet and other inferior gems, and many of the rare minerals.

It is my belief that in some districts surprising results

bunches, so that 'robbery' occurs by inclusion in these bunches. About eight years ago I tried a number of experiments with rather crude laboratory appliances, and tried to overcome this by 'free-falling' in air, 'pulsating waves,' 'varying intensities,' etc.; but I could not gain much improvement over the work done by standard machines on the market. I came to the conclusion that the defect inherent to all of them is that the magnetizable particles are drawn together on converging lines of force; hence in a fine material of high permeability this robbery by 'bunch inclusion' is bound to occur.

About six years ago my attention was drawn to some experimental work on these lines conducted by Dr.



DEWATERING SLUICE FOR PLACER MINING.

will be obtained, in regard to the quantity and value of the by-products, if a properly designed plant is used to save them; while in others only a mass of black sand with a little associated fine gold would be obtained.

Whatever is saved, it is certain that the largest bulk will be magnetic black sand, and as this is at present practically worthless and only interferes with the final separation of the gold and platinum and of any other possible by-products, our next step will be the drying of the various concentrates, followed by treatment in magnetic separators.

The question of magnetic separation of this very fine black sand of high magnetic permeability is serious, for the reason that it bunches together with intense attraction, and non-magnetic particles are picked up in the

Heintz for the Oro del Norte Co. in which he used a diamagnetic alloy, and inserted a plate of this between the electro-magnet and the sand to be treated, the effect being that the magnetic particles traveled along diverging, instead of converging, lines, so that there was no robbery by inclusion in bunches. This appealed to me strongly, but as at that time claims for patents were made and there was a certain reserve in the matter, I did not care to go further.

It appears to me that all that is required is to work out the mechanical details of a machine using this principle to get an almost perfect magnetic separation for fine black sand; but it will require knowledge of mechanical design and of other branches of magnetic separation, backed by sufficient capital.

Up to this point we have been treading on fairly safe ground, and the analysis made and suggestions given, although no doubt open to criticism, are based on the results of practical observation. But from the stage of fine concentration onward, it must be purely a case of experiment and abstract suggestion, for the simple reason that so far as I know no continuous-action concentrating plant has ever been tried at a placer mine, and therefore the products as coming from normal conditions of mining have not been available. We have no real idea as to the amount, proportion, or value. Hence my further suggestions must be taken for what they are worth.

The first narrow streak of concentrate that is cut out separately will probably be found to be so rich and so reduced in quantity that it will be a simple matter to extract the gold and platinum. Any of the following may be considered: wind separation, magnetic separation, leaching of the iron followed by amalgamation of residue, sodium amalgam when there is platinum (see Bulletin on Black Sands by David T. Day, page 62), grinding in small pans. For the hematite and chromite, if cut out separately, magnetic separation of black sand, fine grinding, and hand amalgamation of residue may be adopted. Direct crucible smelting, with lead as a carrier, is also effective for either of these products. For the streak carrying garnet and other minerals, I suggest magnetic separation, followed by wind separation of residue, and possibly use of greased plates or electrostatic separation.

These latter suggestions sound costly and complex, but as a matter of fact they all lend themselves to small-stage operations, and although the original bulk of gravel mined may be thousands of tons per day, the volume of fine product to be treated would only be a few tons per day, of material possibly worth many dollars per ton.

Recent Devices for Saving Gold. Practically all of the gold-saving devices that have been advertised within the last ten years, and all of the experiments conducted at the large placer mines, have been on routine lines, always employing fixed riffles and merely aiming at improvements in the 'boil' or in the shape of riffles, position of tables, screen, etc. A notable diversion has been the work of Charles Janin and J. W. Neill (see *Mining and Scientific Press*, November 7 and 28, 1914). The application of jigs to the saving of gold on dredges is of particular interest in that it is the first instance of any attempt being made at the continuous removal of the concentrate; although apparently no attempt has been made to save coarse concentrate or 'included value' or possible by-products.

In an editorial on page 710 of the *Mining and Scientific Press*, November 7, 1914, referring to the dredgemaster's estimate of his losses, the following remark is made: "Incidentally he is fortified in his conclusion that the metallurgical work of the dredge is well done by the fact that adding plates and tables improves recovery little. The great bulk of the gold is saved, as Mr. Janin shows, on the first few feet of tables."

If we refer to the tables of tests on page 721 of the same issue we note that the great variation in percentage saved, in relation to the continued value as indicated by the drill-tests, shows the impossibility of accurate sampling, which is a proof of the erroneous conclusion that may be drawn regarding the efficiency of the gold-saving appliance of a dredge, if the recovery is based on the relation of samples of heading and tailing.

The argument, so frequently put forward, that the high percentage (of the total saved) that is extracted on the first few tables is a proof that the losses are negligible, appears to be a fallacy. It really only proves that certain gold that is easy to catch settles quickly; and overlooks the fact that a piece of gold that boils out of the first two or three riffles will probably boil out of the tenth riffle; and it entirely overlooks the possible value of 'included' gold or by-products.

Mr. Janin's work shows a fairly big average recovery, and is probably of as high a grade of work as any done today; and the methods of sampling are as perfect as the present methods of the art permit; but still all the work is based on the sampling of 'free gold.' There is no doubt that the 'black sand' rarely contains 'included values,' it is only an associate of the free gold. Again, in the gravel deposits of the flat flood-plains exploited by dredging the proportion found of other mineral particles, likely to carry 'included' gold, is probably very small in comparison to old-channel gravels in the mountains and nearer to the source of the gold and minerals.

The jigs, no doubt, will help, especially in dredging where space is limited, but they will fail in saving all of the coarse concentrate, and herein lies the possibility of future development.

Another attempt out of the routine, to which my attention was recently drawn, is a shaking table, designed by J. B. Giffen, which was used successfully at Manhattan, Nevada. This was a shallow placer where water was scarce; the table was 8 ft. long by 32 in. wide, and had 64 inches of riffled surface, it handled successfully 40 cu. yd. of roughly screened gravel in 8 hours, using only 9 gal. of fresh clean water per minute; the tailing went to a settling-pond, and the water was pumped back for use. The operators claim that they saved 90% of the gold, and also a small amount of platinum. Another of these machines is operating successfully, treating the tailing from a small undercurrent in a mine on the Klamath river, in Oregon. The operators claim that they saved $2 per hour from tailing that was declared to have not a trace of gold, as proved by ordinary pan and rocker tests.

Another useful little machine is the Dibert gold-extractor, designed for beach-sand, and mining on a small hand-scale. It consists of a hopper, a vibrating screen, and a steeply inclined riffled-tray. This machine would appear to be useful for testing large samples.

Both of the above machines, while useful and no doubt effective for a particular class of work, do not fill all of the requirements needed to solve the problem; in fact, there is no machine on the market today that will do so.

What we require is a plant that will save everything heavy, including the coarse concentrate, and then make the final separation of gold, platinum, etc., in stages.

Wet Method of Mercury Extraction

By E. BRYANT THORNHILL

Little has been done in recent years on the metallurgy of mercury except in improving the furnaces for distillation and the condensers. G. V. Northey used water concentration at the Manzanita mine for some time and reports success. Clifford G. Dennis recently made some tests on floating the cinnabar and got good results, considering the crude apparatus used. The small profits of the business, however, except to those having high-grade ore, have not been conducive to experiments involving any radical change in the treatment of ores. The present high price of the metal, due to its use in making explosives, has stimulated the industry to an extent not seen in years. Practically all foreign competition has been shut off and American producers are getting almost any price they demand.

At present, two methods are in use to obtain mercury from its ores on a large scale. One depends on the fact that at a high temperature the oxygen of the air combines with the sulphur of the mercuric sulphide, forming sulphur dioxide and metallic mercury. The other depends upon heating the mercuric sulphide with iron or lime, the sulphur combining with the iron or lime, setting the mercury free. The first method is carried out in shaft-furnaces, usually of the continuous type, and is the more important of the two commercially. The second method is applied in retorts and is too expensive a procedure except for rich ores.

In spite of its universal application, the furnace method has disadvantages that will never be overcome. These are high cost of installation, quantity of soot caught with the mercury in the condensers, imperfect condensation, low extraction, particularly on low-grade ores, poisoning of workmen, excessive amount of mercury tied up in condensers, and the time required to place mercury on the market after the plant is put into operation.

The cost of building a continuous furnace of the type most used in California is approximately $1000 per ton of capacity. This figure would be excessive in some cases and low in others, but represents the average cost. On low-grade ores, 0.5% or lower, the soot caught with the mercury in the condensers usually necessitates retorting the product. The brick-work of the condensers absorbs mercury, and furnaces have been known to run from eight months to one year before any clean-up could be made. The actual investment in a furnace plant would not only be the installation cost of $1000 per ton of capacity, but would include operating costs until mercury could be placed on the market.

To those considering the installation of a furnace plant, to take advantage of the present high prices, the time required to put the mercury on the market is of especial importance.

These disadvantages led C. A. Mulholland to experiment with a hope of devising a wet process for the extraction of mercury, particularly from low-grade ores. It has long been known that mercuric sulphide is soluble in alkaline sulphides containing free alkaline hydrate, and Becker, in his monograph, 'Geology of the Quicksilver Deposits of the Pacific Coast,' made elaborate experiments to prove that the California deposits were due to the dissolving and subsequent precipitation of cinnabar from such solutions. The scheme of treatment suggested by Mulholland, deduced from his experiments, was to grind the ore in an alkaline sulphide solution, whereby the cinnabar was dissolved, separating the solution from the ore by filtration or decantation, precipitating the mercury out of solution with zinc hydrate, which brought down a mixture of zinc sulphide and mercuric sulphide, dissolving the zinc sulphide out of the precitate with sulphuric acid, and retorting the remaining precipitate of mercuric sulphide to obtain metallic mercury. The hydrogen sulphide formed by dissolving the zinc sulphide was used to regenerate the sodium sulphide solution. The chemical reactions involved in Mulholland's scheme are:

$$Na_2S + HgS = Na_2S \cdot HgS$$

$$ZnSO_4 + 2NaOH = Zn(OH)_2 + Na_2SO_4$$

$$Zn(OH)_2 + 2NaOH = Na_2ZnO_2 + 2H_2O$$

$$Na_2S \cdot HgS + Na_2ZnO_2 + 2H_2O = HgS + ZnS + 4NaOH$$

$$ZnS + H_2SO_4 = ZnSO_4 + H_2S$$

$$2NaOH + H_2S = Na_2S + 2H_2O$$

The sodium sulphide solution was destroyed each time it went to precipitation and was regenerated by introducing the hydrogen sulphide formed when dissolving the zinc sulphide with sulphuric acid. The mercury was obtained from solution as the sulphide and was retorted with lime or iron.

Where the cost of mining is low, Mulholland estimated that mercury ores as poor as 0.3% could be worked at a profit by this process. No commercial application of this process has ever been made, to my knowledge.

The Buffalo Mines, at Cobalt, of which T. R. Jones is general manager, is at the present time using a wet method to recover mercury as sulphide from amalgamation tailing. This should be equally applicable to cinnabar ores. The mercuric sulphide is dissolved out of the tailing with sodium sulphide and the mercury precipitated on scrap aluminum. The chemical equations are

$$Na_2S + HgS = Na_2S \cdot HgS$$

$$3Na_2S \cdot HgS + 8NaOH + 2Al = 3Hg + 6Na_2S + 2NaAlO_2 + 4H_2O$$

$$2NaAlO_2 + Ca(OH)_2 = 2NaOH + Ca(AlO_2)_2$$

From the equation, 11 lb. mercury should be pre-

cipitated with 1 lb. aluminum. Practically the ratio is about 7 : 1, as some hydrogen is given off during the precipitation. Not only is the sodium sulphide combined with the mercuric sulphide regenerated, but the sulphur with the mercuric sulphide goes to form sodium sulphide. The caustic soda is regenerated by the addition of lime, which also assists settling or filtration. These points have all been verified by laboratory experiment and actual practice. With a clean cinnabar ore the mercury would be obtained wholly in the fluid form without retorting, and by straining through canvas it would be made ready for market.

Over 40,000 lb. mercury has been recovered by the Buffalo Mines by this process at a cost of approximately 13c. per pound. The applicability of the process to cinnabar ores cannot be questioned, both as regards cost and recovery, and it should obviate most of the difficulties inherent in the distillation method. The cost of installation should not exceed $500 per ton of capacity. Since standard cyanide machinery can be used: crushers, pebble mills, Dorr classifiers, thickeners, etc., the plant could be erected in a minimum of time and mercury could be placed on the market in three to four days after the plant was put in operation.

The mercury produced at the Buffalo Mines by this process was assayed by Ledoux & Co., who reported silver only in determinable quantities. The sodium sulphide used costs $1.25 per cwt. f.o.b. chemical works for the commercial crystals and the aluminum for precipitation consists of casting-foundry turnings costing $2.50 per cwt. f.o.b. foundry.

Scale of Operations at Broken Hill, New South Wales

How the war has affected Broken Hill is well shown by the following table of output for the first and second six months of 1914:

	Jan.-July. Tons.	July-Dec. Tons.
South	172,000	111,891
North	156,000	104,755
Proprietary	153,000	121,316
British	110,000	27,218
Central	107,000	73,321
South Blocks	87,000	54,376
Block 10	48,000	37,853
Junction North	46,000	9,848
Junction	10,000	.....
Block 14 (sulphides)	18,000	.....
Block 14 (carbonates)	6,000	9,058
Totals	913,000	549,636

The mines producing are as follows, according to the *Mining Standard*: Proprietary, Central, Zinc Corporation, South, North, and Block 14 (the latter on a small scale). The non-producers are Block 10, British, Junction North, and Junction. During the last half of 1914 Amalgamated Zinc produced 45,286 tons of zinc concentrate from 165,448 tons tailing. None of the product could be sold.

Operations of the Yukon Gold Company

The Yukon Gold Co. operates dredges near Dawson, in the Yukon, at Iditarod in Alaska, and at Oroville in California. It also conducts hydraulic operations near Dawson. The report of the general manager, O. B. Perry, for 1914, contains the following information:

The eight Dawson dredges worked from May 12 to October 23. This was about 20 days shorter than the previous season, due largely to the discontinuance of the use of purchased power. The dredging season is now limited in length by the operation of the company's hydro-electric power-plant, which, owing to climatic conditions, has water available only from May 10 to October 20, approximately.

The average length of the dredging season was 164 days, during which the dredges operated 87.2% of the possible time. They mined 4,800,781 cu. yd., yielding $2,602,685, or an average of 54.21c. per yard. The cost, including depreciation, was 27.62c. per yard. This is about 2c. lower than last season. The results, compared with 1913, show a decrease in yardage, gross value, and net profit. The first was due to the shorter period of operation; the second followed from the decrease in yardage; also there was a reduction in value of 10.92c. per yard. Less high-grade ground was dredged than the season before, the depth of tailing handled being greater, which reduced the value of the ground. The total cost was less than the previous season by $189,792. Royalties paid to owners were $111,107 less.

While the total yardage was smaller than in 1913, the average duty of the dredges was higher for the operating time. This was due in a large measure to the excellent power service maintained by the company's plant. The thawing cost was reduced 1.39c. per yard. It was lower than for any previous season since operation commenced. During the season a total of 421,835 sq. yd., or 68.6% of the ground handled, was frozen and had to be thawed by steam.

The Iditarod dredge commenced operations May 4 and stopped for the winter on November 11. The boat handled 668,737 cu. yd. This produced $739,631, an average of $1.10½ per cubic yard. The total operating cost, including a depreciation charge of $50,000, was $335,825, or 50.2c. per yard. This is a decrease of 14.1c. compared with the previous year. The operating season was 191 days, during which the dredge ran 4210 hours, or 91.91% of the possible time. In general, the boat was operated under more favorable conditions than the previous season. The maximum grade of the creek did not exceed 5%. Few boulders were encountered. Although large quantities of granitic sand were handled, the disposal of this was not a serious problem. During the season 67,260 sq. yd., or 74% of the total area, was thawed by steam.

The three California dredges, operated by the Pacific company, dug 3,198,192 cu. yd., yielding $322,571, at a

cost of $136,772. The average cost of the dredging operations was 4.27c. per yard, including depreciation. The dredge on Butte creek began work on October 3, so that only three months are included in these figures.

A total of 3,241,641 cu. yd. was moved at the hydraulic mines. This produced $544,262, at a cost of $245,686. The working cost was 7.6c. per yard, exclusive of depreciation of the main ditch, a decrease of 2.1c. compared with 1913. The total water used amounted to 519,834 miner's inches, compared with 406,135 in 1913, a gain of over 25%. The duty of the water was 6.02 cu. yd. per inch.

The Twelve-Mile water system was operated from May 8 to September 30, inclusive, a total of 146 days. The average daily delivery was 3561 miner's inches. The ditch was operated for 96.4% of the possible time. Severe frosts early in September caused considerable difficulty in keeping the ditch open, otherwise the system gave excellent service.

Leases on claims owned by the company in the Yukon and Iditarod carried under the head of 'lay operations,' yielded a total of $135,897, at a cost of $6525. As mentioned in the last report, expired leases, where they are in line of dredging, have not been renewed.

All operations yielded gold worth $4,345,046. Operating charges totaled $2,050,889. The net profit was $1,184,819. Dividends amounted to $1,050,000.

The "lay operations" mentioned in this report refers to an important feature of mining in the North. Small parties or partnerships of working miners will take a lease or 'lay' on an alluvial claim, paying the owner a royalty up to 50% on the gross output. For this rich tribute the claim-holder may have done nothing beyond locating the ground or having it located for him. In the case of a company like the Yukon Gold, the ground will have been purchased and the leasing of it means that it is not suitable for large-scale operations on company account.

The photograph of hydraulic mining on this page illustrates operations on the big alluvial deposit known as the White Channel, thus named on account of the preponderance of white quartz pebbles in the gravel. This is a mass of Pliocene drift, as much as 200 ft. thick, but much thicker before it was eroded. From this erosion the creeks of the Klondyke were enriched, more particularly Bonanza and Eldorado, famous during the great rush 17 years ago. Indeed, nearly all the gold of the present low-level valleys is of secondary origin and derived from the re-distribution of the older gravels. This applies also to the flats now being dredged so successfully. These flats are frozen to bedrock except where the live water of the present creeks passes, so that artificial thawing has been necessary. The cost of the thawing has been decreased gradually to one-half what it was, say, seven years ago, but it is still a heavy tax. To decrease this item, it is customary now to strip the moss and frozen mould covering the gravel, so as to expose it to the natural thaw under the sun during summer. In this way the gravel becomes loosened as much as 12 to 16 feet in a single season, as against the maximum penetration of the winter frost to 6 or 7 feet.

HYDRAULICKING THE WHITE CHANNEL DEPOSIT NEAR DAWSON.

Platinum in Southern Nevada

By ADOLPH KNOPF

*Introductory. The discovery of platinum-bearing gold ore at the Boss mine was announced in October 1914. Early in that month an examination of the deposit was made by me, the results of which are here given.

The Boss mine is situated in the Yellow Pine mining district, Clark county, near the extreme southern part of Nevada. The main settlement of the district is Good Springs, distant 8 miles from Jean, a station on the San Pedro, Los Angeles & Salt Lake railroad. Good Springs lies on the east side of a desert range known as Spring Mountain, but the mine is situated on the west slope, 12 miles from Good Springs, by a road that crosses the range through a low pass.

The deposit on the Boss claim was discovered some 30 years ago, having been located for copper, the presence of which is plainly indicated by chrysocolla and other oxidized copper minerals. In the nineties the property was bonded and a leaching plant was built at Good Springs to treat the oxidized copper ore, but, the process proving a failure, the property reverted to its original owners. Not until recently has the gold and platinum content of the ore been recognized. The owners, Messrs. Yount and White, discovered the high gold content by sampling and assaying, and the Boss Gold Mining Co. was organized in March 1914.

The failure to recognize previously the auriferous character of the ore needs explanation. It seems to have been due in part to the fact that, although the ore can be shown by assays or chemical means to carry considerable gold, the presence of the gold, as I have verified personally, is not evident on panning. Moreover, some extraordinarily rich material (the plumbojarosite, assaying as high as $6000 per ton in gold) yields when panned a black residue that might easily be thrown away as worthless black sand. This unpromising black residue when strongly scoured by rubbing it in the pan with a piece of iron, rolls out into yellow flakes and quills, and its identity as gold becomes manifest. The discovery of the platinum content of the ore is due to the acumen of H. K. Riddall, chemist for the Yellow Pine Mining Co. In running assays of the Boss ore he noticed that the gold buttons, instead of being smooth, had rough cauliflower-like surfaces. He suspected that the buttons might contain platinum, and this suspicion was strengthened by the fact that solutions obtained on parting, instead of being colorless, as is the rule when the gold is alloyed with silver only, showed yellow and brown tints, indicating the presence of platinum and palladium. By systematic tests these metals were then proved to be present. This result was soon verified by a number of other assayers, although one supposedly reliable assaying firm in Los Angeles reported that the ore contained no platinum. Two samples sent to the Geological Survey by Mr. Hale were submitted for assay to Ledoux & Co., of New York, who reported on September 9, 1914, as follows:

	1.	2.
	Oz.	Oz.
Platinum	7.38	99.08
Gold	11.55	111.00
Palladium	....	16.00

Note. Concentration by panning shows that the metals are in the free state, being apparently alloys of gold and platinum metals. Owing to uneven distribution, assaying is very difficult and the above results can only be considered as approximately correct. Assay for palladium was omitted on No. 1, but the sample contains 1 or 2 oz. of this metal. A little iridium is present in No. 2.

Prior to the discovery of the platiniferous character of the ore some small shipments of high-grade copper ore and of high-grade gold ore had been sent to the smelter at Salt Lake City, but after the platinum content was recognized, production was suspended, pending arrangement for the advantageous disposal of the platinum and allied metals.

In October negotiations were under way for the treatment of certain lots of high-grade ore by the Pacific Platinum Works, of Los Angeles, whereby this firm agreed to pay $46 per ounce for the combined platinum and palladium content, after deducting a treatment charge of $300 per ton.

Late in the year the mine was sold by the Boss Gold Mining Co. to W. C. Price and associates for $150,000, according to O. J. Fisk, former manager of the company.

The great interest that attaches to so unusual and remarkable an occurrence of platinum and palladium in a gold-bearing lode hardly needs comment. The Boss vein is one of the few primary deposits in which metals of the platinum group occur in more than traces and, with one possible exception (the New Rambler mine in Wyoming), is the only primary deposit of economic importance in which these metals are the constituents of predominant value.

General Geology. The prevailing rocks of the district are stratified dolomites of middle Carboniferous age. They are considerably, though not acutely, folded and are broken by faults. This formation is economically the most important assemblage of rocks in the district, as all of the ore deposits occur in it or in the dikes cutting it.

Limestones of Pennsylvanian age and red sandstones and shales of probable Mesozoic age are also present in the district, but they are of no special concern here, as they lie at a considerable distance from the area in which the Boss mine is situated.

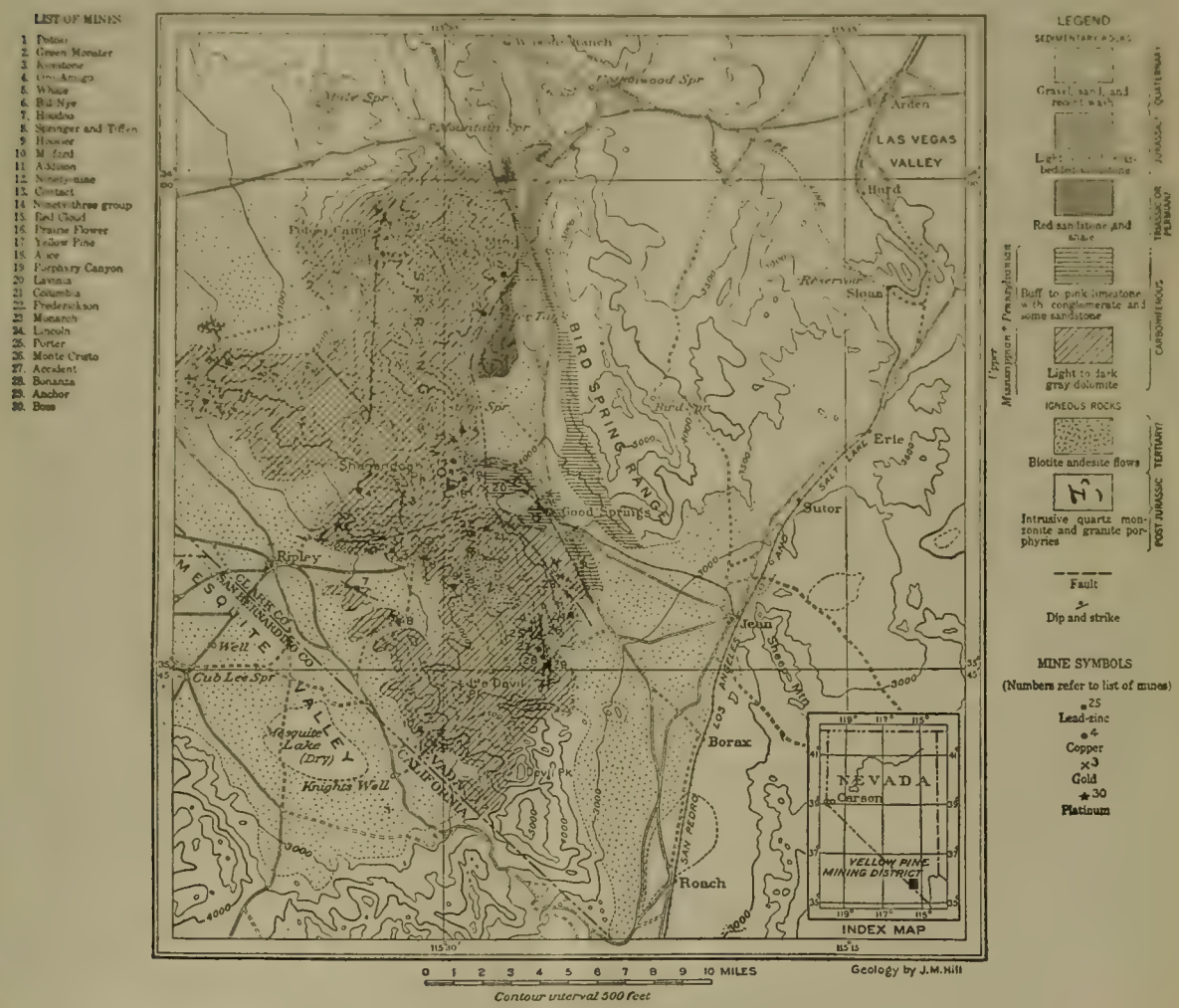
*Abstract from Bulletin 620-A, U. S. Geological Survey, entitled 'A Gold-Platinum-Palladium Lode in Southern Nevada.'

Intrusive igneous rocks are not common in this district, in fact, the areas occupied by them are so small as to be barely perceptible on the geologic map. They consist of stills and short dikes of quartz monzonite porphyry and granite porphyry, as a rule considerably altered.

The principal metalliferous deposits are bodies of lead zinc ores inclosed in dolomite or limestone. The prevailing minerals are smithsonite and cerussite; galena

Some copper deposits have also been developed. They consist predominantly of oxidized copper minerals forming irregular replacements. Tetrahedrite, which has been recognized in the gold ore of the Lavina mine, and chalcocite are the only copper-bearing sulphides found in the district.

Finally, brief mention should be made of the so-called vanadium deposits. On the Bill Nye claim, for example,



SKETCH MAP OF YELLOW PINE MINING DISTRICT, CLARK COUNTY, NEV.

occurs to some extent, but zinc-blende, presumably the parent of the oxidized zinc ores, is present in only one mine.

Gold deposits were formerly of some importance in this district, the Keystone mine, the most productive, being credited with an output of $1,000,000. At this mine the gold is disseminated through quartz-monzonite porphyry, which has been highly altered by the development of sericite and siderite. In general, the deposits are closely associated with the porphyry dikes and may stand in genetic relation to them. Certainly the chemical alteration produced in the porphyry dikes indicates that the ore-forming solutions were ascending thermal waters.

a dolomite breccia cemented by a copper-bearing lead vanadate, probably cupro-descloizite, forms a tabular deposit 18 to 24 inches thick, which has been exposed by an incline to a depth of 12 feet.

The Yellow Pine district, in which the Boss mine is situated, is the most productive zinc and lead district in Nevada. In 1913 it yielded 29,060 tons of ore, containing $1268 in gold, 192,339 oz. silver, 283,592 lb. copper, 6,204,065 lb. lead, and 14,369,709 lb. zinc, valued in all at $1,239,081.

The rock at the Boss mine consists of dolomite in beds ranging from a few inches to several feet thick. The beds comprise a dark-gray or black variety, fetid with

hydrogen sulphide on fresh fracture, and a more prevalent pale-buff variety. They not uncommonly carry crinoid fragments and are of late Mississippian or early Pennsylvanian age—that is, middle Carboniferous.

The rocks strike east and dip gently north. The structure is that of a broad anticlinal arch, whose crown has been broken by faults. In the immediate vicinity of the mine the rocks are practically horizontal.

A small mass of granite-porphyry or dike of no linear persistence occurs 600 ft. north of the mine. This rock is characterized by numerous large corroded phenocrysts of quartz and kaolinized feldspars embedded in a fine-grained groundmass. It accordingly resembles the small masses of intrusive granite-porphyry and quartz-monzonite porphyry scattered throughout the district. The porphyry is highly altered and has been considerably prospected for gold, but has proved of too low grade to be profitable, carrying at best only a few dollars in gold.

The orebodies so far developed are characterized by oxidized copper and gold-platinum-palladium. The copper ores consist largely of chrysocolla and colloidal complexes of chrysocolla and limonite; these ores are reported to carry only minor amounts of the precious metals. The gold-platinum-palladium ore consists of a fine-grained silicious matrix containing a bismuth-bearing variety of plumbojarosite (a hydrous sulphate of iron and lead). There is no fixed ratio between the content of gold and the platinum metals, nor between the content of platinum and palladium. This variability seems to be a result of the prevailing oxidized condition of the ore. The palladium is probably in excess of the platinum.

The copper ore-shoots and the precious-metal ore-shoots can be mined separately, it is said. This segregation of the metals that makes this feasible will assuredly be found less complete as depth is attained.

The orebodies of the Boss mine occupy a nearly vertical zone of fracturing in the horizontal strata of dolomite. At the surface this zone is 30 ft. wide, but the precious-metal shoots are confined to the 12 ft. resting on the foot-wall. The length of the mineralized zone exposed on the surface is about 100 ft., but the orebodies do not extend continuously over this distance. At the portal of the upper adit the foot-wall strikes N 5° E and the hanging wall strikes N 25° E. The principal ore-shoot forms an irregular pipe pitching at a low angle northeast.

The dolomite within the zone of fracturing has recrystallized to a coarse white spar, and this dolomite spar makes up the rock inclosing the ore-shoots.

PLUMBOJAROSITE. A particularly rich shoot of ore has been developed by a winze sunk from a point near the end of the upper adit. In this shoot are small masses of what are locally known as greenish talc. Some of these were mined separately and two shipments aggregating about 1 ton were sent to the smelter at Murray, Utah. On a control sample of this ore, Ledoux & Co. reports as follows: Gold, 111 oz.; platinum, 99.08 oz.; palladium, 1% oz. per ton; iridium, trace.

The "greenish talc," determined chemically and microscopically, proves to be a bismuth-bearing variety of the rare mineral plumbojarosite. It is a greenish-yellow mineral of smooth unctuous feel, which under the highest power of the microscope is seen to consist of perfect hexagonal tablets averaging 0.01 millimetre in diameter. It carries considerable mechanically admixed gold and platinum metals. An analysis of the purest obtainable material was made in the laboratory of the United States Geological Survey by R. C. Wells, with the following results:

Fe_2O_3	31.80	CO_2	0.43
Al_2O_3	0.14	As_2O_5	0.09
SO_3	24.08	P_2O_5	trace
PbO	16.75	SiO_2	6.90
H_2O-	0.02	TiO_2	0.37
H_2O+	8.55	Au	0.79
CuO	1.97	Pt	0.05
Bi_2O_3	6.34	Pd	0.22
CaO	0.06	Ir	trace
MgO	0.14	Ag	trace
K_2O	0.22		
Na_2O	0.52		99.88

Reduced to ounces per ton, the analysis shows gold to be present to the extent of 234, platinum 15, and palladium 64 oz. Assays of similar material are reported to show as high as 575 oz. gold, 230 oz. platinum, and 30 oz. palladium. The silica and titania shown by the analysis represent an admixture of quartz and octahedrite.

The gold and platinum metals can be partly separated from the plumbojarosite by panning, but long before a clean separation can be effected fine gold and especially platinum pass into the tailing, in spite of the utmost precaution. The gold is extraordinarily rough and spongy; delicate platy forms are common, and some is intergrown with quartz and plumbojarosite or is molded around minute quartz crystals. It is more or less blackish, and aggregates of the finer particles look like so much black sand. Treatment with hydrochloric acid and annealing, however, bring out the normal yellow color of gold.

The pockets of plumbojarosite occur in a porous, fine-grained silicious gangue, which is a replacement of the dolomite. The pores and cavities evidently resulted from the leaching of sulphides; they are now partly filled with malachite in small botryoidal groups, or more commonly with powdery plumbojarosite.

The only sulphide-bearing ore exposed in the mine at the time of visit was in the sub-level below the upper adit. Here, in particularly tight ground, about 3 ft. of copper ore rich in chalcocite had been opened. An average sample of this ore, as reported by the management, showed copper 15.1% and platinum metals 0.40 oz., gold 0.13 oz., and silver 1.2 oz. per ton.

The chalcocite, which is of the steely kind and shows conchoidal fracture, occurs as small blebs and finely disseminated particles embedded in a close-grained silicious gangue. It is partly altered to brochantite, the basic sulphate of copper, which forms small glassy emerald-green prisms implanted on the sulphide from which it was derived. Examination of this ore under the micro-

scope shows that it is an aggregate of quartz, chalcocite, and brochantite, with octahedrite present as a rare accessory mineral; the brochantite occurs in partial replacement of the quartz and is somewhat more abundant than would be estimated from inspection by the unaided eye. An oxidized bismuth compound is associated with some of the chalcocite.

GENESIS OF THE ORE. The Boss deposit represents in the main an irregular silicious replacement of dolomite along a series of vertical fractures. On account of the prevalent oxidation and the inconsiderable depth to which the workings have penetrated, primary sulphides have not yet been reached. The chalcocite, the only sulphide so far found, most probably originated as a precipitate from downward-moving solutions whose copper was derived from primary sulphides formerly exposed to oxidation near the surface.

The deposit yields as yet no especially strong evidence concerning the genetic conditions that prevailed at the time it originated. Some clue is perhaps afforded by the presence of the titanium oxide minerals, octahedrite, and rutile. Both of these are rather uncommon in metalliferous deposits. Of the two, rutile is the more common. It is, for example, somewhat abundant in certain of the auriferous deposits of the Juneau gold belt, which are veins that originated at high temperature; in fact, according to W. H. Emmons,* rutile is restricted to high-temperature veins. Octahedrite occurs in the tourmaline-bearing copper veins of Las Condes, Chile;† in tin veins of Saxony associated with apatite, fluorite, and chlorite; and in fissure-fillings in the Alps, but these veins are not notably metalliferous. The Alpine veins are thought to have formed at temperatures between 250 and 400°. In view of the affiliation generally shown by the octahedrite and rutile with deposits of high-temperature origin, the suggestion is advanced that the primary ore of the Boss deposit was formed under conditions of moderately high temperature.

The facts at hand cannot of themselves be held to prove that the ore deposition was genetically connected with the intrusion of any particular dike or igneous mass now visible at the surface. It is probable, nevertheless, that the mineralization followed as a sequel to the intrusion of the magma from which the granite-porphyry dikes were derived, for these are the only intrusives that penetrate the rocks of the district.

The deposit, as already described, is highly oxidized and contains abundant oxidized copper compounds and plumbojarosite. These minerals indicate that the primary sulphides will be found to carry copper, iron, lead, bismuth, and precious metals. The extraordinary richness in gold, platinum, and palladium of ore containing notable quantities of plumbojarosite raises an important problem. It is not impossible that the plumbojarosite may have originated essentially in place by simple oxidation of sulphides that were extremely rich in precious metals. A partial analogy for this supposition is furnished by the development of the brochantite in the chalcocite-bearing ore; the brochantite appears to have formed in place from the chalcocite without any important migration of copper. For the origin of the plumbojarosite, however, the following explanation appears to fit the known facts more closely. B. S. Butler,‡ who has recently shown that in the oxidized ores of Utah plumbojarosite is rather common, although heretofore unrecognized, believes that in the occurrences studied by him the plumbojarosite was produced by the action of ferric solutions on galena; the lead has remained essentially in place, but the iron may have come from some distance. It is therefore suggested that in the Boss orebody descending solutions rich in ferric sulphate attacked primary galena, forming the plumbojarosite, and that this reaction caused the concomitant precipitation of the gold, platinum, and palladium. According to this explanation, an efficient solvent for the precious metals was active and in this connection the fact established by R. C. Wells, during the chemical investigation of the plumbojarosite, that the precious metals are rather soluble in hydrochloric acid in the presence of plumbojarosite is highly suggestive.

On the whole, then, it is likely, in view of the probable mode of origin of the plumbojarosite and of the evidence of leaching indicated by the porous nature of the silicious ore, that a certain amount of re-distribution of gold, platinum, and palladium has taken place by the action of descending surface solutions. It would follow, then, that in depth, below the zone of oxidation, the pockets of extremely high-grade ore, such as are now being extracted, will be found to give way to ore of moderate grade.

*'A Genetic Classification of Minerals,' *Economic Geology*, Vol. 3, p. 625, 1908.

†Lindgren, Waldemar, 'Mineral Deposits,' p. 655, 1913.

‡'Occurrence of Complex and Little-Known Sulphates and Sulpharsenates as Ore Minerals in Utah,' *Economic Geology*, Vol. 8, pp. 315-316, 1913.

Milling Costs at Goldfield Consolidated

In 1914 the 100-stamp mill and cyanide plant treated 332,750 tons of ore at the following cost:

Department.	Per ton.	Department.	Per ton.
Crushing and conveying.	$0.046	Surface and plant	$0.005
Stamping	0.124	Steam heating	0.001
Chilean mills	0.103	Store and office	0.013
Elevating and classifying	0.020	Stable	0.002
Tube-mills	0.242	Watchmen	0.022
Concentration	0.052	Superintendence	0.045
Neutralizing	0.061	Lighting	0.018
Settling	0.069	General expense	0.007
Dissolution	0.461	Mill tools	0.003
Filtering	0.062	Electrical department	0.018
Residue	0.002	Pumping battery water	0.025
Assaying	0.019	Experimental	0.002
Precipitation	0.062	Clean-up	0.024
Refining	0.046	Total	$1.606
Water	0.052		

In the total charges, labor absorbed 21.86%, supplies 56.60%, and power 21.54%, and in the combined cost of milling and concentrate treatment these were reduced to 18.44%, 47.77%, and 18.18% respectively.

CONCENTRATES

Readers of the MINING AND SCIENTIFIC PRESS are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

EVERY EXPLOSIVE when exploded exerts pressure in all directions.

MOST EXPLOSIVES suitable for use in such work as quarrying are unsuitable for use in deep mines or in close workings.

PLATINUM found its first use as a material for resisting chemical action. It is now used in jewelry, particularly for setting diamonds; also in electrical apparatus.

GRANULATED NITRO-GLYCERIN POWDER such as is generally sold in the United States contains about 5% nitroglycerin, 35% combustible matter, and 60% sodium nitrate.

A RELIABLE THERMOMETER should be placed in all thawing-houses for explosives. It should be visible from the outside. The maximum temperature is not to exceed 80° Fahrenheit.

CHROMITE at Selukwe, Rhodesia, is found in schist in lenticles that are original crystallizations of the igneous magmas from which the schist has been derived by metamorphism.

CADMIUM is a deleterious impurity in zinc, as employed in the making of brass, if present in excess of 0.5%. Up to 0.25% the presence of cadmium in spelter exerts no unfavorable effect.

POTASH SALTS occurring in the mud of Columbus marsh, Nevada, have been absorbed from solution and are held in loosely combined form, according to the investigations of W. B. Hicks.

ELECTROLYTIC BATHS are not of service in cases of lead poisoning, according to the views of a recent investigator, as the lead accumulated in the tissues is a part of organic compounds not easily ionized.

CHROMITE BRICK can be used to advantage in reverberatory furnaces for smelting antimony, arsenic, bismuth, and tin, because the slags produced in the reduction of these metals are extremely corrosive and the oxides act as acids in attacking a basic lining, so that a neutral material is desirable.

PYRITE CONCRETIONS in South African sandstones are derived from pyrite nodules formed by replacement of the sandstone. Atmospheric and surface-water action on these produce the concretions, according to R. B. Young.

THE PANAMA CANAL is now operating at a profit. In March the tolls amounted to $560,785. Operation and maintenance cost $423,275. The surplus was $137,510. Since July 1, 1914, the total revenue is $2,895,300; charges, $3,018,889; deficit, $123,588.

CONCRETIONS containing large amounts of iron, manganese, and alumina found in Germany lying about a foot below the surface of soil overlying diluvial sand are thought to have originated from the precipitation of iron and manganese coming in solution from below.

MINE TIMBER should be properly cared for on the surface while waiting to be used underground. Important factors affecting the amount of deterioration are as follows: position of the yard, method of piling the lumber, climate and season of the year, and dimension of the stock.

PLATINUM production of Russia decreased in 1914 from 173,642 to 156,775 oz. The market for the metal was principally France and Germany. In July 1915 there is to be an export duty of about 30% placed on raw material. This will result in refineries being started in Russia.

LOCAL TERMS in the Wisconsin zinc district are as follows: 'dirt,' ore and waste as broken in the mines; 'sulphur,' iron sulphide; 'jack,' zinc sulphide; 'lead,' galena; 'tiff,' calcite; and 'velvet,' profit, referring to the galena when not too intimately mixed with blende to allow easy separation.

PICRIC ACID is used in the manufacture of ammunition. It is made by mixing carbolic acid with strong sulphuric

acid. The sulphonate is diluted with water. The liquor is then poured slowly into nitric acid. This is allowed to cool. The crude picric acid crystallizes out, and is purified by re-crystallization. All traces of nitric and sulphuric acids are washed out with water. The crystals are then dried, graded, and packed. When heated or struck, this salt explodes violently. Organic substances treated with nitric acid yield the acid.

Labor employed at the Modder B. mine, on the Rand, in 1914 averaged 319 whites and 2023 colored persons. This force mined 470,489 tons of gold ore, of which 440,000 tons was treated. The average stoping width was 59 in. Last year the Bunker Hill & Sullivan company, Idaho, mined and treated 440,819 tons of lead-silver ore. The lodes are wide, and generally worked by adits. A total of 620 men was employed in December. Operating expenditures were $4.74 and $2.64 respectively at the two mines quoted.

Chemicals permitted to be used as coloring matter in food in Canada are as follows: Caramel, cochineal, saffron, chlorophyll and innocuous vegetable color extractives, certain coal-tar dyes not containing arsenic in excess of 10 parts As_2O_3 per million, calculated on the actual weight of coloring matter, and not containing heavy metals (except iron), when used in quantities not exceeding 2 grains per pound (1 part in 3500). The use of copper salts in the greening of peas is permitted, provided the amount of copper (expressed as metallic copper) in the peas does not exceed 80 parts (by weight) per million in the drained peas, or 10 parts per million in the liquid. These substances are considered to fall within the definition of harmless coloring materials.

The zinc-mining district of southwest Wisconsin is situated in the centre of a rich farming region. The fee-owners of the land are usually farmers. The prevalent custom is for an operating company to lease ore-bearing land from the fee-owner. A royalty, usually 10% of the gross receipts, is paid as rent or as the fee-owner's share of the earnings. Unless otherwise stated in the lease, the owner pays all real property taxes on his fee. If the land covers an ore-deposit, he must pay a real property tax on an increased assessment, due to the increased value of the land, as well as an income tax on his royalty from the mine. Sometimes a mining company buys the area it intends to mine. In this case the company pays all taxes on the property and on income from the property. The surface is usually leased to others. Again, a company, after buying the land outright, sells the surface. In this instance the mineral rights are assessed separately on the same basis as real estate, that is, to the fee-owners of the mineral rights.

Oil wells that have passed the flowing stage and are being pumped, may still continue to give off much gas at the casing-head. The quantity may vary from little or nothing at some wells to 500,000 cu. ft. or more at others. When enough of the gas is available it is used for pumping on the lease, the excess being wasted. A steam pumping engine of 50 hp. requires about 25,000 cu. ft. of gas for 10 hours' operation. From 12 to 15 cu. ft. of natural gas is needed per horse-power-hour for gas engines that are used on leases for pumping oil wells. If there is not enough of the gas available for working pumps, it is all allowed to go to waste, or perhaps some is used for heating and lighting a few scattered houses on the lease. The efficient utilization of the casing-head gas ordinarily is a difficult problem. The many miles of pipe that would have to be laid to transport it from a field would usually be an unjustifiable expense. However, some towns, among which may be mentioned Warren, Pennsylvania, and Sistersville, West Virginia, are lighted and heated largely with casing-head gas. In general, however, the oil-man considers casing-head gas as waste gas and its escape necessary in oil-well operations to permit the maximum flow of oil into the well from the surrounding strata.

Sublimed white lead is an amorphous white pigment possessing excellent covering and hiding power, is very uniform, and fine in grain. It is a direct furnace product, obtained by the sublimation of galena. It is largely used by paint manufacturers. It is a stable and valuable paint pigment. Samples of the product are to be seen at the Missouri mineral booth at the Exposition. The Dutch process of making white lead depends on the action of carbonic acid gas from decomposed tan bark and manure, in the presence of vinegar, on pig lead. The acid salt that is then formed is slowly converted into a hydrated carbonate. This process is in operation at the exhibit of W. P. Fuller & Co. at the Exposition. The plant is as follows: Selby pig-lead is melted in a 2500-lb. capacity furnace. The temperature is 800°F. The molten metal is cast into lead buckles on a perforated chain casting-machine. The buckles are ⅛ in. thick, weighing 4 oz. In a large plant they weigh 16 oz., being 6 in. diameter, and the usual thickness. An elevator carries the buckles to a pile. They are then laid in earthenware corroding-pots. The bottom portion of the inside is glazed; above this it is porous. Twenty ounces of diluted vinegar, equal to 3% acetic acid, is put in the pots. The charges are arranged in layers in damp tan bark. In about 10 days this ferments, a temperature of 165 to 170° being attained. The heat vaporizes the vinegar, acetic acid attacks the lead in the pots, forming lead acetate; carbon dioxide from the bark then attacks the acetate, changes it to basic lead carbonate, and releases acetic acid, which again reacts on the metallic lead. Time taken for complete corrosion is from 90 to 100 days. The dry carbonate is taken from the pots, powdered, ground with water, washed and floated, passed through 200-mesh silk, thickened in a series of settlers, pumped to a storage-tank, and weighed in charges. An agitator next mixes the thick lead with the required amount of oil. This form of lead mixes well with oil. The remaining water, which floats above the mixture, is run off. The white lead is finally ground twice by stones, cooled, and filled into steel or wood kegs of various sizes.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

MANILA, PHILIPPINE ISLANDS

MINING ASSOCIATION.—MINE TAXATION.—GOLD OUTPUT.—BENGUET CON. MILL AND MINE.—DREDGING.

The operators of fourteen of the leading gold-mining properties in the Philippines have recently organized themselves into an association to be known as the Philippine Mining Association. The purposes of this organization are to bring accurate information concerning Philippine mining before the public both locally and abroad. To this end the society will publish a bulletin for free distribution, to be issued from time to time, and will attempt to furnish authoritative information concerning Philippine mines and mining conditions. It is hoped that one result of this publicity will be an increased interest in local mining on the part of American investors. It has not been possible up to the present to interest any large American capital in Philippine mining ventures. The various concerns now operating were financed either locally, on the China coast, or in Australia and New Zealand. Judge Frank

VALLEY OF AUTAMOK RIVER, BENGUET MOUNTAIN PROVINCE. TOP CENTRE SHOWS SITE OF BENGUET CONSOLIDATED MILL.

B. Ingersoll, general manager of the Gumaos Placer Co., managing director of the Malaguit Dredging Co., and an official in several other organizations, is president of the Association.

Another line of endeavor on the part of the organization will be an attempt to counteract the tendency toward increased taxation of mines, which was manifested in the last legislature, by educating the public to an accurate knowledge of Philippine mines and mining, so that they may be in a position better to judge as to the fairness of increased taxation. A tax of 1½% was imposed on the gross output of gold mines after the first of last January. The original law provided for a tax of 5% of the gross output of precious and semi-precious metals, but after a series of public hearings by the committee to which the bill was referred, the tax was diminished to 1½% and imposed on the output of gold mines only. Since the bullion from most of the mines carries a small proportion of silver, the tax applies to silver as well as gold in practice. Mining men generally opposed the taxation on the ground that the industry was too young to survive without serious injury. As it works out in the case of one of the larger companies, the increased taxes amount to about 2½% of the total capitalization.

In spite of adverse legislation, however, the last few months have seen much advance in the progress of gold mining. The Philippine production of gold for the year 1914, according to the figures prepared by the Division of Mines, Bureau of Science, was ₱2,349,267, an increase of nearly 36% over the production for 1913. The figures given out by the Director of the United States Mint for the gold production of the Philippines in 1914 are ₱2,120,000, a sum that probably does not include bullion in transit nor bullion sold in Europe and Japan.

More than 50% of the Philippine production came from lode mining at Araroy, Masbate, where four mills with a combined capacity of about 300 tons daily are in operation. The seven dredges in the Paracale-Mambulao placer region yielded more than ₱1,000,000 in 1914. The larger part of the remainder of the output came from the Mountain province, where one 10-stamp mill, two 3-stamp mills, and one 5-ft. Huntington mill were operating during a part of the year. Filipinos, working on the Palidan slide near Mancayan, recovered more than ₱40,000 worth of gold by panning during the past year.

The Benguet region in Mountain province will undoubtedly become an important contributor. The 10-stamp mill on the Headwaters property is being profitably operated under lease. The Acupan Mining Co. is assembling a 3-stamp mill on a claim, which is known to be good, on Batuan creek, and the new 10-stamp mill of the Benguet Consolidated Mining Co. is rapidly nearing completion. Twice previously floods have carried away the mill on the Benguet Consolidated property, so that the new mill is the third to have been erected there. C. M. Eye, general manager for the Benguet Consolidated Co., who has had entire charge of the design and erection of the new plant has supplied the following notes on the present condition of the property:

The new mill will be of the all-sliming, cyaniding type, and its equipment will include: one 8 by 12 Hercules Blake crusher; ten Hendy stamps of 1050 lb. with high narrow-discharge mortars set on wooden blocks; one Dorr duplex classifier in closed circuit and on the same level with a Denver Engineering Works, 6 by 10 ft. tube-mill; elevator from classifier to a primary Dorr thickener in a 25 by 12-ft. vat; three Dorr agitators in series in 14 by 12 ft. vats for continuous work; four secondary thickeners in series in 25 by 12 ft. vats, arranged to work on the continuous discharge counter-current system; one clarifying vat with canvas leaf-filters and wet-vacuum pump; three double-line, 7 compartment zinc-boxes, made by the Atlantic, Gulf & Pacific Co., Manila; two Gould triplex pumps for solution transfer, each with a capacity of 75 gal. per min.; a battery of Gould diaphragm pumps between thickeners for pulp transfer; an automatic tailing-sampler following the line of vats; and a complete clean-up equipment including a Case oil-fired tilting furnace. The solution-flow is recorded automatically in tons per 24 hours by means of a recording-gauge on a small vat, from which the solution escapes through a calibrated standard orifice. All tankage is of corrugated steel, the choice of material being governed partly by the saving made possible in freight charges, which are excessive in this region.

Power will be distributed by General Electric motors; the stamps are on a 25-hp. back-geared motor and the tube-mill is operated through a friction-clutch by an ordinary 50 hp. motor. The total motor horse-power is 105, while the maximum load with the crusher in operation is estimated at 100 hp. Hydro-

electric power is to be generated by a Pelton-Doble wheel direct connected to a 120-kw. generator situated down-stream from the mill. The pipe-line is 6000 ft. long and yields a head of 300 ft. gross, 260 ft. net, with a flow of 5 second-feet. The diversion-dam is made of logs on a concrete footing and is 18 ft. high by 45 ft. long. Electric current will be transmitted at 2380 volts over a transmission line 2400 ft. long to the mill, where the voltage will be stepped down to 220.

A new adit is being driven from the lowest practicable elevation to drain the old workings. This adit will be about 500 ft. long when it reaches the vein. A new adit will also be driven from the present mill-site to the upper levels of the mine to serve for a haulage-way. An old cross-cut is being extended on the line of this adit and during the advance the cross-cut recently passed through 41½ ft. of ore assaying 180 pesos per metric ton. Concentrate from this ore assayed more than 4000 pesos per ton. The vein in the old mine is being developed to the eastward by a drift along the hanging wall with cross-cuts to the foot-wall at 50-ft. intervals; the first of these cross-cuts revealed 6½ ft. of ore assaying 160 pesos per ton, while the second cross-cut, just completed, encountered 9½ ft. of ore assaying 70 pesos. On the level of the old drainage-adit, which is about 80 ft. below the new mill-adit, there is more than 1000 ft. of old workings which was driven through good ore. This part of the mine is now flooded but will be unwatered by the new adit.

The Cansuran Placer Co., which recently began hydraulicking operation on Cansuran creek about 12 kilometres south of Surigao, the capital of Surigao Province in Mindanao, will also be a producer of gold this year. The company is hydraulicking several adjacent areas of coarse gravel aggregating 325 acres. The ground was taken up on the recommendation of R. Y. Hanlon, who tested the gravel by digging a series of 181 holes and obtained an average of 44 centavos per cubic yard over the territory to be worked. The average depth to bedrock is 4 yards. The gravel is coarse but the individual boulders are embedded in clay. Water is obtained from the head of Tuganan river and conveyed to the claims through ditch, flume, and pipe-line with a total length of over a mile. The head varies from 100 to 300 ft. over different parts of the ground to be worked. Two 6-in. monitors and one 7-in. monitor are in place and an area of about 5 acres will have been cleaned-up within a short time. The work has been hampered by a shortage of water during the present general drouth.

The Australian dredges, at Paracale, which now number four, have had a normal run during the past year and yielded the usual dividends. The Malaguit dredge has lost some time because of the necessity of replacing some of the machinery, but has made a generally satisfactory record. The Gumaos dredge has finished its second year of operation with a total production of ₱912,205 (two years and three months time). The sum of ₱535,000, or 107% of the capitalization, has been distributed in dividends during this period. The average value of the Gumaos ground for monthly dredge-runs has varied from 5 centavos to ₱1.28 per yard. At places the dredge has dug to a depth of 52 ft., while elsewhere bedrock was encountered at 20 ft. or even less. These data afford an idea of the irregularity of the dredging ground in this district. The average value per cubic yard for the period of operation has been 49 centavos. The average depth to bedrock has been about 35 ft. and the average cost of dredging, about 18 centavos per yard.

According to Press Bulletin 40 of the Bureau of Science, Manila, the division of mines has received a number of inquiries concerning the discovery of gold near Iligan, Mindanao, which was reported in the local press several months ago. The discoverer of the new field is Allen Smith, Jr., of the Philippine Scouts. He has released to the public certain information supplied by him to the Bureau of Science. The claims located are 12 miles east-northeast of Iligan. The deposit is a conglomerate. Twenty assays have been made on the material, 17 of which return from ₱6 to ₱30 per ton. If the samples were properly taken, these results are interesting. There is plenty of conglomerate in the Islands, but it is not generally of any commercial value. An engineer made an examination of the area in May.

CRIPPLE CREEK, COLORADO

STRATTON'S AND PORTLAND LEASING SYSTEMS DISCUSSED.

The excitement of the week has been the reported sale of Stratton's Independence to the Portland Gold Mining Co., the adjoining property to the north. We may now conclude that the era of consolidation has arrived. In many ways it is the logical step; in others it is not going to be such a good thing for the district. Such consolidations result in greater economy generally, but it is equally true that fewer men will be employed, and that less money will be in circulation here. It will hurt leasing somewhat, as both of these mines have done considerable leasing in the past under different systems. The Independence has used a flat royalty with a profit-sharing system attached, which has been very satisfactory to both lessee and company. Many of the men now leasing have been there since the leasing system was inaugurated. The Portland company has been experimenting with the 'split-check system,' which has hardly had a fair trial yet. The fault with this system is that where the company supplies all the material and the lessee supplies all the labor only, the former wants to say where the dead-work is to be done, and how much it is willing to stand. In the other system the lessee uses his own judgment entirely, and works his block any way that he sees fit, provided only that it is done in a workmanlike manner. The Independence charged a flat royalty of 30%, and supplied air and machines, and until recently, hoisting, free. The time of each lessee and his crew was kept, and $5 per shift was allowed for each shift worked. Thus, when a settlement was made, the 30% royalty was first deducted. Then allowance was made for the number of shifts worked. If the amount then due the lessee was $300 to $1000 he was charged a further 20% of the sum, whatever it was, between $300 and $1000, or 30% on sums between $1000 and $2000. The drawback to this system was that the company had to do all the development. The lessee would work when there was ore in sight and not otherwise. As a practical comparison of the two systems, it may be said that the Independence lessee either made over 50% of the net returns, or there was relatively no net returns at all. The fact that the company made its dividends right along is pretty good evidence that the lessees made good profits. How long could a company last on the split-check system when the net returns failed to pay expenses? It is not yet known what the new policy will be on the Independence, but most of the present lessees have made application to the new owners to retain their leases. How a reduction in the number of lessees would affect the camp is easily seen, and it is to be hoped that no leases will be cancelled, but rather, that more will be granted.

GOLDFIELD, NEVADA

JUMBO EXTENSION.—BOOTH SUIT SETTLED.—VELVET CLAIM.—MERGER RESUMES WORK.

A deed has been filed for record in the office of the recorder of Esmeralda county, transferring to the Jumbo Extension Mining Co., from the Reorganized Booth Mining Co., all title to ore and veins found in the Velvet, Polverde, and Dick Bland Fraction lode claims, the property of the Jumbo Extension company, within the extended end-line planes of the Booth claim. This is the first deed ever filed in this county in settlement of an apex-suit. The document had attached revenue stamps valued at $315. It is expressly stipulated in the deed that the Booth company does not, by this deed, sell or transfer

any extralateral rights other than those within the territory specified, but reserves its rights in all territory beyond this ground, to the southeast of the Jumbo Extension claims. This, it is said, is the object of transferring apex-rights by deed, instead of in the customary manner of ceding such rights. The terms were discussed editorially in the *Press* of May 29.

Under the terms of a tentative agreement between the two opposing factions of the Merger Mines Co., all litigation is to be terminated; but the minority faction retains the right to bring suit against the Jumbo Extension company for the recovery of the Velvet claim. It is conceded by all who are interested that the only issue on which a suit can be based is the validity of the sale of the Velvet claim by the Merger Mines Co. to the Jumbo Extension. The opinion is held generally by the best authorities that this transaction cannot be questioned. The possibility of any further litigation, involving the Jumbo Extension company, is regarded as remote. There is no likelihood of any serious dispute between the Florence and Atlanta companies, as it is realized that it would require an expenditure of a large sum of money and entail work for at least three years before any apex could be established here, even if it exists. It is probable that these companies will enter into a side-line agreement in the near future.

Work has been resumed by the Merger Mines Co., under the direction of the receiver, Carl Johansen, for whom W. C. Rannells is acting as superintendent. Mr. Rannells had charge of the famous Hayes-Monnette lease at the Mohawk. A. I. D'Arcy continues as general manager for the Merger company, and the work is supervised by him. Drifts have been started, east and west, from the top of the rise from the 1265-ft. level, which cut the shale-latite contact. Interest centres in the east drift, by means of which it is hoped to find the Jumbo Extension ore-channel here.

TORONTO, ONTARIO

Nickel Mining and Smelting.—Steel Balls in Tube-Mills.—Vipond, Crown Chartered, McIntyre, Temiskaming, and Princess Mines.

The great demand for nickel for the manufacture of war munitions has stimulated nickel mining at Sudbury. The Canadian Copper Co. is extracting more ore from the Creighton mine than before. It is making preparations to increase the output considerably. A new inclined 5-compartment shaft is being sunk. A new hoisting and crushing plant will be installed. Many new houses are being erected for accommodation of a large working force. The reverberatory-furnace department, which has been closed since August is again in operation. It will treat the fine ore and dust, about 15,000 tons per month. The ball-mill and Wedge furnace-plant used in connection with the reverberatory has also been started. The construction of a new 25-ft. blast-furnace, larger than any in the district, has been begun.

Recent experiments with steel pebbles in Hollinger tube-mills have proved highly satisfactory. They indicate the possibility of crushing 20 tons per stamp per day. A new electric hoist is being installed at the Hollinger main shaft. It will enable a large tonnage to be raised from the 1500-ft. level.

The annual report of the Vipond company shows a deficit of $33,365 for the year ended March 31. During the last quarter there was a surplus of $26,605.

The Crown Chartered Co. is being liquidated. The property is advertised for sale by tender receivable up to June 8.

At the McIntyre, No. 4 vein is opening well on the 600-ft. level. It has widened to 26 ft., assaying $12 per ton.

The Temiskaming & Hudson Bay is resuming work at its No. 2 property to the south of the Little Nipissing. The Cobalt Lake fault runs through the property. Geological conditions are considered favorable.

The Princess mine has been leased by La Rose Consolidated to Sidney Smith, of Haileybury, on a royalty basis.

According to A. A. Cole's annual report, the amount of ore treated at Cobalt in 1914 was 743,531 tons. This was an increase of 78,686 tons over 1913. Concentrate shipped totaled 12,682 tons containing 3,847,806 oz. silver. Seventeen plants operated during the year. Since 1908 there has been 2,727,12[illegible] tons treated in the district. Further abstracts from this report will be made for the *Press*.

QUEBEC, CANADA

Mineral Output in 1914.—Asbestos, Copper, Mica, and Graphite.—Men Employed.—Control of Properties.—Prospects.

The total mineral production of the province of Quebec in 1914 amounted to $11,325,428. In 1913 it was $13,119,811. However, there has been a fairly steady growth since 1902 and 1903, during which it was less than $3,000,000 each.

The official figure for the province's production of asbestos in 1914 shows a value of $2,900,839, compared with $3,830,504 in 1913. This is due almost entirely to no exports to Germany in the latter half of the year. So hard hit was the asbestos business in the early period of the War, that most of the mines practically discontinued operations. It is gratifying to note, however, that the demand picked up early in 1915, principally due to increased use in the United States, where exceptional efforts are being made to capture the trade of asbestos manufactured products for South America, formerly almost monopolized by Germany. As an index of the amount of asbestos rock which has to be mined to obtain the relatively small percentage of 'fibre,' which is the product sold from the mines, in 1914 there was mined 2,127,395 tons, from which only 120,652 tons of asbestos fibre was obtained and sold, less than 6%. It is evident that, though the fibre brought a price varying from $11 per ton, for the poorest milled grade, to $300 per ton for the long, silky, crude product, with a total average value of about $27 per ton, that the 2,127,395 tons of rock mined, being finally worth only $2,900,839, makes the surprisingly low figure of less than $1.40 per ton of rock mined. This shows that the business must be economically done.

It is interesting to note that copper production of the province is a considerable item. There are two producing mines and several prospects. The most striking success in the copper field of Quebec is the McDonald mine, of the Weldon Mining Co. near Weldon station on the Quebec Central. The copper and sulphur ore of the province produced in 1914 was valued at $801,129 from 117,778 tons, against $812,899 in 1913.

The mica industry, which produced $117,083 in 1913, decreased to $55,636 in 1914. This represents 423,821 lb. of the material, or an average value of about 13c. per pound. Of course the selling price per pound of mica varies through extremely wide limits. It fluctuates with the size of the sheets, quality, toughness, etc. It was to be expected that the War would interfere with Quebec's output, since London is the world's market for it. It is usually sold there by auction.

Graphite production, which a few years ago held promising hopes from several new mines and mills, has been a great disappointment. It has fallen to negligible importance.

During 1914, an average of 6756 men were employed in the mines, quarries, mills, and concentrators of Quebec, compared with 8611 during 1913. Of this number, 3116 were employed in mines, where nine deaths occurred. This is equal to 2.84 fatalities per 1000 men, as against 3.19 in 1913.

The larger mineral operations of Quebec are for the most part controlled by Americans in New York or Boston. In addition are a number of local companies engaged in mining. Labor conditions and railroad facilities are good. In a geological way, a variety of minerals are known to occur in the old pre-Cambrian formations of the province, but there is also a seeming tendency for the deposits to be pockety and irregular.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press.

ALASKA

Utilization of the water supply in the mining districts of the Yukon Tanana region is one of the important elements in reducing the cost of mining. The water supply is not only used directly in placer mining, but is also of importance to the lode-mining industry in supplying power. During the period from 1907 to 1912 the engineers of the U. S. Geological Survey were engaged in measuring the streams in the various placer areas of the region, especially in the Fairbanks district. The results of this investigation have been published annually. They are now summarized and discussed in a volume recently issued, entitled 'Surface Water Supply of the Yukon - Tanana Region, Alaska, from 1907 to 1912,' Water-Supply Paper 342, by C. E. Ellsworth and R. W. Davenport.

Juneau

The first unit of the Alaska Gastineau mill treated 57,000 tons in April. During the last 10 days of the month the average was 2159 tons per day. Residue was 5c. per ton lower than in March. Costs were about 12c. lower. The ore is increasing in value. Construction of the other units of the plant is being hurried. Transport and tramming charges were lower. By July 1 the reservoir should be filled. No. 2 unit at No. 1 power-house is complete. The Salmon Creek division is practically finished. Preliminary work has been started on the Annex Creek scheme. The railroad is easily handling the tonnage required. In one 8-hr. shift two trains hauled 3500 tons. Underground work is confined to preparing stopes. The caving system of mining is a success. One stope on No. 5 level has yielded 350 tons per machine-shift for two months. In April 106,986 tons was broken, of which 61,912 tons was trammed to the ore-ways. Stoping costs are satisfactory.

Recent telegraphic advice states that the Gastineau mill is treating 2420 tons per day, one day's run being 2644 tons.

April returns from the mines on Douglas island were as follows:

Results.	Mexican.	Treadwell.	United.
Stamps working	120	540	270
Ore crushed, tons.....	18,830	75,212	43,799
Concentrate cyanided, tons.	446	1,653	953
Total gold recovered.....	$33,932	$140,279	$88,507
Profit, construction deducted	$8,850	$43,376	$22,069
Average per ton.....	$1.80	$1.86	$2.02

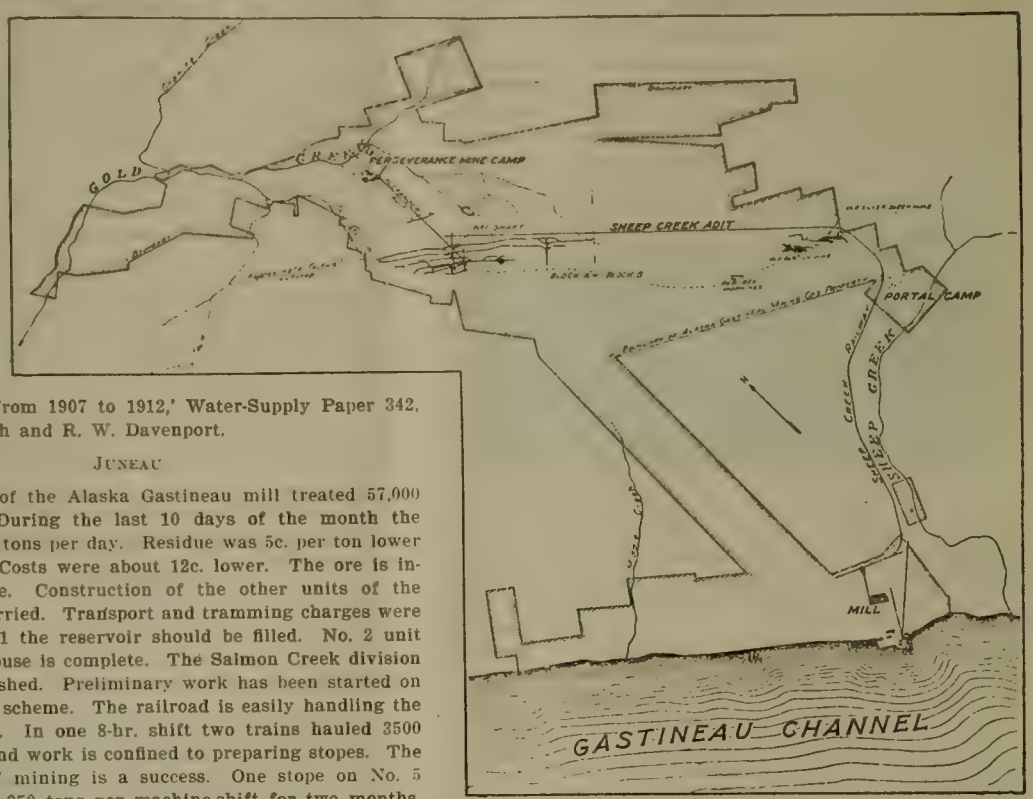
The reports of these companies for 1914 should soon be available for review.

A good seam of lignite has been discovered at the south end of Admiralty island, 40 miles from Juneau, by J. C. Hyde, C. Gundlach, J. Sandman, and P. Carlson. They are now preparing to develop the deposit.

ARIZONA

Cochise County

A large amount of copper ore has been developed in the Swisshelm Mountain Mining Co.'s claims, six miles from McNeal, on the El Paso and Southwestern line. An 1100-ft. adit has been driven. Four to 14% ore was opened. More machinery is to be ordered. Shipments may start in 90 days. High copper prices are adding to Bisbee's prosperity.



LOCALITY MAP OF ALASKA GASTINEAU PROPERTY.

Gila County

While the water on No. 12 level of the Old Dominion is decreasing slightly, it is still about 7,000,000 gal. per day. A new waste-conveying system is at work at the A shaft. The concentrating plant is treating 600 tons per day. The three turbo-generators have been overhauled. During May the smelter averaged 45 tons of copper per day. The basic-converter installed in July 1913 is still producing all the metal.

Mohave County

(Special Correspondence.)—As mentioned in the *Press* last week, the United Eastern Mining Co. has decided to erect a treatment plant. Ore above the 565-ft. level is estimated to be worth $2,000,000. A lode 37 ft. wide has been opened at this depth. It is all of profitable grade. At 300 and 460 ft. the lode is 23 and 40 ft. wide, respectively. The ore is oxidized and amenable to simple treatment. A main working shaft is to be sunk. Ample water will be available for the plant.

A 60-hp. engine, 375-cu. ft. air-compressor, 22-hp. hoist, jack-hammers, and drill-sharpener have arrived at the United Western mine. This adjoins the Eastern. The incline shaft has been straightened and enlarged. It will be sunk to 400 ft. A 40-ft. head-frame is being erected.

Oatman, May 24.

At 400 ft. in the Copper Prince at Swansea, which was closed two years ago, the lessee has opened a fair tonnage of 7 to 15% ore.——Prospectors from the Big Bend district brought a number of nuggets into Kingman last week. Some sluicing of the gravel is to be started soon.

CALIFORNIA

April oil production statistics include the following: rigs completed, 15; wells drilling, 138; completed, 33; abandoned, 11; producing, 5884; daily average, 244,563 bbl.; total output, 7,336,900 bbl. The increase over March was 460 bbl. per day. Stocks total 59,770,789 barrels.

Amador County

The 2400-ft. level of the Bunker Hill mine has been re-timbered. Rises are to be driven to connect with the 2200-ft. level. This will improve ventilation and make more ore available for the mill. Hardinge mills are to be installed in the plant.—— T. Jenkins is to operate the Monte de Oro mine on a royalty basis.——At the Central Eureka 30 of the 40 stamps are crushing. Sinking below 3100 ft. is soon to start. J. E. Davis is superintendent.

Butte County

At Forbestown, W. Lewis of Los Angeles has five stamps crushing ore from the William Beik mine. The equipment is to be enlarged.——In the Stirling district, situated in the mountains, there is increased activity as the snow melts.—— A road is being constructed to C. C. Antram's mine.

Nevada County

(Special Correspondence.)—Rich ore was found on May 25 in the Union Hill mine at Grass Valley, in a rise 25 ft. above the 800-ft. level, 130 ft. west of the main shaft. Bunches of rich ore were cut in the west drift after passing a reverse dipping vein containing no gold. The rise was started where the ore was richest. At a height of 25 ft. the rise cut a slip extending horizontally into the foot-wall. Here 30 in. of specimen ore was disclosed. After picking down as much of the quartz as could be loosened, a light charge was blasted. The hole made showed free gold on all sides, with 36 in. of rich quartz in the back, following the regular dip of the vein. The flat portion of the vein yielded several candle-boxes of ore valued at $5 to $10 per pound. This part of the mine has never been prospected below the 300-ft. level, although it produced a great deal of high-grade ore in the old workings near the surface. The mine, which is a consolidation of the Union Hill, Lucky, and Cambridge mines, is bonded to a San Francisco company named Union Hill Mines, of which G. S. Johnson is president and manager. The company is operating 15 of its 20 stamps on ore from this development, and a shoot which was opened 200 ft. east of the shaft, and 130 ft. above the 800-ft. level.

San Francisco, May 25.

Shareholders in the Pennsylvania Con. company have received $3 per share, over $200,000, as part payment for their shares, sold to the Pennsylvania Mines Syndicate, which owns the Empire mine adjoining the Pennsylvania.——A good development has been made at 400 ft. in the Montana mine, two miles from Nevada City. The Willow Valley Mining Co. owns this and other claims. Work is to be extended. The mill is to start soon. ——The Golden Center of Grass Valley has acquired the Peabody mine on Gold hill. This company now controls about 130 acres.

The new 60-stamp mill at the Empire mine has been accepted by the company from the contractor, Robert Hathaway.

Placer County

The old Larkin mine, two miles south of Placerville, was sold last week to C. F. Becker, of Sacramento, acting for San Francisco people. The Selby mine adjoining has been bonded to Eastern capitalists. It has been opened to 240 ft. Included in this deal is the Peacock copper mine.——Rich ore has been cut at 500 ft. in the Pacific mine at Placerville. There has been a change in lessees operating the property. Five stamps are working.

Sierra County

Construction of a new stamp-mill at the Plumbago to replace the one burned some time ago, is under way, in charge of Robert Hathaway of Nevada City.

Siskiyou County

Ore dumps made at many mines in this county about 50 years ago are now being profitably worked.

COLORADO

Clear Creek County

The remodeled mill at Idaho Springs is receiving plenty of ore for treatment.——A 20-ton lot from a new development in the Waldorf at East Argentine returned 1.53 oz. gold, 67.1 oz. silver, 12.85% copper, and 8.05% lead, a total value of $91.94 per ton. Lessees are doing well. The mill is closed on account of water supply. About 1500 tons of ore awaits treatment.——$65 to $75 ore is being extracted from the Santiago adjoining.——Lessees at the Capital are getting good results.

Dolores County

Lessees at Rico mines are meeting with satisfactory results. Among the properties being developed are the William J. Bryan, Hiawatha, Emma, Ocean Wave, St. Louis, Rico Wellington, and Rico Consolidated. The last named is a well-known regular producer.

Gilpin County

Rich gold-silver ore is being mined by the Bates Leasing Co. at Black Hawk. So is the Cashier Gold Mining & Milling Co. from the Pittsburgh mine. The latter also contains copper. Hutchins and Roberts, lessees at the Old Town mine, have had good settlements from their gold-silver ore. The Eureka is developing well.

Gunnison County

The Doctor zinc mine near Aspen is being developed by lessees. Results are very encouraging. As soon as a market is available a daily output of 100 tons can be maintained. Thirty per cent ore was recently opened in an adit.

Lake County (Leadville)

Lowering water in the Penrose shaft is resulting in a recession in mines on Fryer and Carbonate hills. The level in the latter is several feet lower.——The zinc smelter is receiving plenty of carbonate ore.——Another 30-ton shipment of oxide has been made, making three to date. The best carbonate ore is coming from Fryer Hill mines.——The Garbutt is producing 50 tons of $15 ore daily. A wide lode is being worked. Plans are nearly complete for the new mill.——Ibex lessees are mining a heavy tonnage of ore.——The Jennie June shaft, in the East Tennessee district, is down 265 feet.

Teller County (Cripple Creek)

On May 24 the Elkton Con. distributed 2c. per share, totaling $50,000. The amount for the current year is $100,000.——The Co-operative Mining, Milling & Leasing Co., which has a 20-year lease from the state on school section 16 on Bull hill, is to extend its development. A sub-lease is held by another syndicate. The main shaft is down 800 ft. Total gold yield is about $700,000.——McGillvary and partners, lessees at the El Paso, have opened some rich ore. The company's new hoist is working.——Four cars of about $1200 ore has been shipped from the Cresson mine during the past 10 days.——In April, net earnings of the Golden Cycle Mining & Reduction Co. were

$62,000. The regular dividend of 2c. per share will be distributed on June 10.——El Paso made a profit of $3000. A loss has resulted for about a year.——At the Alpha and Omega claims of the Dig Gold company on Gold hill, the shaft has been enlarged, and a hoist and compressor erected. Part of the ground may be subleased. Large shipments are to be made from the Economic dump.

IDAHO

Blaine County

The Wilbert Mining Co. has issued a report for the year ended May 1, 1915. It operates in the Dome district, 40 miles from Arco. The mine produced 7522 tons of ore. Of this 6685 tons was milled, 657 tons shipped, and 180 tons stored. The ore averaged 30.3% lead and 2.5 oz. silver, and 55.81% lead and 8.69 oz. silver, respectively. The shoot on No. 4 level is 190 ft. long, averaging 30 in. wide. On No. 5 it is 110 ft. long, of high grade. The mill operated less than five months. The lead market was responsible for this. Recovery was 80.7% lead and 83% silver. The plant will resume on June 1. Including an assessment, boarding-house, and other income totaling $23,758, the revenue was $109,871. Cash on hand amounts to $3342.

Shoshone County (Coeur d'Alene)

The Interstate-Callahan company has for some time been looking for a mill-site. A 36-acre tract between Enaville and the north fork has been acquired. Water-supply, tailing disposal site, and a railroad are handy. The company has issued a report for the quarter ended March 31. There was 25,430 tons of ore mined. Of this, 21,392 tons was milled. Concentrate produced was 808 tons lead, containing 25.16 oz. silver and 57.24% lead; and 9369 tons zinc, assaying 49.8% zinc. Crude ore shipped was 106 tons lead and 2200 tons zinc. All shipments totaled 12,483 tons. Total charges were $4.172 per ton. The net profit from $529,610 of products was $400,253.

The Success Mining Co. expects to make a profit of $90,000 in May. Probably the dividend for June will be 3c. per share. The mine produces zinc ore.

On June 4 the Bunker Hill & Sullivan company paid dividend No. 213, of $81,750. The total to date is $16,200,750.

MICHIGAN

The Copper Country

There are about 17,000 men employed in this region at present.——At the White Pine the shaft is down 1100 ft. on the incline. The lode is widening on lower levels. The daily output is 400 tons. About 700,000 lb. of mineral is ready for the smelter.——Tonnage from the Osceola in April was the largest in years.——Steel rods are being used in a mill at the Quincy in place of pebbles. This is an experiment.——The Franklin is sending over 200 tons of ore per day to the mill. The output is to be increased to 300 tons.——Mass is milling 1200 tons daily.——At 900 ft. in the New Arcadian the ore is better than in other parts of the mine. The shaft is being sunk to 1050 ft. ——One stamp at the re-built Isle Royale mill is nearly ready to crush.——Two more furnaces have been blown-in at the C. & H. plant at Hubbell.——The Copper Range Consolidated is organizing first-aid and safety crews at its properties, the Baltic, Champion, and Trimountain. Mass copper is being extracted from the last named. A five-year working agreement has been arranged between the Hancock and Quincy companies. The former can use No. 7 shaft of the latter during specified hours, also extract ore which the Quincy has proved to exist in Hancock ground. The Quincy buys 75 acres of land from the Hancock at a depth of over 5000 ft. for $191,000 It would be 15 years before the Hancock could reach this area. Two hundred men are to be added to the force.

MISSOURI-KANSAS-OKLAHOMA

According to C. A. Wright of the U. S. Bureau of Mines, tests show that mills in the Joplin district recover only from 65 to 70% of the zinc. He advocates systematic experimenting to increase this result and has prepared a paper on the subject.

Heavy rain interfered with small operators in the region last week. The output was as follows:

Ore	Week	21 weeks
Blende	10,333,100	211,606,680
Calamine	392,080	16,473,475
Lead	1,842,750	33,393,330

Average value last week was $70.15, $42.31, and $50.78 per ton respectively.

Zinc ore producers last week were gloomy, as no quotations were being made for their product. A shut-down of many mines was feared.

A 300-ton mill is being erected for the Onamena Mining Co. at Duenweg. Drilling has revealed a good deal of ore.

MONTANA

Silverbow County

Nearly all of the Anaconda company's mines are now working six days a week.——The Washoe smelter has too much ore on hand, and the St. Lawrence, Badger State, and Poulin

BUSINESS PORTION OF BUTTE, LOOKING NORTH.

mines have been closed temporarily.——The Butte & Superior company is to sink a large shaft. It will be equipped with a powerful hoist. Results at 1300 and 1500 ft. in the Black Rock claim are very satisfactory.——Both of the above companies have raised miners' wages to $4 per day.

NEVADA

Esmeralda County

The downward extension of the new orebody in the Jumbo Extension has been opened by a rise from the 952-ft. level. The ore in the rise is worth $83.90 per ton. This is 64 ft. above the level. The shale formation is broken up.——On July 31 the Goldfield Consolidated will pay 10c. per share.—— Since May 15 the Goldfield Atlanta has sent 80 fifty-ton carloads of $30 ore to the Western Ore Purchasing Co.'s sampler.

Humboldt County

No. 2 bullion shipment from the Rochester mill was worth $25,000. The railway is to be extended to the plant, three miles from the present terminus.

Lyon County

At the Rockland mine the new mill has started. E. J. Schrader is general manager.——Lessees at the Empire-Nevada have sent 100 tons of 5.88% copper ore to the Hazen sampler.——The Nevada-Douglas company is busy at its Western Nevada mine. A shaft is down 500 ft. Cross-cuts at 100, 200, and 300 ft. have opened a fair tonnage of ore.

Owing to the metal market, the Mason Valley Mines Co. shut down its mines and smelter near Thompson in the third week of October 1914. The report of the general manager, Jules Labarthe, covers the year 1914. A geological examina-

tion was made of the property during the period. Most of the development was done on the east orebody, which, while not as large as the main shoot, will produce a considerable tonnage. The shrinkage system of stoping gave good results. On properties adjacent to the smelter a great deal of prospecting was accomplished, leases and options being secured. Smelting costs were reduced, and the stoppage on October 20 was the first interruption since January 6, 1912. Ore from Shasta county, California, was being treated up to the time of closing. Future smelting operations are dependent on the stability of the copper market, the available tonnage of customs ore, and the development of the Mason Valley property. Further opening of copper ore at Goldfield should also help the smelting situation.

In 9¾ months the smelter treated 75,038 tons of company, and 61,159 tons of custom ore, a total of 142,197 tons. This yielded 9,127,974 lb. copper, 11,553 oz. gold, and 221,151 oz. silver.

Financial results were as follows:

	1914.	1913.
Sales of copper, gold, and silver	$1,708,801	$2,809,919
Cost of metal sold	1,608,094	2,526,644
Operating profit	$100,707	$283,275
Other income	5,607	5,037
Total income	$106,314	$288,312
Selling cost, Federal tax	75,458	82,408
Net profit	$30,956	$205,904
Bond interest, etc.	71,130	85,340
Deficit	$40,174	*$120,564
Previous surplus	347,461	226,897
Final surplus	$307,287	$347,461

*Surplus.

Nye County

Shareholders of the White Caps Co. of Manhattan have decided to have a reorganization. The new company will be known as the White Caps Mining Co. It will have a capital of 2,000,000 shares. An assessment of 1½c. per share will be made.——The War Eagle 20-stamp mill has been treating ore from the Little Grey for 10 days. Amalgamation and cyanidation will give a good recovery. A good deal of ore has been opened.——A new Gates crusher is being installed at the Mushett-Wittenberg mill. These people have obtained a lease on the Consolidated. The ore will be treated at the Manhattan Milling & Ore Co.'s plant.——More specimen ore has been extracted from the April Fool claim.

Seven mines and lessees at Tonopah last week produced 11,001 tons of ore valued at $223,978.——The sweeping of the valuable salts that form a crust on tailing dumps at Tonopah mills has kept a fair number of men busy for some years. Most of the product has been sent to smelters, but transport, treatment, and losses are high. The Nevada Securities Co. has been formed to use a new process for the sweepings. The MacNamara mill is to be leased, with J. B. Tregloan in charge.

OREGON

Ores and minerals from Oregon are on view at the Exposition. They will be soon described in this journal.

The University of Oregon, at Eugene, has planned work for the summer. Graham J. Mitchell, of the geological department, and B. S. Butler, of the School of Mines, will study Curry county. Warren D. Smith, head of the department, will examine the stratigraphy of the west slope of the Cascades. These investigations are for the Oregon Bureau of Mines and Geology. A field class will be held at Crater lake. Next year the department of geology will occupy new quarters. New equipment is to be added to the laboratory.

Josephine County

(Special Correspondence.)—Since it has been definitely decided that Twohy Bros., of San Francisco, will take over the California & Oregon Coast railway, 11 miles long, and will build the line as far west as Takilma, 40 miles, in the Waldo copper district, there has been a marked improvement in mining operations of western and southern Josephine county. Especially is there an increase of interest in copper and low-grade gold quartz. There are a number of low-grade properties in the Kerby, Waldo, and other districts, that only require railroad transport to be profitable.

C. E. Tucker, the former superintendent of the Takilma smelter, has secured a lease on the Queen of Bronze copper claims in the Waldo district. He has miners at work and will ship ore to the Kennett smelter, California. Auto-trucks will be used for hauling ore from the mines to Grants Pass. Six hundred tons of ore is now in the bins at the mines, ready for shipment. A large amount is in reserve.

A. C. Epperly, manager of the Columbia hydraulic mines, of Grave creek, states that the final clean-up for the season will soon be made. Though the Columbia is one of the oldest placer mines in Josephine county, it has an extensive area yet to be sluiced. The output will be up with the high average maintained for the past 20 years. Portland men are owners of this mine. L. A. Lewis is president.

W. J. Huselton, manager of the Wyoming placers on Tennessee gulch, near Kerby, says that cleaning-up is now in progress. Though the water supply was cut short, owing to lack of snow in the mountains, the richness of the ground worked brought returns up to the usual mark.

Grants Pass, May 20.

UTAH

It is stated in Salt Lake City that Utah and Nevada zinc producers may form an association to aid the mining of this metal. Although spelter is high, many mines cannot sell their product, smelters fixing a high basis for ore shipped, as much as 40%. This matter is discussed editorially in this issue.

Beaver County

The Horn Silver Mining Co. has issued a report for the year ended December 31, 1914. Seventy men were employed. The mine has been opened to 1000 ft. Ore reserves are about 10,000 tons. The output was 24,121 tons worth $163,979. Lessees mined $37,184 also. The profit was $13,178. The surplus at the end of 1914 amounted to $76,240.

Juab County

The leasing system may be tried at the Chief Con. mine. At other mines in the Tintic district it has resulted profitably to all concerned. The company is to diamond-drill an area east and north of Eureka.——Rich lead-silver ore is being opened at and below 1700 ft. in the Eagle & Blue Bell.——From its output of zinc ore the May Day is making a fair profit. A dividend of 3c. per share was paid last week.

Washington County

Considerable excitement prevails regarding the new district of Goldstrike. The township is 38 miles south of Modena, which is on the main line of the Salt Lake 'Route.' A regular passenger and freight service has been started. The return fare is $10. Freight costs 1¼c. per pound. A number of companies have been organized to prospect the area. The May 15 issue of *The Salt Lake Mining Review* contains an illustrated description of Goldstrike. The climate is good, the altitude being 5000 ft. There is plenty of timber available, also a good supply of water. The Bull Valley company holds 15 patented claims. It has driven over 2200 ft. of adits, cross-cuts, and rises. Part of the property has been leased. The Goldstrike Mining & Development Co. has a 3-stamp mill and gasoline engine at work. Working costs should be low. Mining can be done by means of adits. The ores are free-milling. The country rock is limestone, cut by porphyry dikes. A good deal of trenching and other prospecting work has been done.

WASHINGTON

OKANOGAN COUNTY

In the Twisp district the Montana mill is shipping bullion regularly. The mine contains a fair tonnage.

STEVENS COUNTY

New machinery has been erected at the Security Copper Co.'s mine at Chewelah. Six veins have been opened. Shaft-sinking is under way. L. K. Armstrong is in charge.

CANADA

BRITISH COLUMBIA

At Three Forks the Rambler-Cariboo mill is treating about 2000 tons of zinc-lead ore per month. Concentrate produced is from 175 to 200 tons of zinc, and an equal quantity of lead. From 30 to 60 tons of crude lead ore is shipped each month. At 1200 ft. in the mine there is a shoot of zinc ore 5 ft. wide and 40 ft. long. Ore reserves are estimated at 9200 tons in the mine. W. A. Cameron is in charge.

ONTARIO

At the Porcupine Crown the 19,000 tons of tailing from the old plant is being treated. It averages $3.50 per ton. A profit of $30,000 is expected. Dividend No. 6 will be paid on July 2. Work has been resumed at the Keeley mine, South Lorrain.

A new vein, 4 in. wide, assaying 2000 oz. per ton, is being opened in the south end of the Coniagas No. 4 shaft, at No. 4 level. This shaft is at one of the busiest corners of Cobalt. ——On July 1 the McKinley-Darragh company will distribute 3%, equal to $67,431. The total is 202%, and $4,539,571.

YUKON

On May 7 the Yukon Gold Co.'s dredges were ready to start the season's work. In 1914 they commenced on May 11. The hydraulic plants were also ready. Chester A. Thomas, E. E. McCarthy, George Coffey, Warren McFarland, and R. E. Franklin are in charge of the various departments.——About 1500 tons of silver ore is being hauled from Galena creek to Mayo, for shipment to smelters.

KOREA

The Oriental Consolidated company reports that in March 180 stamps crushed 23,500 tons of ore. Revenue from all plants totaled $155,326. The net profit was $79,520.

MEXICO

SONORA

A three-ton Packard auto-truck is to replace mules for carrying supplies to El Tigre mine.

The report of the Greene-Cananea Copper Co. for 1914 has been issued. It contains the following information: The mines contain more and richer ore developed than for years. Owing to the revolution in Mexico the mines and works worked irregularly. On August 15 they were closed indefinitely. The property is in good order. There was 384,690 tons of ore mined at a cost of $3.09 per ton. Development totaled 31,859 ft., at 65c. per ton. This is included in mining. One unit of No. 2 mill treated 147,394 tons. Copper output was 20,131,317 lb. The total income was $3,852,998. All expenditure, including depreciation of $160,071, amounted to $3,237,206. The net profit was $615,792. In 1913 the income was $6,139,917 and profit $2,186,260. Dividends totaling $1,000,000 were paid. The year started with balance of $5,012,581 and ended with $4,628,373. The net cost of producing copper was 10.6c. per pound.

The MINE INSPECTORS' INSTITUTE OF THE UNITED STATES OF AMERICA will hold its eighth annual meeting at St. Louis on June 8, 9, 10, and 11. Subjects to be discussed are uniform mine legislation, shot-firing advantages, prevention of ignition of coal dust when black powder is used, and how accidents from roof-falls may be reduced. J. W. Paul is secretary at 40th and Butler streets, Pittsburgh.

PERSONAL

W. A. CLARK is at Jerome.

D'ARCY WEATHERBE is at Toronto.

EDWIN E. CHASE is at Silverton, Colorado.

W. H. LANAGAN has gone to British Columbia.

J. H. BAKER is at Jerome on his way to Mexico.

BERNARD MACDONALD is here from Los Angeles.

CHARLES A. VAN ZANDT is here from New York.

LLEWELLYN HUMPHREYS has returned to Los Angeles.

JOHN B. FARISH is expected in San Francisco about June 22.

C. V. DREW has returned to New York from Cerro de Pasco.

E. M. HAMILTON has arrived in San Francisco from London.

ARTHUR S. EAKLE is engaged in geological work in Alpine county.

GEORGE H. GARREY has completed his geological work in Nevada.

W. W. BARNETT is engineer and assayer to the Ellamar Mining Co. in Alaska.

EDGAR A. COLLINS is taking a short holiday on the Klamath, in northern California.

LEON F. LE BRUN has been appointed superintendent for the Neville Free Coinage Mines at Cripple Creek.

W. L. CLARK, manager for the United Verde Copper Co. at Jerome, started the new smelter at Clarkdale, Arizona, on May 26.

GEORGE O. BRADLEY, CHARLES E. BRUTT, and JULES LABARTHE have formed a partnership as engineers, with offices in the Hobart building, San Francisco.

LUIS O. ABELLI, Bolivian Commissioner to the Panama Exposition, will represent the Department of Mines and Metallurgy on the Superior Jury of Awards.

THOMAS T. READ has been elected chairman of the Department Jury on Mines and Metallurgy at the Panama-Pacific Exposition, and will represent that department on the Superior Jury, which convenes this week to make the final award.

Obituary

LEWIS A. MERRILL, agricultural engineer for the Salt Lake Route and the Mammoth Copper Co., died at Salt Lake City on June 1, the result of injuries received in an automobile accident near Kaysville, Utah. He was well known in Utah from his connection with the Agricultural College.

D. A. LOUIS died in London on March 25 at the early age of 58. An energetic and clever man, widely traveled, and a good linguist, he will be missed from the ranks of the active members of our profession, but it is more as a genial comrade and a trusty friend that his passing will cause pain to busy men in many corners of the earth.

Schools and Societies

COLUMBIA UNIVERSITY held its commencement on June 2. There were 2160 graduates, a record.

The Colorado branch of the A. I. M. E. held a dinner and meeting at Denver on May 29. The Institute secretary, Bradley Stoughton, was present.

The UNIVERSITY OF UTAH held its commencement on May 30. A large number of degrees were conferred. Students from the geology department have been visiting Tintic with Hyrum Schneider, the instructor.

On May 28 the COLORADO SCHOOL OF MINES held its 41st commencement. Twenty-five graduates received the degree of E.M.; one received that of M.S. The theses written discussed many metallurgical problems.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, June 3.

Antimony	35 —35¾
Electrolytic copper	19¼ —19½
Pig lead	5.25
Quicksilver (flask)	$80.00
Spelter	22 —22¼
Tin	39½—41
Zinc-dust, 100-kg. zinc-lined cases	27

EASTERN METAL MARKET
(By wire from New York.)

NEW YORK, June 3.—Electrolytic copper is quiet, although the tendency is upward, lead is very strong, with an upward tone; the spelter market is uncertain and there are few sellers. June dividends are estimated at $114,000,000.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
May	27	Apr. 21	16.85
"	28	" 28	17.93
"	29	May 5	18 63
"	30 Sunday	" 12	18.75
"	31 Holiday	" 19	18.68
June	1	" 26	18.50
"	2	June 2	18.67

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13 60	July	13.26	....
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13.60	....	Dec.	12.75	....

April returns were as follows: Anaconda, 20,500,000 lb. Chino, 5,027,548 lb.; Nevada Con., 1,710,684 lb.; Ray, 5,333,387 lb.; and Utah Copper, 12 015,148 lb. Estimates of Calumet & Hecla for May give 8,900,000 lb. Wages at Anaconda mines have been raised to $4 per day.

Dividends declared by copper companies are as follows: Ahmeek, $2.50; American Smelters Securities, 1½ and 1¼% on A and B stock; Calumet & Arizona, 50c.; Champion, $1; Chino, 75c.; Guggenheim Exploration, 4%; Nevada Con., 37½c.; Old Dominion, $1. Ray, 37½c.; and Utah, $1 per share.

Copper exports during the second week of May totaled 11,501,528 lb., worth $1,968,693. Quotations in London on June 2 were equal to 19½c. for electro at New York.

In 1914 the Granby company produced 23,320,097 lb. copper, 435,275 oz. silver, and 43,882 oz. gold. Ore reserves are estimated at 23,101,075 tons. The annual meeting was held in New York on May 18. No dividend was declared.

According to Henry R. Merton & Co., the world's production of copper in 1914 was 923,888 metric tons. In 1913 it was 1,005,978 tons. The United States contributed 525,529 tons. Japan was second with 68,058 tons.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending	
May	27	Apr. 21	50.18
"	28	" 28	50.60
"	29	May 5	50.33
"	30 Sunday	" 12	50.06
"	31 Holiday	" 19	49.93
June	1	" 26	49.77
"	2	June 2	49.40

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	....
Feb.	57.53	48 45	Aug.	54 35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58 52	50.25	Oct.	51.12	....
May	58.21	49 87	Nov.	49.12	....
June	56.43	....	Dec.	49.27	....

The silver market shows weakness. Pixley & Abell, London, consider that on account of supplies any sharp advance is improbable at present. On July 1 the Tonopah Belmont will pay 12½c. per share for the second quarter.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 76 lb., are given below:

Week ending			
May	6	70.00	May 20 75.00
"	13	75.00	" 27 75.00
			June 2 80.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60.00	Aug.	80.00	....
Mch.	39.00	78.00	Sept.	76.25	....
Apr.	38.90	77.50	Oct.	53.00	....
May	39.00	75.00	Nov.	55.00	....
June	38.60	....	Dec.	53.10	....

The local market is strong and an advance is likely.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date		Average week ending	
May	27 4.40	Apr. 21	4 20
"	28 4.40	" 28	4.23
"	29 4.40	May 5	4.20
"	30 Sunday	" 12	4.20
"	31 Holiday	" 19	4.20
June	1 4.40	" 26	4.20
"	2 4.40	June 2	4.40

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	....
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	....	Dec.	3.80	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date		Average week ending	
May	27 20.00	Apr. 21	9.37
"	28 21.00	" 28	11.04
"	29 22.00	May 5	12.21
"	30 Sunday	" 12	14.33
"	31 Holiday	" 19	15.08
June	1 23.00	" 26	17 79
"	2 24.50	June 2	22.10

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	5.22	9.05	Aug.	4.45	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9.78	Oct.	4.75	....
May	4.91	17.03	Nov.	5.01	....
June	4.84	....	Dec.	5.40	....

Reports from Boston state that there have been transactions at 27c. per pound. Last week ore was sold at Joplin for $85 per ton, basis of 60% metal. The weekly output is 5800 tons of concentrate and 500 tons of calamine. Reserves are about 7000 tons. Spelter in London is £95 per ton, or 23.75c. per pound. The Butte & Superior company has declared its quarterly dividend of 75c. and an extra dividend of $2.50 per share. The Interstate-Callahan will pay $1 per share.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	....
Feb.	39.76	37.23	Aug.	50.20	....
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	39.28	Nov.	33.51	....
June	30.72	....	Dec.	33.60	....

Tin is quiet at 37.50 to 38c. per pound.

Eastern Metal Market

New York, May 28

Interest is almost entirely centred in the great rise in spelter prices and the far reaching effects of its scarcity. Nearby deliveries of prime Western bring 20 to 22c., and premiums are willingly paid for future deliveries. Never before have the producers been sold up so thoroughly, or so far ahead. Much talk is heard of finding substitutes for spelter. The copper demand has slumped for the time being, and concessions in price are possible on all sides. Consumption is unquestionably held back by the inadequacy of facilities for producing certain products. Makers of shrapnel, for instance, are having difficulty in securing copper tubes from which are cut the rings fitted to the base of the shrapnel-cases. The brass-sheet mills are loaded to capacity with orders for months to come. The price of lead has been advanced twice in the week, $2 per ton each time. Tin is weaker because of the extremely large arrivals, business has been quiet. Antimony has been in light request, but is scarce and the high prices hold. Aluminum is also higher and scarce.

In general business, the hoped-for betterment does not materialize very fast, although the railroads are doing a little more buying and the same is true of industrial plants generally. There is some waiting to determine if the country is to become involved in international complications.

COPPER

The market has been neglected by both domestic and European buyers. The lack of demand has developed pressure to sell on the part of second-hands. They have quoted down to 18.50c. cash, New York, and there have been reports that still less would be accepted. The producers, most of whom have been holding to 19c., 30 days, delivered, now show a tendency to make concessions. The situation is one where the brass and copper mills, which are filled with orders for practically the balance of the year, are covered for their immediate needs. The exports for the month are excellent, considering the conditions. The National Brass & Copper Tube Co., in its *Copper Gossip*, says:

"Consumption of copper in this country at present is enormous, and manufacturers are required to cope with conditions which are likely to call for enlarged capacity if demand continues to develop at the recent rapid rate. If purely industrial requirements should show a marked increase during the next six months the brass and copper mills may prepare for a record-breaking melting of copper. It will not be surprising if this country will soon consume more copper annually than at any time in the past."

Today the market gained some strength, and 18.62½c. was quoted.

SPELTER

A wild scramble to buy spelter has sent prices up with a rush to levels which exceed the price of electrolytic copper, which, needless to say, breaks all records. Prompt metal is now quoted at 21 to 22c. Ordinary differentials between positions, and prices, East and West, have been more or less disregarded in the haste to buy. Forward deliveries as well as nearby shipments are commanding premiums, and little is to be had at the high prices. Business has been done into next year. Never before have the producers and sellers been in such a tight position. Some of the transactions have been large. The scarcity caused activity to taper off this week. Ordinary prime Western spelter, spot delivery, commands 22 to 23c., if it can be found; June ranges between 20 and 21c. The average for fourth quarter delivery is about 18.50c., and for delivery in the first quarter of 1916 the quotations range from 17c. upward. Sellers have been obliged to decline business. It is reported that one company last week sold 3,500,000 lb. for delivery running late into the year, at prices ranging from 16.25 to 20c. The latter was paid for choice grades. Since then prices have advanced steadily.

The scarcity and consequent high prices, coupled with the sold-up condition of the mills, has had a most serious effect on brass and copper products. The American Brass Co. has withdrawn its prices, as mentioned in the *Press* last week. Orders for hundreds of tons of sheet-brass cannot find acceptance. For ordinary yellow or Muntz sheets, 25.50c. has been asked, and 24 and 25c. has been paid for brass-rods. Jobbers whose stocks are replete are reaping a harvest, and the small consumer does not know what to make of it. The mills seem particularly averse to considering export orders. The causes of the situation may be summed up as follows: the enormous demand for cartridge metal and other metal for munitions of war, while the combined foreign and domestic demand exceeds production. Manufacturers of war materials at first though they must have high-grade spelter, but when that became scarce they have turned to ordinary grades and found that it does not carry an excessive amount of impurities into the finished products. There is much talk of substitutes for spelter, and for the products into which it enters. Black sheets coated with tin and lead are cheaper today than galvanized sheets, while painted sheets are a common substitute. If the present trend continues it is believed that recourse will be had to copper sheets for purposes where the price has heretofore been prohibitive. As for sheet-zinc, aluminum sheets can now be sold at a lower price. The base price of sheet-zinc has been advanced to 22c. by one of the large interests.

LEAD

The surprise of the week was an advance of $2 per ton, or 10c. per 100 lb., making the quotation 4.30c., New York, May 26. Up to that time the market had been quiet. The advance stimulated buying, and on May 27, there was another advance announced by the large interest, also of $2 per ton, making the New York quotation 4.40c. per pound. On May 28 there was a further advance to 4.50c. New York. It appears that domestic consumers were well covered, but there were some good-sized inquiries in the market which hung-fire. The independents were apparently unable to take care of them, as they are comfortably filled with orders. Subsequent to the last two advances referred to the independents advanced their St. Louis price to 4.32½c., then to 4.42½c. Exports have been good.

TIN

The market has been almost uniformly quiet, heavy arrivals have put a quietus on all fears of a shortage for the time-being. The trend of the market has been steadily downward, which was to be expected, in view of the plentiful supply. There have been days of good buying, but the quiet ones were more frequent.

ANTIMONY

The market has been quiet. The situation is not changed with regard to English brands. They are unobtainable and therefore not quoted. Chinese and Japanese are quoted at 35 to 38c. Owners of deposits of antimony ore are seeking financial backers; but it is a question how successful they will be in view of the fact that the present abnormal condition will pass with the end of the War.

ALUMINUM

Buyers are casting about, but with poor success, to buy sheet aluminum through other than the ordinary channels. Sheets are nominal at 31 to 32c. The metal is scarce and prices have advanced from 25.50 to 26c. for 98 to 99% purity.

Current Prices for Oils and Candles

(Corrected monthly by Standard Oil Co., California.)

All prices are f.o.b. San Francisco except where otherwise specified, and are subject to change without notice.

Granite Mining Candles.	Per set, cents.	Granite Mining Candles.	Per set, cents.
6s-12 oz.-40s	8¾	6s-14 oz.-20s	9½
6s-12 oz.-20s	9	6s-16 oz.-40s	10
6s-14 oz.-40s	9¼	6s-16 oz.-20s	10¼

Extra hard 1c. per set higher than the above.

The following prices are for oils (Calol) in wood barrels; cases (2-5 gal.) 3c. per gallon higher.

	Per gal., cents.		Per gal., cents.
Compressor oil	40	Light gas engine oil	28
Amber gas engine oil	40	Red compressor oil	26
Castor machine oil	20	Red engine oil	17
Dynamo and motor oil	24	Turbine oil	30
Engine oil	24	Turbine oil, heavy	30
Gas engine oil	26	Diesel engine oil	40
Heavy gas engine oil	45	Cylinder oil	37
Heavy red engine oil	19	High-pressure cylinder oil	50
Heavy red journal oil	21	Low-pressure cylinder oil	37
Ice machine oil	28	Valve oil	44

The following prices are for oils in iron barrels, cases (2-5 gal.) 7c. per gallon higher, except on Eocene, which is 8c. per gallon higher.

	Per gal., cents.		Per gal., cents.
Pearl oil	9	Engine distillate	7
Headlight oil	10	Aroturps	18
Eocene oil	11	V. M. and P. Naphtha	10½
Red Crown gasoline	11½		

	Per bbl.
Calol fuel oil, f.o.b. Richmond Refinery	$0.85
	Per ton.
Petrolastic cement X	$13.00
Petrolastic cement XX	12.00
Asphaltum	$5.50 to 12.50

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted, except as noted, f.o.b. San Francisco. Buying prices marked *.

	Min.	Max.
Antimony ore, 45 to 55%, per ton	$55.00	$65.00
Arsenic, white, refined, per lb	0.04	0.05
Arsenic, red, refined, per lb	0.12	0.15
Asbestos, chrysotile	100.00	350.00
Asbestos, amphibole	5.00	7.50
Asphaltum, refined, per ton	11.50	20.00
Barium chloride, commercial, per ton	50.00	60.00
Barium sulphate (barytes), prepared, per ton	20.00	30.00
Bismuth ore, 15%, per ton	*250.00	upward
China clay, English, levigated, per ton	15.00	20.00
Chrome ore, according to quality, per ton	7.50	10.00
Cobalt metal, refined, f.o.b. London, per lb	1.90	....
Coke, foundry, per 2240 lb	12.00	15.00
Diamonds (according to size and quality):		
Borts, per carat	2.00	15.00
Carbons, per carat	55.00	80.00
Feldspar, per ton	5.00	25.00
Firebrick:		
Silica, per M	50.00	55.00
Snowball, per M	40.00	45.00
Flint pebbles for tube-mills, Danish, per 2240 lb	21.00	24.00
Fluorspar, per ton	10.00	15.00
Fuller's earth, according to quality, per ton	20.00	30.00
Gilsonite, per ton	35.00	40.00
Graphite:		
Amorphous, per lb	0.01	0.02½
Crystalline, per lb	0.04	0.13
Gypsum, per ton	5.00	7.50
Infusorial earth, per ton	10.00	15.00
Iridium	55.00	....
Magnesite, crude, per ton	5.00	7.50
Magnesite, dead calcined, per ton	20.00	25.00
Manganese ore, oxide, crude, per ton	10.00	15.00
Manganese, prepared, according to quality, per ton	50.00	75.00
Mica, according to size and quality, per lb	$0.05	$1.00
Molybdenite, 95% MoS_2, per ton	1000.00	1500.00
Monazite sand (5% thoria), per ton	150.00	200.00
Nickel metal, refined, per lb	0.45	0.60
Ochre, extra strength, levigated, per 100 lb	2.00	3.00
Osmiridium, per oz	30.00	40.00
Platinum, native, crude, per oz	30.00	45.00
Silex lining for tube-mills, per 2240 lb	35.00	45.00
Sulphur, crude, per ton	25.00	30.00
Talc, prepared, according to quality, per ton	20.00	50.00
Tin ore, 60%, per ton	425.00	450.00
Tungsten ore, 65%	425.00	450.00
Uranium ore, 10% min	25.00 per unit	
Vanadium ore, 15% V_2O_5, per ton	150.00	180.00
Wolframite (see tungsten ore).		
Zinc ore, 50% up, per ton	*15.00	20.00

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Heimann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are f.o.b. San Francisco and subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66°, drums, per 100 lb.	$ 0.80	$ 1.10
Acid, sulphuric, com'l, 66°, carboy, per 100 lb.	1.25	2.00
Acid, sulphuric, C. P., 9-lb. bottle, bbl., per lb.	0.13	0.18
Acid, sulphuric, C. P., bulk, carboy, per lb.	0.09½	0.12
Acid, muriatic, com'l, carboy, per 100 lb.	1.60	3.00
Acid, muriatic, C. P., 6-lb. bottle, bbl., per lb.	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, per lb.	0.10½	0.15
Acid, nitric, com'l, carboy, per 100 lb.	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., per lb.	0.16	0.22
Acid, nitric, C. P., bulk, carboy, per lb*	0.12½	0.15
Argols, ground, bbl., per lb.	0.10	0.20
Borax, cryst. and conc., bags, per 100 lb.	4.25	5.15
Borax, powdered, bbl., per 100 lb.	4.75	5.60
Borax glass, gd. 30 mesh, cases, tin lined, per 100 lb.	11.50	14.50
Bone ash, 60 to 80 mesh, bbl., per 100 lb.	0.50	6.50
Bromine, 1-lb. bottle, per lb.	0.55	0.65
Clay, domestic fire, sack, per 100 lb.	1.50	2.00
Cyanide, 98 to 100%, 100-lb. case, per lb.	No quotes	
Cyanide, 98 to 100%, 200-lb. case, per lb.	"	"
Cyanide, 129%, 100-lb. case, per lb.	"	"
Cyanide, 129%, 200-lb. case, per lb.	"	"
Lead acetate, brown broken, casks, per 100 lb.	9.00	10.50
Lead acetate, white broken, casks, per 100 lb.	10.50	10.75
Lead acetate, brown broken, casks, per 100 lb.	9.00	10.50
Lead acetate, white, crystals, per 100 lb.	12.50	13.25
Lead, C. P., test., gran., per 100 lb.	13.00	15.00
Lead, C. P., sheet, per 100 lb.	15.00	18.00
Litharge, C. P., silver free, per 100 lb.	11.50	13.50
Litharge, com'l, per 100 lb.	8.00	9.50
Manganese ox., blk., dom. in bags, per ton	20.00	25.00
Manganese ox., blk., Caucasian, in casks, per ton (85% MnO_2—¾% Fe)	130.00	140.00
Nitre, double ref'd., small cryst., bbl., per 100 lb.	13.50	14.00
Nitre, double ref'd., granular, bbl., per 100 lb.	13.50	14.00
Nitre, double ref'd., powdered, bbl., per 100 lb.	13.50	14.00
Potassium bicarbonate, cryst., per 100 lb.	22.00	25.00
Potassium carbonate, calcined, per 100 lb.	25.00	35.00
Potassium permanganate, drum, per lb.	0.65	0.75
Silica, powdered, bags, per lb.	0.03	0.05
Soda, carbonate (ash), bbl., per 100 lb.	1.45	1.75
Soda, bicarbonate, bbl., per 100 lb.	2.00	2.50
Soda, caustic, ground, 98%, bbl., per 100 lb.	3.00	3.25
Soda, caustic, solid, 98%, drums, per 100 lb.	2.80	3.00
Zinc shavings, 850 fine, bbl., per 100 lb	26.00	....
Zinc sheet, No. 9—18 by 84, drum, per 100 lb.	No quotes	

*Extra charge for packing nitric acid for shipment to conform to regulations.

PYRITE AND SULPHURIC ACID IN 1914

Production of the above has just been published by the U. S. Geological Survey. The pyrite output was 336,662 long tons worth $1,283,346. This is a small decrease compared with 1913. Virginia is the leading producer. Imports totaled 1,026,617 tons, an increase of 176,025 tons. Sulphuric acid production amounted to 3,762,417 short tons of 50° acid, valued at $24,163,331. This does not include 21,993 tons of fuming acid worth $316,596. Copper and zinc smelters made 950,798 tons valued at $5,190,293.

COMPANY REPORTS

RAY CONSOLIDATED COPPER COMPANY

This company's mine is at Ray, Pinal county, and mill at Hayden, Gila county, Arizona. The report covers 1914.

Development tributary to the three main shafts amounted to 75,261 ft. Total to date is 452,233 ft. Mining operations have destroyed 182,760 ft. of this. Re-calculated ore reserves amount to 74,765,789 tons, averaging 2.214% copper. There was extracted 2,426,739 tons of ore, containing 1.760% , also 2591 tons of 11.867% ore. Mining costs were 62.42c per ton, a reduction of 10.81 cents.

The mill concentrated 2,427,700 tons, with 67.88% recovery, at a cost of 49.88c. per ton.

Concentrate and ore smelted yielded 59,044,700 lb. metal. The net cost of production was 8.763c. per pound.

Revenue from copper, gold, and silver was $7,597,724. Operation cost $5,281,484. Adding miscellaneous income to the operating profit, there was available $2,655,163. Interest reduced this to $2,395,623. Dividends paid amounted to $1,089,322. At the beginning of the year the surplus was $2,758,126; at the end, $3,776,368.

CHINO COPPER COMPANY

This company's excellent report for 1914 contains the following information:

A little drilling was accomplished for development purposes. Including the ore proved in the South body, reserves are estimated as 90,270,155 tons, averaging 1.75% copper. Further drilling should add to this total. Overburden removed amounted to 3,173,717 cu. yd. The steam-shovels also mined 2,114,910 tons of ore. Mining cost averaged 36.52c. per yard. The new coarse-crushing plant near the mine reduced the cost of shoveling ore.

From August to the end of the year the mill was operated at 66% capacity. A total of 1,907,300 tons of ore was treated during 1914. This averaged 2.1151% copper. Concentrate produced was 147,925 tons. Including 2,093,723 lb. metal in 19,405 tons of ore sent direct to the smelter, the year's output was 56,841,977 lb. Milling cost 55.01c. per ton, a decrease of 6.07 cents.

Metals sold realized $7,247,197. The net profit was $3,222,579. Dividends amounted to $2,169,065. The year started with a balance of $3,743,167, and ended with $4,566,402.

NEVADA CONSOLIDATED COPPER COMPANY

The eighth annual report of this company, covering 1914, contains the following data:

Prospecting with churn-drills was continued on the west side of the Ruth orebody, on the Kearsarge and Eclipse claims, and in the Liberty pit north of the 'clastic' dike. Thirty-four holes were drilled a total depth of 13,160 ft. Ore reserves at the end of 1914 were estimated at 41,020,296 tons, averaging 1.68% copper. Of the 2,636,535 tons of ore mined, only 123,324 tons was from underground work. Overburden moved amounted to 3,044,966 yards. Steam-shovel mining cost 15.17c. per ton. In 1913 it was 17.75c. Stripping cost 31.71c. per yard.

The mill treated 2,640,294 tons of ore averaging 1.483%. The recovery was 68.48%. Reverberatory furnaces reduced 515,162 tons of concentrate, ore, slag, etc. Converters produced 50,542,542 lb. copper. Custom ore yielded 1,298,486 lb. Costs averaged 8.91c. per pound of metal.

The revenue was $7,052,499; operating expenses, $6,335,522; profit, $716,977; miscellaneous income, $1,046,044; available for dividends, $1,763,021; distribution, $2,249,389; balance end of 1913, $3,069,643; and balance end of 1914, $2,290,626.

MINING DECISIONS

Mining Partnership—Effect of Dissolution

Where several co-lessees are working a mine for their joint interests they are mining partners within the contemplation of the law. Where one of said co-lessees withdraws from said work and ceases to contribute to the cost of the same, he ceases to be a partner and his former co-partners cannot continue to operate at any expense to him.

Lamont *v.* Reynolds (Colorado), 144 Pacific, 1131. December 14, 1914.

Overlapping Leases and Sale of Royalties

Overlapping leases and the sale of royalties in the Oklahoma lead and zinc field are contrary to law, and henceforth will not be tolerated. This is the substance of a decision handed down by the Supreme Court of the United States. It is of extreme importance to every mining operator in the Miami field, where so much development work is being carried on right now. The Joplin letter of May 8 discusses this subject.

Eminent Domain—Value of Mineral Rights

Where a power company condemned a right-of-way for the erection and maintenance of a transmission-line, and acquired only the use of the surface of the land taken for such right-of-way, the owner can recover only the value of the surface taken unaffected by the value of any minerals that may be underneath the surface.

Alabama Power Co. *v.* Keystone Lime Co. (Alabama), 67 Southern, 833. January 11, 1915.

Forms of Contracts *re* Oil Lands in Withdrawn Areas

The Secretary of the Interior has issued a set of instructions and blank forms of application and contract, permitting persons who make application for placer patents to oil lands withdrawn from entry, to enter on such lands and drill for oil, on condition that they deposit one-eighth of the gross proceeds in escrow in a national bank. Such deposits are to be held by the bank until the Department of the Interior finally disposes of the application for patent. If said application is granted, the money is to be returned to the depositor. If the patent is refused, the money is to be delivered to the United States Treasury.

Instructions of November 20, 1914, 43 Land Decisions, 459.

Oil Lease—Lessee's Right to Select Well Locations

A land-owner leased to another the right to drill wells for the extraction of oil and gas. The lessee selected as a location for one of his wells a reservoir-site being prepared for use by the land-owner. Another site chosen was ground on which excavating for the foundations of a building had been completed. The lessor's superintendent prevented the lessee from carrying on drilling operations on either location, it appearing that there were equally advantageous locations near by which would not interfere with the lessor's plans. Held, that an injunction would not issue at the suit of the lessee to aid him in totally disregarding the rights of the lessor, where his own inconvenience was slight in comparison with the injury to the lessor which would result from the proposed drilling operations, and his damage if any would readily admit of compensation.

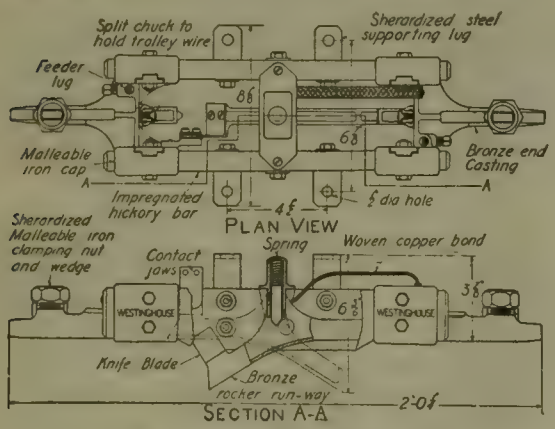
Gillespie *v.* American Zinc & Chemical Co. (Pennsylvania), 93 Atlantic, 272. January 2, 1915.

New Machines and Devices

Information based on letters and catalogues from manufacturers.

Automatic Section-Insulator

Patent No. 1,126,092 has been recently granted to William Schaake, of the Westinghouse Electric & Manufacturing Co., on an automatic section-insulator. These insulators are inserted in trolley-wires where it is desirable to energize a section when the trolley passes on to it, and to de-energize it when the trolley passes off. They are used extensively in mining in-



THE AUTOMATIC SECTION-INSULATOR.

stallation where a branch is to be energized only when the locomotive is on that branch. Leakage losses and dangers of contact by persons passing under the trolley-wire are thereby averted when the locomotive is not on the branch. Street-railway companies sometimes use them in the same way. The circuit is opened and closed by a switch-blade mounted on a rocker that the trolley operates. In one position the blade connects with copper-contactors. In the other there is no connection.

Commercial Paragraphs

The varied uses of BUCYRUS steam-shovels is further described and illustrated in *The Excavating Engineer* for May.

A pamphlet describing its instructive exhibit at the Exposition has been issued by the PELTON WATER WHEEL Co., San Francisco.

Book No. 210, 48 pages, of the LINK-BELT Co., Philadelphia, illustrates 'Link-Belt' wagon and truck-loaders. A large variety is manufactured.

The KELLEY FILTER PRESS Co. announces that it has moved its New York office from 80 Maiden Lane to the Hudson Terminal building, 30 Church street. Emil E. Lungwitz is in charge.

The SMOOTH-ON MANUFACTURING Co., Jersey City, New Jersey, will be pleased to send a copy of Pamphlet No. 4, on the use of its 'Smooth-On' water-proof mixture, to persons writing to the above address.

In *Leschen's Hercules* for May are described the foundations for the Harahan bridge, Memphis, Tennessee (the main bridge is 2550 ft. long); the Mill Creek storm sewer, St. Louis; the new third lock and canal at Sault Ste. Marie, Michigan; and lowering a 20-ton valve down a 250-ft. shaft. In all these operations LESCHEN'S wire rope was used.

The WILSON-SNYDER MANUFACTURING Co. and the WILSON-SNYDER CENTRIFUGAL PUMP Co., of Pittsburgh, Pennsylvania, have opened a branch office at 52 Vanderbilt avenue, New York, in charge of A. H. Sherwood.

'Marion Reliability and Your Profits' is the title of Catalogue 93 of the MARION STEAM SHOVEL Co., Marion, Ohio. The 48 pages describe and show the general use of shovels. Specifications are given with certain models.

In the May *Webster Method*, the WEBSTER MANUFACTURING Co., of Tiffin, Ohio, describes its installation of conveyors at the new smelter of the United Verde Copper Co., at Clarkdale, Arizona. Nearly 7000 ft. of belting was used in the plant.

Bulletin No. 60 of the WILFLEY MINING MACHINERY Co., London, describes the Hoover rapid laboratory sizer. This apparatus consists of a series of screens mounted in frames, made so that the tops and bottoms of adjacent frames fit into each other. The whole is suitably rotated. It is claimed that besides accuracy in screening, one-thirtieth of the time occupied in hand work is required.

The ROESSLER & HASSLACHER CHEMICAL Co., of New York, have an interesting little booth in the Palace of Mines and Metallurgy at the Exposition. It contains various chemicals, including sodium cyanide, cyanide chloride mixture, bichromate of potash, hyposulphite of soda, and permanganate of potash. A mechanical electro-plating apparatus is of interest. A picture at the back represents an alchemist at work.

The DODGE SALES & ENGINEERING Co., distributer of the products of DODGE MANUFACTURING Co., Mishawaka, Indiana, has just issued a new 125-page illustrated catalogue covering the full Dodge line of gearing. For a number of years the Manufacturing company has made a specialty of this class of transmission, and the line embraces many thousands of patterns and methods in a most complete manner for the general requirements of the trade.

Barometric jet-condensers are used at many steam plants. In Form No. 1001, the CRESSON-MORRIS Co., of Philadelphia, discusses the condensing plants it manufactures. Using the Beyer counter-current type the following advantages are claimed: high vacuum at exhaust of prime-mover; ability to vary quantity of cooling water in direct ratio to load of prime-mover, without impairment of vacuum; operation of vacuum under all conditions; low operating costs; and permissible use of dirty, gritty, or acid cooling water continuously, without necessity for cleaning or repair. Ingersoll-Rogler dry air-pumps are used with these condensers.

The INTERNATIONAL STEAM PUMP Co., of New York, sends information regarding a large pump contract awarded Henry R. Worthington by the Panama Canal Commission. This plant is for dry dock No. 1 at Balboa. The contract involves design, fabrication, and delivery on the Isthmus of the structural, mechanical, electrical, and hydraulic parts required for this installation. The pumps consist of four main units with a capacity of 11,000 cu. ft. of sea-water per minute, two drainage units of 1200-cu. ft. capacity, and a bilge pump of 25-cu. ft. capacity. A great number of accessories are included. Delivery is guaranteed within 210 days. The International company also sends Information Bulletin 23. It deals with the Laidlaw feather valve for air-compressors. The valve consists of three parts. Severe tests have proved its efficiency.

Mining and Scientific Press

Edited by T. A. RICKARD

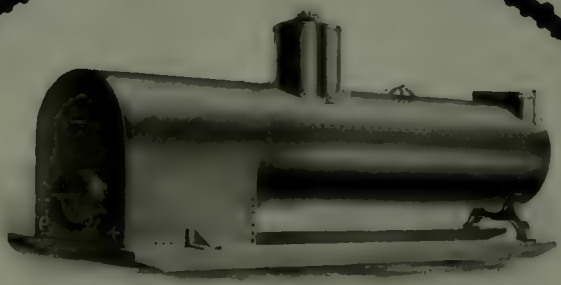
Volume 110 SAN FRANCISCO, JUNE 12, 1915 Number 24

SMELTER SMOKE may not be palatable to some of our farmer friends, but it smells sweet to us, as the expression of useful metallurgical activity. With the

A SMELTER IN ARIZONA

rising price of metals we expect to see more signs of beneficent industry such as are illustrated in this picture. All the base metals have risen rapidly in market-value and the effect of it is becoming manifest in a revival of mining throughout the mineral regions of the West.

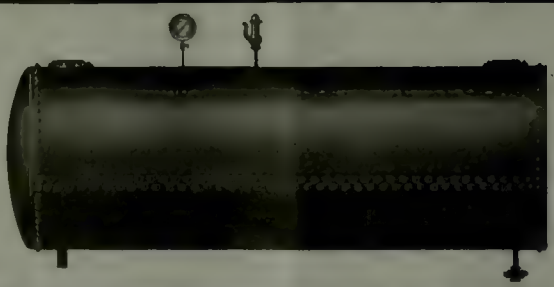
STANDARD HORIZONTAL TUBULAR BOILERS



ANY SIZE — ANY STYLE

NEVER LONG TO WAIT. USUALLY CAN BE SHIPPED FROM STOCK AT ONCE

AIR-
RECEIVERS
TANKS, Etc.



VERTICAL
or
HORIZONTAL

THE HENDRIE & BOLTHOFF MFG. & SUPPLY CO.
DENVER

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Advertisers Index—Last Page
Buyers Directory—Page 28

TABLE OF CONTENTS

EDITORIAL

Page.

NOTES 895

A RISE 897

We yield to the wishes of our correspondents.

PROCESSES AND PUBLICITY 897

The unwisdom of exploiting technical processes in the daily press.

HOPE IN MEXICO 898

The latest move of American diplomacy has some possibility of success.

DISCUSSION

PROFESSORS OF MINING.

By *Ross E. Browne* 899

A distinguished engineer gives his views.

SPECULATION IN MINES.

By W. H. Shockley 900

Over-valuation of shares and manipulation make it dangerous for the uninitiated.

RISE OR RAISE?

By H. N. Herrick 900

Conclusion of the discussion on this word.

DREDGING COSTS.

By James Wilson Neill 901

Comparison of the Oroville and Yosemite total costs.

EXPERIMENTS IN SMELTER-FUME ABATEMENT.

By E. A. Hersam 902

The associate professor of metallurgy in the University of California advises caution.

ARTICLES

TECHNICAL REMINISCENCES—III.

By Albert R. Ledoux 903

What happened to a dredging company at Pachuca, James J. Hill's intimate knowledge of his railroad system, how Roosevelt shot a bear, serving as an involuntary guard, and how he established a reputation for insight are entertainingly related by Dr. Ledoux.

CHINA'S MINERAL EXHIBIT 906

A creditable exhibit has been made, in spite of transportation difficulties and the few companies that are in a position to participate.

GOLDFIELD REVISITED—III.

By T. A. Rickard 907

Latite, dacite, and alaskite are characteristic rocks of the district. Three main lode-channels have been found, the ore occurs in largest masses where the lode traverses dacite. The deepest shaft is down to 1772 ft. The lode finally strikes the underlying shale and conforms to it. How far it will persist in this formation can only be proved by deep exploration.

THE MOTOR-TRUCK AT TONOPAH 909

Trucks convey 5 tons per trip a half mile at a cost of 12½c. per ton. The cost of tires is 6c. per mile.

ADVANCEMENT OF MINING IN COLORADO.

By George J. Bancroft 910

Numerous discoveries in depth have recently been made. The possibility of legal conflict has been avoided by a disposition to 'get together' which argues well for the future.

HOME-MADE APPARATUS FOR CYANIDE-TESTS.

By Horace F. Lunt 911

By the exercise of ingenuity useful pieces of apparatus for laboratory tests can easily be improvised from materials everywhere available.

CORNISH MINING.

By W. J. Loring 912

Illustrations of old methods practised in Cornwall that have now been superseded. By spending 4s. more per ton of ore the total cost was decreased 11s. per ton.

THE SHUI-KOU-SHAN MINE IN HUNAN, CHINA.

By H. Y. Liang 914

The most important lead mine in China is described by its general manager. It produces almost 3000 tons of zinc ore per month, and 500 tons of galena, carrying 30 oz. silver per ton. It is entirely under Chinese direction and is worked by a combination of ancient and modern methods.

DETERMINATION OF GOLD IN BLISTER COPPER.

By Rowland King 917

Most of the copper is slagged with litharge, the rest is removed by a double scorification before cupelling. Results for silver are low, but accurate for gold.

NOVEL METHOD OF HAULING ORE CARS 917

Ingenious adaptation of a Ford motor to haul mine-cars from the mine to the mill.

DEPARTMENTS

CONCENTRATES 918

REVIEW OF MINING 920

Special correspondence from London; Cripple Creek, Colorado; Joplin, Missouri; Platteville, Wisconsin.

THE MINING SUMMARY 924

PERSONAL 928

OBITUARY 928

THE MARKET PLACE 929

EASTERN METAL MARKET 930

COMPANY REPORTS 931

Isle Royale Copper Co.; Tamarack Mining Co.; Calumet & Hecla Mining Co.; Rio Tinto Copper Co.; United States Smelting, Refining & Mining Co.

BOOK REVIEWS 932

'Direct-Acting Steam Pumps,' by Frank F. Nickel; 'Practical Oil Geology,' by Dorsey Hager; 'Tunneling,' by Eugene Lauchli.

RECENT PUBLICATIONS 932

NEW MACHINES AND DEVICES 933

Cyanidation at the Exposition; Pumps, Crushers, and Steel at the Exposition; Underground Shoveling-Machine; Commercial Paragraphs.

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NEW YORK ENGINEERING COMPANY

2 Rector Street, New York

EDITORIAL

T. A. RICKARD - - - - Editor THOMAS T. READ - Associate Editor

JOPLIN celebrated the rise in zinc to "$100 jack" by engaging a band to parade the streets. By the time the band had ceased playing, the price had risen to $106.

OUR correspondent at Houghton makes pleasant mention of the presentation to Mr. James MacNaughton from the employees of the Calumet & Hecla and its subsidiary companies. Time has justified Mr. MacNaughton's stand in 1913. He has won not only the regard of his associates in the management of these mines but the cordial respect of all the workers.

PIG-IRON output is increasing. In May the average daily production was 72,599 tons, as against 48,236 tons in December and 67,646 tons in May last. Ore shipments during May were 5,012,359 tons, as against 3,852,063 in the corresponding month of last year. There is no better barometer of industry than the iron trade, although Disraeli used to insist that the production of sulphuric acid was the best index.

AT the recent meeting of the Plymouth Consolidated Company, in London, the chairman was able to make a cheerful report concerning finances at the office and developments at the mine. Ore averaging $4.50 per ton is being worked at a cost of $3.25. The mill has proved most efficient. Local information is corroborative. We congratulate Mr. W. J. Loring, of Bewick, Moreing & Co., on the confirmation of his estimates.

ON whichever side the sympathy of Americans may be ranged in the great European struggle, they will unite in supporting the President in his effort to guide the destinies of the nation. Not without strong prejudices ourselves, we appreciate the sincerity of the President's effort to steer a true course amid the complexities of the time. The position of an idealist and a pacifist in this warring world is comparable to that of a philosopher pitchforked into a street-fight. The language he talks falls upon uncomprehending ears, and his attempts to abate the quarrel may seem to the eager onlooker so ineffective as to verge on the ridiculous. While fighting is in progress, the pacificist seems less of a man than the willing warrior, but his own people, and eventually the world at large, will recognize that there is a moral courage even higher than physical bravery. A generation hence the people of the United States, and those of Europe also, will be grateful to Mr. Woodrow Wilson for keeping his head at a time when the provocation to instant belligerent action was so obvious.

PSYCHOLOGY is a factor in mining also, says Mr. George Bancroft, who writes in this issue concerning Colorado. Thus he is in agreement with the President, who introduced the idea into a discussion of the state of general business. However that may be, we are glad to welcome Mr. Bancroft to the hospitality of our pages. No one is better informed concerning mining in Colorado, where distinct improvement has been noticeable of late.

AS USUAL we note several interesting items in the précis of technology appearing in *The Mining Magazine*. No portion of our contemporary at any time has exhibited more sincerity of purpose. Not to abstract, but to summarize intelligently, to peptonize indigestible facts with understanding comment, is a feat of journalism second to none. We tender our hearty compliments to Mr. Edward Walker, who, we happen to know, is the editor of this department of the *Magazine*.

CLASSIFICATION of the literature of applied science is to be attempted by an organization that has been formed by representatives of 20 of the leading technical societies, who met in New York recently. Mr. W. P. Cutter, librarian of the United Engineering Societies library and secretary of the new organization, known as the Joint Committee on Classification of Technical Literature, has outlined a plan for collating all the existing classifications and compiling a general system. It is expected that this will serve as a basis for the filing of clippings, for cards in a card-index, and for printed indexes; and that the publishers of technical periodicals might be induced to print against each im-

portant article the symbol of the appropriate class in this system, so that by clipping these articles, a file might be easily made which would combine in one system these clippings, together with trade catalogues, maps, drawings, blue-prints, photographs, pamphlets, and letters classified by the same system.

GOLD has been found in Northern Nigeria, heretofore associated with tin mining. But the effort to explore and develop the gold-bearing gravel, as well as the possible veins in the bedrock, of the Barco river have been hindered by departmental red tape of a most irritating kind. We sympathize with the operators in Nigeria, for the British government has not abandoned the parochial notion that mining is a disreputable adventure to which official support must not be given too hastily. As if the British empire, like the American republic, had not followed in the footsteps of the voyageur, the explorer, and the prospector. The historic fact is so plain that it needs no argument.

ZINC and its alloys are to the fore just now; so are the ores from which it is derived. It is opportune to explain why the carbonate of zinc is called 'calamine' in England and 'smithsonite' in America, these names being interchanged in labelling the silicate. At one time the oxidized ores of zinc were known as 'calamine,' which, like the *galmei* of the Germans, is a corruption from *cadmia*, itself derived from Cadmus, in recognition of its reed-like stalactitic forms. The first investigator to separate the silicate from the carbonate, and to establish the identity of the two minerals, was James Smithson, as is recorded in his paper on 'The Chemical Analyses of Some Calamines,' read on November 18, 1802, and appearing in the Philosophical Transactions of the Royal Society, London, in 1803. After this publication by Smithson, the name smithsonite was given to the silicate and that of calamine to the carbonate. Unfortunately in America the naming was reversed. It is about time for the authorities on mineralogy to come to an agreement on the matter, for the present confusion is alike absurd and unnecessary.

RUPTURE of diplomatic relations between America and Germany would have one regrettable consequence, among many: it would render impracticable a continuance of relief in Belgium, and other regions now the beneficiaries of American philanthropy. In the Belgian Relief Commission we take a special interest, for it was started and organized by a mining engineer, Mr. Herbert C. Hoover, assisted cordially by a number of other members of the profession, notably Millard K. Shaler and Edgar Rickard. Never were the initiative and intelligence developed by a successful engineering career put to more immediate public usefulness. Among many wise steps taken by Mr. Hoover, we may mention the arrangement made at the start for a monthly audit of the accounts of the Commission. This is done regularly by the leading firm of accountants in London. If other charities were conducted in a similar businesslike way they would command greater confidence. Mr. Hoover has received, and is receiving, great praise for his work in behalf of the distressed people of Belgium; we can only add our own knowledge of his untiring devotion to a noble purpose.

TWO readers of our paper have cancelled their subscriptions on account of pro-German sympathy. For personal prejudices at this time no apology is necessary. "'Tis a mad world, my masters." We are trying to conduct the MINING AND SCIENTIFIC PRESS as an American paper, which it has been for 55 years. To those who forego its use on account of political feelings, we tender our sympathy, but we suggest that it is unwise, in a moment of irritation, to cut off your nose to spite your face. One of our editors is a pro-German, as he is entitled to be from the fact that his father was a German. That fact does not cause us to depreciate his useful assistance.

ONE of our subscribers writes to inquire whether the declaring of war by Italy will have any effect on the cyanide supply, being evidently of the belief that cyanide has been forwarded to this country from Germany through Italy. It is difficult to obtain exact information in regard to cyanide, but, as nearly as we can learn, none has been forwarded to this country from Germany for some time. The plant at Perth Amboy has been enlarged and is probably able to supply the needs of consumers in the United States. The plants in England have increased their output and are supplying the South African companies and British mining companies elsewhere, but only small amounts are available for American consumers. So far as this country is concerned, therefore, that source of supply is practically negligible. The trade apparently has been readjusted along national lines, for the sellers in this country are refusing foreign orders, in order that their regular customers here may be protected. Buyers of small lots that have been in the habit of purchasing from the firm that would quote them the lowest figure will not improbably have to pay the higher prices justified by the present situation, but there seems no reason to suppose that contract customers need anticipate any difficulty.

WHILE the recent financial conference between the Secretary of the Treasury and the delegates of the Central and South American republics did not result in any definite scheme of co-operation, it was rendered memorable by a proposal made informally on the part of Mr. Bryan to several representatives of the Pan-American Union. He suggested an interchange of credit to be accomplished by the United States taking from a South American government its obligations at 4% and giving in exchange a like amount of 3% United States bonds, the difference of 1% to be devoted to the amortization of the South American securities. This has been pronounced, by good authority, both a daring and a brilliant conception. Undoubtedly if the United States

is to develop trade with her neighbors to the south she must be prepared to finance them. Trade follows credit.

ELSEWHERE in this issue we print an interesting account of the largest lead-zinc mine in China. This supplements the statement made in last week's issue by Mr. H. Y. Liang as to the opportunities for development of mining enterprises in that country. So far foreign participation in mining in China has proceeded along what appears to us the wrong lines. Efforts have been made to obtain concessions covering all the mineral rights in large areas, but such concessions have invariably proved a source of diplomatic difficulties that usually have been settled to the complete satisfaction of neither side. The normal and practicable method is the examination and exploitation of individual properties of promise, of which there are many in southwestern China. The laws of China heretofore have been unfavorable to foreign participation in mining enterprise, but a new spirit now pervades that ancient country and as a mining region of the future it is well worth attention.

DECISION by the United States District Court for New Jersey refusing the petition of the Federal Government to dissolve the United States Steel Corporation as a combination in restraint of trade has been hailed with a sense of relief by business men all over the country. Probably the ruling will not be appealed to the Supreme Court, as President Wilson is reported opposed to injecting further uncertainty into the domestic business situation by continuing the suit. At the time the hearings in this trial were being held we reported the substance of them in our correspondence columns and it is only necessary to recall how it was demonstrated that even at its inception the Steel Corporation had not a monopoly of the iron and steel business and today does a smaller proportion of the total business than it did then. As to controlling the iron ore reserves of this country, that has long since been shown to be a baseless allegation. The only point in which the Court found any ground for the complaint were the meetings of all the producers held a decade ago, but these have long since ceased. The suit against the Steel Corporation was filed in 1911, largely to meet the political exigencies of the national campaign of the following year, and it has long outlived any usefulness it may have had in that respect. In a recent issue Mr. A. F. Willoughby described the important and valuable work done by the Steel Corporation in increasing the efficiency and welfare of its employees, in which respect it has set a standard that is being followed as rapidly as practicable by other mining corporations. As we pointed out at that time, it is the large size of the Corporation that has made this development possible, while the immense benefit to the community that has accrued from it is only just beginning to be realized. It will not be surprising if the final judgment of history is that in bringing about this great advance the Steel Corporation has made a contribution to the progress of civilization far outweighing all its other activities.

A Rise

A few months ago the former editor of this paper adopted the word 'rise' as the correct spelling of the technical term 'raise,' meaning an interior opening or shaft made by mining upward. The form adopted had been used previously, notably in the McNeill code book, a volume lacking, it may be, the authority of a dictionary but representing usage among many men of business all over the world. As to the correctness of 'rise,' there is no doubt. If your salary is raised—a pleasant idea at a time like this—the result is a rise in your salary. For raising the question, we do not apologize; it resulted in a rise, from many directions. The transitive and intransitive became reversed, and the objective became overwhelmed in the subjective. However, we are not professors but professionals, using the language that is our common heritage but not posing as the final arbiters. We shall concede the point to our many friends insistent that the change is unnecessary and undesirable. In this warring world, it is not worth while to fight for a grammatical detail. Bigger issues make better game.

Processes and Publicity

In giving notoriety to new processes the utmost caution is required. An example of this is seen in the statements recently made in the press concerning the Heslewood process. For some years Messrs. James and William Heslewood, of Oakland, have been engaged in the experimental development of a process to collect the fume of smelters. The fact that the general principles involved in the process have been known for generations but have so far proved impracticable of commercial application does not necessarily condemn it, for industrial progress consists in learning how to do what no one has been able to do before. There is merely less probability that it will be possible to do something that has been tried without success, than to do something that has never been tried. The process as first devised by Messrs. Heslewood consisted essentially in enclosing the top of the furnace and furnishing the blast necessary for smelting by exhausting at the top instead of blowing in air at the bottom. Two things were to be accomplished by this: The sulphur that ordinarily burns at the top of the charge was prevented from coming into contact with the air and was thus drawn off as elemental sulphur. The gases were also drawn off under sufficient pressure so that they could be exhausted through a tank full of water, which, it was hoped, would catch and retain all the sulphur and other solids. Obvious disadvantages are involved in this procedure. To pump the gases through water requires expenditure of energy, which is the equivalent of money, and after having caught the fume in water the next question is what to do with the sludge thus produced. It cannot be discharged into the running stream, for the smelter would then escape from the farmers only to fall into the hands of the Fish Commission. The net result is the common experience of the

inventor that he solves one difficulty only to create another. In addition, the charging of a furnace with a sealed top would evidently present difficulties. Nevertheless the process presents possibilities and is worthy of experimental research.

Recently the Heslewood patents were acquired by a corporation, and one of the students in the University of California was persuaded to conduct a series of tests in the metallurgical laboratory of that institution. We have seen the report of these, indicating that the process has been modified by the use of oil and steam to reduce all the sulphur to the elemental form, but the tests throw no new light on the essential problem, namely, can the process be made to work on an operative, as contrasted to a laboratory, scale, and at a cost that is not prohibitive. Nevertheless the local press has been furnished, through the usual methods, with highly-colored accounts of the demonstration, at the University of California, of a process that is to revolutionize the smelting industry. We are glad to be able to absolve the Messrs. Heslewood, and the experimenter, from any responsibility for these statements, but it is proper to suggest that it is most undesirable that the prestige of the University should be used by a private organization for commercial purposes. Further, the exploitation of technical processes through the columns of the *Morning Howl* or the *Evening Scream* is no less out of place, and largely serves to defeat its own ends. The tired business man, who derives at least a part of his weariness from the perusal of their columns, has no interest in technical details and naturally assumes that the matter is presented to him as a piece of half-baked fiction. Whether technical processes will work or not is determined by actual experiment, opinions on the question being of interest only to those engaged in the industry and familiar with its conditions. The most brilliant investigator cannot prophesy whether a process will work on an operating scale until it has been tried on that scale. Premature and exaggerated publicity only increases the embarrassment if the experiment prove unsuccessful.

Hope in Mexico

The President has announced that

"The government of the United States must presently do what it has not hitherto done or felt at liberty to do: lend its active moral support to some man or group of men, if such may be found, who can rally the suffering people of Mexico to their support in an effort to ignore, if they cannot unite, the warring factions of the country, return to the constitution of the republic, so long in abeyance, and set up a government at Mexico City which the Great Powers of the world can recognize and deal with, a government with whom the program of the revolution will be a business and not merely a platform."

This splendid statement marks the end of the policy of "watchful waiting." It forms part of a call to the leaders of faction and misrule in Mexico "to act promptly for the relief and the redemption of their prostrate country."

Some of our readers, weary of the ineffective diplomatic correspondence and the equally futile expedition to Vera Cruz, will say that these are brave words indeed, but they have only an academic value. We believe otherwise. Before making this latest move the President was well advised concerning the condition of affairs in Mexico, more particularly the relative strength of the rival leaders, and their ability or inability to govern. His latest emissary to Mexico, Mr. Duval West, of San Antonio, unlike his predecessors in the representation of the President, speaks the language of the country to which he went to make an investigation. He was able to get first-hand information, instead of sitting in the *patio* of a hotel while an interpreter told him what his informants wished to say. In short, we believe that Mr. Wilson has finally been placed in possession of the facts. Hence his latest *pronunciamento*.

The resignation of Mr. Bryan as Secretary of State may affect the position in Mexico, by promoting a more resolute policy at Washington. On his resignation becoming known across the border, the opinion was expressed that it forecasted a firmer attitude toward Mexican affairs. That also is our opinion.

Not 1% of the population is taking part in the desultory fighting. The battles are suitable for newspaper consumption, not much more. Reports concerning the issue of these guerrilla fights are contradictory, of course, because the results are inconclusive. The latest story is that Obregon has defeated Villa and Angeles near Leon. All that can be inferred from recent information is that the Carranza or Constitutionalist group has been getting a little the best of it, and that the Villa or Convention group of *revoltosos* has lost ground. It is more nearly certain that no party shows any signs of becoming ascendant and that meanwhile the country is being beggared to the point of famine. The Chamber of Deputies in session at the capital, under the Acting President, General Garcia, has been invaded not by Zapatistas or Carranzistas but by hordes of hungry men, women, and children shouting, "We want corn." That cry, more than the grandiose announcements of 'battles' lost or won, is the keynote to the Mexican position at this time. Garcia is reported to have told the convention delegates and the mob that the treasury was empty, that the fields had been laid waste by the contending revolutionaries, and that the only hope for the people was to lay down their arms and begin the tilling of the soil.

Thus the signs multiply that the inconclusive factional warfare is about played out. If at this juncture the President can inspire some of the native leaders, such as the "neutral party" of which we hear at La Paz, to make a sincere effort to unite all of the constructive men in the distracted country, something may be done to restore tranquility, and after that political stability. The wish may be father to our thought, but we confess to more hope for Mexico than at any time during the past two years.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment

Professors of Mining

The Editor:

Sir—In the last issue of the PRESS, in discussing the proper qualifications for a professorship of mining, you express a preference for the "trained teacher of the sciences applied to mining," and indicate that the selection of practical men for the purpose has not, on the whole, proved successful. In the absence of statistical information, I assume the latter part of your statement to be well founded—in fact, it appears quite plausible. A good practical man will always serve as a good example; but take him away from his practical work, and in the absence of special qualification, he is likely to prove a poor teacher.

Still the 'trained teacher,' without practical experience is far from being an ideal professor of any branch of industrial engineering. He lacks familiarity with the conditions which dictate the character of the work to be done, and for that reason has, as a rule, poor judgment in distinguishing between essentials and non-essentials; he is likely to be wanting in a due sense of proportion. The student's time is limited, and we cannot afford to have him waste much of it.

A chair of 'Mining,' from an ideal standpoint, is difficult to fill properly. As you say, "the scope of knowledge required is staggering." In a school of mines, if we should provide two chairs, the one of 'mining engineering,' the other of 'metallurgy,' the engineering chair would doubtless be the hardest to fill satisfactorily, for the scope is the more difficult to represent in the laboratory, and the character of instruction which it is feasible to give is less easily defined. One difficulty in teaching mining is due to the student's lack of familiarity with the conditions, and this cannot well be supplied in the class-room. At Freiberg we were required to spend six months in and around the mines before entering upon the academic work. We were shifted from job to job until we acquired some practical idea of the situation. Our American schools of mines are not as a rule so situated as to make this practicable, and our mines are not under the same governmental control. At Freiberg we were further expected at intervals during the periods of instruction to do special practical work at the mines and metallurgical establishments. After leaving the Academy, I was able to undertake either surveying or assaying, but in other respects I found myself ignorant of all useful work around the mines. Thus the Freiberg course was rather ideal in some respects, but far from perfect in others. As I now look back, the course in mining proper seems to have been very poor. In fact, while there are excellent courses in chemistry, mineralogy, geology, metallurgy, civil and mechanical engineering, I do not know of any college course in mining proper that amounts to much. There may be such, but I am not familiar with it.

The student should graduate with a good foundation in chemistry, mineralogy, geology, metallurgy (in a general way), and in the elements of civil and mechanical engineering, and for practical purpose he should have a fair facility in surveying and assaying. Without detriment to his work in these subjects, the professor of mining, no matter how well qualified, can do little more than give an outline of the main branches of engineering involved in mining, such as excavating, hoisting, pumping, timbering, etc.; for there is not time enough in the ordinary undergraduate course, and the student's mental digestion is already overtaxed. Lectures by experts may be well enough as matters of diversion, or as incentives to the more ambitious, but the average student will not be qualified to profit by them.

So far as my experience has taught me, I should rather see the graduate well founded in the fundamental engineering and chemical branches without much knowledge of practical mining, than to see the greater stress laid on the latter subject. The present undergraduate course in our university does not permit of much more than this in any event. Very few of our successful mining engineers knew much of actual mining before entering the field. The best service the professor in charge can render is to insist upon the fundamental work being thoroughly done. If post-graduate work were feasible on any considerable scale, which is doubted at the present time, a different view of such work might be taken.

As the matter now stands, it seems to me the professor of mining should be qualified by education and experience, not so much to give special instruction in mining proper, as to see that the students under his charge may get suitable instruction in the fundamental subjects; that their work may be so planned as to be specially thorough in the directions in which it is most likely to be useful in the future. This requires knowledge both practical and theoretical. The professor of an engineering college should be mature enough to have a practical grasp of his subject, and young enough to possess an enthusiastic desire to make his course a success. He should be, say, preferably between the ages of 35 and 45 years when selected. In a general way, it will be conceded that the personality of the teacher is always of special importance. He should

have the faculty of inciting both interest and effort.

The question arises, where are such men to be had? There are doubtless many such, the trouble is that they are likely to be ambitious in a practical way, and will not be attracted by the salary of a professor. The work will probably appeal more to those among the qualified who already have adequate means of living.

In conclusion, I must say I thoroughly agree with you in laying special stress upon the importance of the "sciences applied to mining," but I should not be satisfied with a trained teacher without practical experience.

Ross E. Browne.

Berkeley, June 1.

Speculation in Mines

The Editor:

Sir—In this letter I confine myself to precious-metal mines whose shares are listed on some stock exchange. My advice to people who have never speculated is identical with *Punch's* advice to those contemplating matrimony: Don't. And this same advice is given by most mining engineers of my acquaintance, including some who have made large fortunes by legitimate—and illegitimate—deals. The reason they thus advise is that not one man, or woman, in a hundred who speculates in mining shares ever makes a permanent profit; the shares are invariably quoted at least two or three times their intrinsic value, and hence, taking the whole list, there must be a loss to the speculators of fully 50% of all the money they put in.

The question naturally arises: if there is such a certainty of loss in the aggregate, why do people buy the shares? I answer this question by asking another: Why do people buy lottery tickets although the sale of them is illegal and there is an absolute certainty of loss for the whole group of buyers? Infants in arms know that the answer is that each individual buyer of a lottery ticket thinks he may win the big prize and every buyer of a mining share hopes for a Mohawk—where a 20c. share went to $20 within a year.

In addition to the over-valuation of shares, the buyer is confronted with market manipulation. Take the case cited by Dr. Ledoux, in your issue of May 15, where Rothschild paid his fee by purchasing Rio Tinto shares and selling them at a profit: Rothschild certainly had inside information and probably bought the shares for less than they were worth and sold them for more; that is, he acted on information not available to the ordinary shareholder. Sometimes this manipulation is carried much further; for example, a mine is paying a fair monthly profit, if the outlook for the future is good the dishonest management will probably work the lower-grade ore, do much dead work, lay in large stocks of supplies, and give unfavorable tips to the brokers, meanwhile selling blocks of shares. As a result of all this, down go the shares and the insiders load up. When the proper time comes the joyful news goes forth that the shares are marked for a rise, rich ore is worked, as few supplies as possible are bought, dead work is stopped, great profits are made, and the shares are valued on the basis of long-continued profits at the abnormally stimulated rate, and after a few months down go the shares again, *et cetera*.

Perhaps it is as well to state clearly that such manipulation of shares is not universal, nor does it follow that marked variation in the price of shares is evidence of manipulation. Often the public makes the price; I happen to know of a mine which was without any ore of consequence but had prospective value because it adjoined a mine that was in bonanza. The management of the bonanza mine withheld all information as to the position of the orebodies and after much blind prospecting the less fortunate owners decided to shut-down and wait developments. The surveyor of this mine, knowing that it was about to close, sold his shares at 40c. The next day the shares were 80c. and remained there for a long time. Some wise brokers decided that rich ore had been discovered and that the mine was shut-down so that the owners could buy the outstanding stock at a lower figure.

What is needed to stimulate interest in mining speculation is the discovery of another Cripple Creek, Goldfield, or Tonopah. In default of such discovery an annual official report by the Bureau of Mines on all mines that are listed in stock exchanges, with a valuation of the shares and discussion of future prospects, might lead to a healthy speculation and to investment of funds by those who now feel that while there are plenty of honestly managed mines there are also others whose dark ways are full of vain tricks.

W. H. Shockley.

Palo Alto, May 22.

Rise or Raise?

The Editor:

Sir—I would suggest that the question lately raised or risen in your discussion department with respect to the use of the word 'rise' is one of fact, and therefore capable of exact determination.

The problem may be stated thus:

Is the type of mine working under discussion ordinarily called a 'rise' by "authoritative writers" or is it not?

To determine the answer to this problem and to justify its position beyond possibility of further question, the editorial staff of your paper has simply to prepare a list, as complete as convenient, of examples of usage from technical literature, somewhat as follows:

Johnson, 'Theory and Practice of Surveying,' p. 399, uses upraise.

'Handbook of Mining Details,' p. 106, uses raise.

Storms, 'Methods of Mine-Timbering,' p. 40, uses raise.

International Text-Book Co.'s books use raise.

'Coal and Metal Miners Pocket Book,' p. 619, uses upraise—defines "rise workings" as generally descriptive of all workings "to the rise of" (that is, higher in the bed than) the shaft-station in coal mines, p. 606. A few

scattering papers in Trans A I M E use raise No complete search.

Technical periodical literature, including some articles in the *Mining and Scientific Press*, uses raise

The Encyclopedia Britannica, 11th Ed., Vol. XVII, p. 531, Fig 6, illustrates and describes such a working as a 'raise.'

The "vulgarisms of the careless educated or reckless illiterate" cited above are the result of a hasty survey of a meagre library, and given only as a suggestion as to method of attack. It was my intention to furnish a parallel column showing examples of the use of 'rise,' but as the resources at command unfortunately fail to show any such, I leave the task to abler hands.

Whatever the decision as to the name, I must confess to certain doubts of the propriety of describing the driving of a 'rise' as 'rising.' The verb 'to rise' connotes a certain spontaneity on the part of the thing rising, whereas painful memories of former experiences suggest that a 'rise' or 'raise' has to be raised.

H. N. Herrick.

Berkeley, Cal., May 12.

[Publications giving reliable information are not necessarily authorities on the use of words; the decision in such matters can be claimed only on behalf of those who show a special interest in the matter. We shall not discuss the question further, having decided to yield to the wishes, not the arguments, of our friends, as is explained in the editorial columns.—Editor.]

Dredging Costs

The Editor:

Sir—In the issue of your paper of February 13, 1915, an incomplete table of costs of dredging by the Oroville Dredging, Ltd., was published; in attempting to compare these costs with those of our company, I was unable to check the figures and finally had recourse to the annual statement of the Oroville company. As others may be in the same condition that I was, I beg leave to give the needed data, to complete the calculations.

Three boats were in operation during that year, but of these, one, the Exploration No. 2, was laid up and dismantled during the year, only working 5.66 months, thus we had a total of 29.66 months working-time on which to figure the yardage; namely 97,693 yd. per month.

The dredges Boston No. 4 and Exploration No. 4 are 7.5-cu. ft. boats, the Exploration No. 2 was a 5-cu. ft. boat. They are digging on the north side of the river, in stiff ground, and the record is no doubt a good one. The "costs" as given in the table are of course not the cost of the operation to the stockholders, but the cost of the work at Oroville, or strictly 'operating cost.' To them should be added the overhead charges, office salaries, etc., etc., to get the actual cost. These are given in the report, and bring the total up to 4.64c. per yard. This is after leaving out items amounting to $8645.45 for machine-shop losses and administration expenses, which, if added, bring the actual cost *to the stockholder* up to 4.94c. per yard.

An accurate comparison of these figures with those of our dredge is not possible owing to the different method of charging the materials. The Oroville statement calls for "labor and material"; we separate them into 'labor' and 'repairs and supplies,' charging into this latter account all materials whatever, labor covering the pay-rolls only, salaries being charged to 'general expenses.'

General expenses with us also covers all items such as bullion expenses, taxes, legal, automobile, and so forth.

Our dredge is a 3.75-cu. ft. boat, digging in 15-ft. ground, clean river wash; the record given is for the last two years of the life of this boat, being the end of a campaign of six years.

Oroville

Time covered by record	29.66 months
Total yards dug	2,897,557
Yards per month	97,693 per boat
Average depth	30.5 ft.
Average running time	20.38 hr. per day
Average running time	84.9%
Costs, material and labor	1.25c.
Electric power	0.75
Water	0.08
Repairs	1.06
Smelting and express	0.03
Taxes and insurance	0.21
General expense	0.66
	4.04c.
Add other costs as above	0.90
Total cost	4.94c.

Yosemite

Time covered by record	24 months
Total yards dug	2,079,717
Yards per month	86,655 per boat
Average depth	15.0 ft.
Average running time	20.90 hr. per day
Average running time	87.1%
Labor	1.256c.
Electric power	0.843
Clearing land and water	0.100
Repairs and supplies	1.02
General expense	1.12
Total cost	4.339c.

These costs are now comparable, being the actual cost to stockholders.

Conditions on the boats are in many respects similar, as in each case they are approaching the time when they would be dismantled; therefore the purchases for repairs and renewals would be kept down to a minimum; that this is the case is shown in the Oroville report, where the up-keep on Exploration No. 2 is much less than on the other boats; on our dredge the repairs were maintained on such material as we would move to a new hull, on others just enough was done to maintain efficiency, and that this efficiency *was* maintained the record of 86,665 yards per month for a 3.75-bucket boat speaks clearly. Of course, this condition only obtains during the last few months of the campaign!

The Oroville report gives some figures of general interest to the dredge-man, in the stated life of the wooden hulls on these boats, to wit, Exploration No. 2, nine years,

worn out and dismantled; Boston No. 4, built in May 1906, therefore now nine years old and digging; Exploration No. 3, built in October 1906, now eight years and seven months, and still digging. It would be interesting to have the data as to what, if any, preservatives were used on the timbers, and what, if any, methods of ventilating the compartments of these hulls were provided in their construction.

JAMES WILSON NEILL.

Snelling, California, May 19.

Experiments in Smelter-Fume Abatement

The Editor:

Sir—A recent outburst of newspaper appreciation has brought again the smelter-fume problem to the popular attention. For those who may forget that serious discovery seldom takes this form of first presentation it is not amiss to say that science has no startling discovery in the field of sulphur-fume abatement to lay before the public at the present time. For many years thoughtful and costly experiments have been conducted in different states and different countries to throw light on this general subject, and the work is still going on. The search for underlying principles, and the investigations to test the applicability of these, to efficient practice, are the successive steps by which progress is made. We must hail every earnest contribution and recognize its merit. Not less important is it to clear the field of the unproved notions that make advancement so devious.

At the University of California we are receiving inquiries as to the results of the operation of a certain experimental smelting-furnace in the laboratories of the Hearst Mining Building. The newspaper references to sundry simple facts may create an impression that the experiments, conducted there, will hardly justify. So many of the so-thought impossibilities of the past have been made the achievements of the present, there is little wonder that people have to be reminded, from time to time, of the sharp distinction there really is between hoped-for discovery and proved fact.

In the smelting industry there are no wants felt more keenly than those of a way to further employ oil-fuel, of a way to reclaim sulphur from sulphide ores, and of a way to obviate the production of sulphur fumes. The accomplishment of all these desired ends by one decisive invention is more than we would ask, and, I believe, is more than anybody will claim. We must look skeptically upon all innovations that run counter to accepted principles, and must question all claims as to new processes, on this order, that are unaccompanied with most convincing proof.

Every metallurgist knows that smelting under a reduced pressure in the blast-furnace, with suction rather than with a blast, will be always subject to a handicap. It is not an effort to be thought of, unless compensating gain is to be derived from some unexpected quarter. Every metallurgist knows that the use of oil or of gas, as fuel for smelting ore, in any sort of a shaft-furnace, will be attended with most serious mechanical difficulties. No possibility in metallurgy has been, perhaps, more fully investigated.

Nothing would be more pleasing, in our domestic industry, than to turn our offensive sulphur gases into a useful sulphur by-product. We know that this may be done someday, just as we knew that someday men could fly, like birds; but we need more knowledge of temperatures, of reactions, and of principles. And after further knowledge of these essentials is had, there will still be much to be done in adapting theoretical principles to profitable practice. We are not justified in applying our conclusions, obtained from small furnaces, to large-scale operation, except by careful degrees and by knowledge in great detail.

At the University of California, one of the students, A. B. Marquand, has recently studied some of the conditions in smelting sulphide ore, with a view to collecting the escaping sulphur, and on a scale somewhat larger than is commonly possible in research laboratories. In his work, Mr. Marquand has been aided by James Heslewood, and his son William, without whose assistance the work could not have been performed on the scale he desired.

The work led to a study of the action of steam and of oil in the roasting and smelting of sulphide ores. The recovery of a large part of the expelled sulphur, in the form of a sulphur product of a purity sufficient to justify its refining and utilization was a notable step in the direction of present-day needs. We shall look, in due time, for a publication by Mr. Marquand of some of his results. We desire, however, much more than has yet been accomplished, or than Mr. Marquand would thus far be able to publish.

Before we can accept the work, for adoption into large-scale practice, we shall ask for proof that he can utilize his fuel efficiently, that he can adapt his furnace to a scale that will admit of a practical output, that he can recover his sulphur with sufficient economy. It is something to have demonstrated what his furnace has actually shown. The difficulty will come in securing economy of operation.

E. A. HERSAM.

Berkeley, June 1.

LATERITE is essentially a mixture of ferric hydroxide, aluminum hydroxide, and free silica in varying proportions. Laterites differ from true clays in the absence of the aluminum silicate, kaolin, and the presence in its place of some aluminum hydrate. Laterites develop only in tropical and semi-tropical regions of heavy rainfall and only from basic rocks. The wide extent and great depth of lateritic deposits make their consideration of prime importance in the study of iron-rich residual deposits. Moreover, laterites represent a more complete decay of rocks and a greater removal of silica, than do ordinary clays. Therefore they must show a proportionate increase in the remaining constituents, and consequently, other factors remaining constant, a residual deposit richer in iron.

Technical Reminiscences—III

By ALBERT R. LEDOUX

One of the first and most important investigations which I was called upon to make was in 1883 in Mexico. An American company had acquired from the city of Pachuca the right to dredge the river running through the town; in fact it had obligated itself to dredge it to bedrock and keep it at a certain level, the only remuneration being that it should have the benefit of any valuable metal recovered in the operation. An English engineer by the name of Brown had brought alleged samples of the river-bed, which showed considerable value in silver and mercury. As is well known, the great *haciendas*, or reduction works, of the district are situated above the town on this stream. The tailing from their *patios* was washed into the stream until it had gradually filled, according to the engineer's report. Retaining-walls or levees had been built higher and higher on each side to prevent the water from overflowing the town. Without any further investigation, the Americans accepted Mr. Brown's report, entered into a contract and erected a plant to treat this tailing and save the amalgam and other metals. They proposed to dredge or pump the tailing from the stream, sluice it into their plant on the river-bank, and recover the metals by concentration. Someone had made tests and had recommended certain machines, and the experiments made on some tons of the material indicated a profit.

I was sent down to be present when the works were started and to report on the process, and incidentally because there seemed to be some friction between the heads of the local management. I was given a power of attorney with full authority over everybody. Upon my arrival, I quickly discovered that the friction arose because there were three heads to the enterprise: a Cornishman, an American, and an Irishman. One had entire charge of the expenditure of the funds; another had charge of the mill; while a third had control of the operations on the river. They were not on speaking terms, and the first thing I did was to call them into a room and say that I proposed to make one of them supreme; that I had made up my mind who it should be, but I wanted them all to agree in advance that they would accept orders from and work loyally under the man that I should select as head. Two of them agreed to this, while the third refused and handed in his resignation.

I might say here that I had planned to leave Pachuca on a certain day for El Chico to look at a mine there—a few hours over the range on horseback—but received a request to call on the *jefe politico*. This official asked me if I intended to go to El Chico. Upon being informed that such was the case, he advised me not to go, saying that some peons who were spending money freely in a saloon had told in the hearing of an agent of the police that they had been paid partly in advance to assassinate an American on a lonely trail to El Chico on a certain day. The *jefe politico* said he supposed I knew who had hired these peons, "a man I had put out of his job," and offered to give me a written permit to shoot him at sight! I found that my desire to visit El Chico had grown considerably less; nor did I wish to shoot the man indicated. I followed the custom of that day in carrying a 'gun,' which was a long Colt suspended from the hip on a belt-swivel. At the noon-hour next day, I showed some of the men working on the plant that I could make a fairly good shot from the hip, and asked them all to let me know where I could find the gentleman, as I understood he had hired men to assassinate me, and that I had authority to kill him on sight. A day or two afterward, the chief of police informed me that my friend had suddenly left town, going across the range to Tuxpan, whence he expected to sail. This man had the nerve to call at my office some six months afterward on the excuse that he wished to have an assay of a sample of ore. I told him that I still had a permit to shoot him at sight, and, although it might not be valid in New York, I was inclined to see, and made a reach for a drawer in which at that time I kept a pistol. He did not stand upon the order of his departure, and I have not heard of him since.

My visit to Pachuca was just before the rainy season began. The river-bed was dry except for a little trickling stream, and was lined with men and women making good wages by washing the sand for amalgam and concentrate. I had some misgivings as to the depth of the deposit, or as to whether the yield below would be found equal to the surface indications, so ordered a shaft to be sunk to bedrock. I found that the tailing which was the source of the revenue of the peons was only a foot or two deep. Below there was practically nothing but boulders, with occasional pockets of valuable sand, and I quickly saw that the company could not by any possibility make money under its contract to dredge the river to bedrock. I had noticed that while the peons were washing the gravel and some were working in the shaft, one of their number sat on the wall facing up stream. Suddenly about noon, he gave a peculiar cry. The men came scrambling up the ladder and joined him on the wall; the women fled from their diggings. In a minute, there came roaring down the cañon a flood of water several feet high, carrying boulders of considerable size, which made a horrible grinding sound as they passed. There had been a cloud-burst in the mountains, and after it passed, the sand and tailing had been absolutely washed away, leaving nothing but the formerly or recently deposited boulders to be seen. The peons, who had all fled to a place of safety, mourned that their occupation was gone until the end of the rainy season, when there would gradually be formed a new layer of tailing which it would pay to wash.

One of my most interesting mining trips was made at the request of Mr. James J. Hill, of the Great Northern Railroad, at the time when the line of the extension from Havre, then known as Fort Assiniboine, to the Pacific Coast was being located by his engineers. It was my duty to report upon the indications of mineral as a possible source of revenue from points relatively accessible to the road. Part of the time I was the guest of Mr. Hill in his car, and we drove into the Sweet Grass Hills region from Fort Assiniboine, some 80 miles, sleeping at an isolated ranch-house or improvised shelter. Somebody had been prospecting near the summit of one of the three peaks of the Sweet Grass Hills, and had found iron ore that yielded copper to assay at a depth of about 100 feet. Several had located on the outcrop, which seemed to be a vein rather than a bed, but they had been puzzled by the fact that the vein continually crossed their side-lines on the strike. I found it to be what might be called a picture formation, differing from anything I had seen before, or have seen since. The igneous rock, which I probably called 'porphyry' in those days, formed the body of the mountain. Near the top it had shoved its way through some old limestone bed, tilting the latter until it stood at a sharp angle, and changing it into as beautiful, white, finely crystallized marble as I have ever seen. This marble appeared to the eye quite like that of Carrara. It formed a ring or collar almost all the way around the top of the peak, and the copper formation had been deposited at the contact between the porphyry and the marble. There was considerable iron —enough to justify exploration some day—and some pockets of rich sulphides, although the average of copper at the bottom of the workings then exposed was very low.

I have only seen one other deposit at all similar: a bowl of marble lying on top of granite on the Mississippi river of Canada. Between the marble and the underlying granite was a limited deposit of chalcopyrite, neither extending into the granite nor into the marble.

Returning to the railroad near the vicinity of Fort Assiniboine at 2 a.m., down the grade from the direction of Benton came a freight-train, with two hot boxes blazing. The train stopped and the crew got busy with water-buckets, when Mr. Hill drove out of the darkness and called out: "What is the number of this train?" Someone answered (let us say) "No. 24." Mr. Hill, who in those days knew almost every man in his employ, called out: "I believe (let us say) Morris is the conductor of 24: Is he there?" A gruff voice answered, "Yes, I am here; who are you and what do you want?" Mr. Hill said, "I am curious to know whether there are any rules as to the speed of freight-trains on this line." The man replied, "I don't know what business it is of yours, but we are supposed to run 20 miles an hour if we have live-stock, and 12 otherwise." Mr. Hill said, "24 does not carry live-stock, does it?" The man replied, "No." Mr. Hill said, "One more question: How fast were you coming down that grade?" The man replied, "It is none of your damn business; who are you, anyway? But I do not mind saying that we were running 25 miles an hour." Mr. Hill said, "Morris, you were running 35 miles down that grade, which accounts for your hot boxes. You have shown that you know the rules of the road; take this train into Chinook and turn it over to so and so, and consider yourself discharged. I am Mr. Hill, the president of the road." Morris came forward with his mouth open and thrust a lantern into the buggy, with the exclamation, "My God, it's the old man!"

I could go on but for my limit, telling similar experiences, showing Mr. Hill's wonderful knowledge of all detail in connection with the railroad of which he was then president. One day we were side-tracked at a water-tank. The engine of a freight stopped near our car. Mr. Hill said: "Hello, that engine is No. 44. Let me see—I believe Jim Smith is the engineer." We got out of the car and Mr. Hill walked over to the engineer, who was oiling up, and said, "Hello, Jim. How is 44 working now? You had her in the shops week before last; I think it was to have a cylinder bored out, wasn't it? Is she all right now?" The man was perfectly astonished and evidently delighted, and afterward said to me: "What do you think of that? I was for ten years on the Blank railroad before I came to the Great Northern. Most of the time I did not know who was president, and I am sure that the president did not know of my existence; but here on the Great Northern, the old man not only knows my name, but has kept watch of old 44, and appreciates it if I treat her well. That's the kind of a man to work for!"

After leaving the railroad on that trip, I was sent into Kootenay Lake district to report on the resources of that region, including the old Blue Bell mine, which had been worked since the early days of the Hudson's Bay Company, and as to the prospects of the then recently discovered camps of Warm Springs, Sandon, and Kaslo. I had an adventure at Warm Springs, now known as Ainsworth, which was as exciting as any that I have experienced.

I had crossed the lake from the Blue Bell with the late Andrew B. Hendryx. A gale had sprung up making it impossible to return by row-boat, and we were obliged to spend the night in the camp. There was no such thing as a hotel, the town consisting of a few houses, several saloons, and a general store. The proprietor of the store offered us blankets and said that we could sleep on the floor. The clerk closed-up after we had lain down, carefully bolted the door, and retired to a little room that opened into the main store. Hendryx and I lay side by side. I had taken my pistol from my hip pocket and put it near my head—not because I expected to need it, but because it was uncomfortable to lie upon. I was awakened after midnight by a light shining in my eyes, and without raising my head, I saw a trap-door at our feet slowly rising, a hand holding a lantern, and a pair of shifty eyes staring at us. I made up my mind that someone intended to rob the store, but thought that he would desist upon seeing that it was occupied. Not so; the man turned the trap-door back carefully, motioned to another, and both came up. Be-

tween them they had a bag. Hiding the lantern beneath their coats, they tiptoed from shelf to shelf, selecting articles which they put into the bag, occasionally glancing in our direction. I had the uncomfortable feeling that it was my duty as a guest of the proprietor to prevent this robbery, but determined to wait until the men had started down the trap-door, when I could cover them easily and hold them while I called the clerk; and then occurred the most unexpected thing that could possibly be imagined. After they had filled their bag, instead of seeking exit the way they entered, or even going out the front door they went to the door of the room where the clerk was sleeping and kicked violently upon it. Hendryx sat bolt upright, as did I. I grasped my gun and awaited developments. The clerk came out and talked to the men and then let them out of the front door and locked it. In my agitation I said, "Do you know that these men have been robbing your store?" "Oh, no," he said, "they are a couple of boys from the Sky Line mine; they are all right. The boss sent them down with some money after a bill of goods. They gambled the money away tonight at a saloon, knew that my boss would not give them credit; that they must be back to work early in the morning; remembered that the trap-door was not usually locked, and so came in and helped themselves to the stock and have given me a memorandum of it. They are all right and will pay me on the first of the month."

I yield to the temptation to tell an interesting story which was told to me on that trip by a trapper, to whom I had given shelter at my camp-fire on Kootenay lake. He said that he had just been up in the Selkirks guiding a man named Roosevelt, who wanted to get a cinnamon or silver-tip grizzly—I had forgotten which—that they had gotten one and that he had just said goodbye to his employer, then Police Commissioner in New York, and was on his way back, but was storm-bound on the lake. He said: "That man Roosevelt is the bravest man I ever saw. He is very near-sighted and has a pocketful of different kinds of glasses. We were going up a narrow trail in the grizzly country, when I saw around the turn not very far ahead, a big bear shambling down. I dropped back and motioned to Roosevelt to look around the corner. He stepped slightly forward and saw the bear not over a couple of hundred feet away. The trail was narrow, on one side a cliff, on the other a ravine. Instead of putting up his gun immediately and shooting, Roosevelt groped around in his pocket until he found the pair of glasses that he wanted, unhurriedly removed the pair he wore, rubbed, put on and adjusted the others, and when the bear got within 50 feet of him, took deliberate aim and killed him." In picturesque language, the old guide said that any son of a gun who would take the time to change his glasses when a grizzly was loping down the trail within a few yards of him, was the bravest man he had ever seen.

I came out to the railroad from Kootenay in a light twin-screw steamboat, which tied up for the night at the Canadian custom-house north of Bonner's Ferry. The house was attractive, surrounded by a flower-garden. The Canadian customs official met the boat, accompanied by a pair of greyhounds and a charming wife. I suppose I should have mentioned the lady first. I had expected to occupy a corner of the cabin with my sleeping bag, but Mr. Dash most cordially invited me to be his guest for the night. They gave me a charming supper, and the lady, about ten o'clock, said that if I wished to retire, she would show me to their guest-room. I caught a queer expression on the face of my host; his wife, however, did not seem to notice it. I said that I was quite ready to retire, but that if it were in any way inconvenient, I could spend the night quite comfortably on the boat. When she protested that they had a spare room entirely at my disposal, I saw my host reach under the table with his foot, endeavoring to attract his wife's attention. He said, "I have made arrangements for Mr Ledoux to sleep in the office. There is a comfortable bed there, and he perhaps will feel more free to get up when he chooses—especially if the boat leaves early." I saw a puzzled expression on his wife's face but I chimed in with my host's idea and was escorted to the office. It contained a safe, a desk, and a sofa with blankets. When my host bade me good-night, he called my attention to a Winchester, leaning against the wall at the head of the sofa. I was soon asleep, but was awakened by a noise. It was a moonlight night and I distinctly saw the shadows of two men working at a window. I could hear them whispering, and then they tried the door. I called out to know who was there and heard retreating footsteps. The next morning, my host asked me if I had slept well. I told him 'Yes' but for this interruption. He then said I had done him a good turn by sleeping in his office; that they had been repeatedly robbed of money accumulated from customs receipts; that their opportunities for sending cash out of the country were infrequent; that he had $2000 in the safe that night and thought possibly some of the rough characters who had come up on the boat might try to break in, and that if they found the office occupied, they would go away, as indeed they did.

And now I must tell how I established my reputation in Colorado. I was under contract to examine a property in the San Juan, and received instructions when I arrived at Denver. The vendor's statement of earnings, and conditions at the mine and mill, made it seem to me that the price asked was extraordinarily low. The time under the option was drawing to a close, and my instructions were to examine the mine and telegraph my Eastern clients whether they should buy it or not. I sought to ascertain the reasons for selling, and was given the usual story of a quarrel between partners, or of the death of a partner—I have forgotten which. Proceeding to the mine, I found it had one of the typical fissure-veins of the region, strong, well-defined, and persistent. The mill-returns showed an excellent profit and the conditions of mining were satisfactory. Work was going on at several levels, but there was an adit at the bottom of the mountain that should have cut the vein a few hundred feet below the lowest working. The people interested tried to keep me out of the 'tunnel', on the ground

that it was caved and dangerous. However, I persisted and soon found what I took to be the reason for the willingness of the owners to sell. They had not caught the vein in this adit; nor had several cross-cuts encountered it. From the angles that I had taken above, I knew the vein should have crossed that adit, unless there was a change in the dip, of which there was no suggestion above; there was no indication of a fault observable. As I came out of this adit in the afternoon, I had a sort of 'hunch' that the dip might have become more flat, and if so, the vein would not be very far from the adit, but on the other side from the cross-cuts. I said to the shift-boss who was guiding me, if that were my mine, I should look "somewhere over there for that vein"—making a sweep with my hand in a general direction.

I determined to wait until morning before telegraphing my people to turn down the option, in view of the showing, and to go through once more. This time, even more strenuous objections were made to my entering the abandoned 'tunnel.' They said that I had seen it already and that there was nothing there. However, I again persisted, and shortly came upon indications of freshly broken rock, which had been piled up in the aperture that had been made. The foreman tried to make me believe that it was in that condition when I visited the mine the day before, but I knew better, and ordered some miners to be brought to tear down the wall. Much to my surprise, when the opening was made, I found that the vein had been encountered and cut through for some three or four feet within a yard or two of the adit. The ore looked as good as anywhere in the mine. I advised my clients to take up the option and found that I had made a great local reputation which, indeed, preceded me to Denver. I do not know how many people told me that the foreman had said that he would give anything to have the knowledge of that tenderfoot from New York, vowing that when I was in the adit the first time, I had pointed to a particular piece of rock that stuck out of the wall, and had said to him that "the vein is in *there*, Jim, not more than a yard;" that he had put a shift at work as soon as I had gone out, and they had found the vein. They had filled up the working in the hopes that I would not see it, for now nobody wanted to sell at the price of the option. It took several visits to Colorado before I could live down the reputation I had gained of being able to see through the country-rock. I actually had to refuse a half interest in one prospect, tendered in the confident belief that I was a clairvoyant.

A SERIES of laterites from India run 13.75, 23.41, 26.61, 34.37, 37.88, 47.27, 51.25, and 56.01% Fe_2O_3. The parent rock is not given. Two laterites from Surinam contain 55.94 and 62.08% ferric oxide. Merrill cites an Indian laterite with 55.5% Fe_2O_3. The parent rock is not given. Culver cites certain unpublished data furnished by W. J. Mead, of the University of Wisconsin, on the lateritic iron ores of Cuba. The original is a serpentine rock, the freshest of which contains 9.8% Fe_2O_3. Their formation from basic rocks is one reason for their high iron content.

China's Mineral Exhibit

The exhibit of China's mineral resources at the Panama-Pacific Exposition is very creditable, when it is remembered that the mining industry is as yet in the first stages of development. Most of the exhibits have been sent by the four or five companies that are exploiting mines on a large scale. The central feature is a large relief model, about 20 ft. square, of the surface plant of the Shui-kou-shan lead mine in Hunan. This is supplemented by topographic and geologic maps, sections of the underground workings and specimens serving to convey a clear idea of the most important metal mine in China, which, though only worked by modern methods for a few years, is producing 3000 tons of lead and zinc ore per month.

Next is the exhibit of the Han-Yeh-Ping Coal & Iron Co., showing sections of rails, I-beams and angles, track-bolts, and other railroad accessories, samples of the various grades of coal mined, and the excellent coke made from it, and also blocks of the iron ore. Numerous photographs show the equipment and methods of working of this interesting property, which was described in some detail in the MINING AND SCIENTIFIC PRESS of October 29, 1910. On the opposite side is the exhibit of the Kailan Mining Administration, into which the Chinese Engineering & Mining Corporation has now been merged. Photographs, samples of coal and coke, and of the various fireclay products made by this large and prosperous company are supplemented by a well-printed booklet distributed by the company. Near-by is the exhibit of the Chee Hsin Cement Co., a formerly affiliated and adjacent enterprise; as cement does not lend itself to display, the company has wisely featured the great variety of tiles for flooring that it produces. In a central glass case are two unusually fine nuggets of gold from northern Manchuria; leaning against the wall beyond are slabs of polished marble that are not likely long to hold the visitor's eye, but which nevertheless indicate the beginnings of profitable industry, for China is a densely populated country, and the materials of construction are likely to be a source of much profit if wisely exploited. The Kwang Tung Cement Works of Canton, started in 1906, exhibits several ornamental casks of cement, of which it produces 200,000 barrels per year. One of the most interesting features, and one likely to be overlooked, is a collection of 15 framed photographs of the property and equipment of the Pai-shui-ho Copper Mining Co. at Feng-hsien in Ssu-chuan. Small blast and reverberatory furnaces are shown, the making of copper from matte by the Japanese *mabuki* method, and the generating of power for the enterprise by large water-wheels, made of bamboo, and much resembling the tailing-wheel at the Calumet & Hecla mill. In various cases there are numerous specimens of the 300 useful minerals that are found in China. Single specimens are not usually of much interest, but in this case they serve to verify the truism that China is a country of great mineral resources.

Goldfield Re-visited—III

By T. A. RICKARD

Geological Notes—Postscript on Milling

In 1908 it was recognized that the big orebodies were in veins traversing dacite, or quartz andesite, which owes its porphyritic habit to phenocrysts of feldspar. The feldspar is labradorite, characterized in this district by alteration to alunite, forming a white clay, which is a factor both in the mining and the milling of the ore. Fortunately (thanks to the vacuum-filter) it has not hindered the milling as much as was at one time anticipated. The thickness of the dacite had not been determined in 1908. Beyond the central area it was known to be covered by andesite and on the bottom (380-ft.) level of the Combination mine, an appearance of andesite dipping 34° northeast had suggested an important change of rock in depth. At that time it was recognized that the lode-channel follows lines of silicification and alunitization. It seemed to me then that any confident expectation of continued persistence of rich ore in depth was not justified by the geologic structure of the district. The "andesite" uncovered under the dacite in the Combination workings is the rock now called 'latite.' This term was originated by F. L. Ransome; the word is derived from Latium, an Italian province; it is applied to effusive rocks intermediate between trachyte and andesite. As employed at Goldfield it represents the "earlier andesite" of the first report published by the Geological Survey. Dacite stands for the quartz-andesite group. It is named after the Roman gold-mining province of Dacia, now Transylvania. It is difficult to distinguish latite from dacite, especially where the rock is altered near lines of mineralization. Latite can be distinguished best by the streakiness of its groundmass, a distinction not available to the miner underground. The dacite is supposed to be intrusive into the latite, the upper portion of which has been eroded. In depth, the workings of the central area, largely identified with the Goldfield Consolidated property, follow the lode first through the dacite, then through the latite, and finally into alaskite and shale. Alaskite is another recent petrographic term. It was proposed by J. E. Spurr in 1900 to cover rocks consisting essentially of quartz and alkali feldspar, without regard to texture. Formerly the term 'aplite' would include such a rock. When I asked a superintendent what 'alaskite' was, he was at a loss to give a definition, so that when I suggested "a sort of bastard granite," he assented hastily. According to Spurr, it represents the last phase of magmatic differentiation. In the Jumbo Extension, at the 1017-ft. station, I saw a vein of alaskite zig-zagging through the shale. It is clearly intrusive into this underlying sedimentary formation, which ranges from a black shale to a 'short' limestone. Previously it was known from exposures on Columbia mountain, where it outcrops in a black band visible from the passing train. In 1908 I wrote of "a core of hard calcareous shale (of Cambrian age) flanked by alaskite and rhyolite." That 'rhyolite' was the 'latite' of a later nomenclature. The sequence thus observed on Columbia mountain is confirmed by the evidence obtained in the deeper mines.

At the Goldfield Consolidated office I was shown the model of the mine. This is most instructive. It indicates that of the many outcrops of quartz, only a few have proved to be the caps of orebodies. The best was the silicious comb on the Combination claim; two-thirds of its length was ore, say, 600 to 700 ft. The model shows clearly that three main lode-channels have been uncovered, namely, the Jumbo, Combination, and Mohawk. The Jumbo was ore-bearing down to 250 ft. only; it was

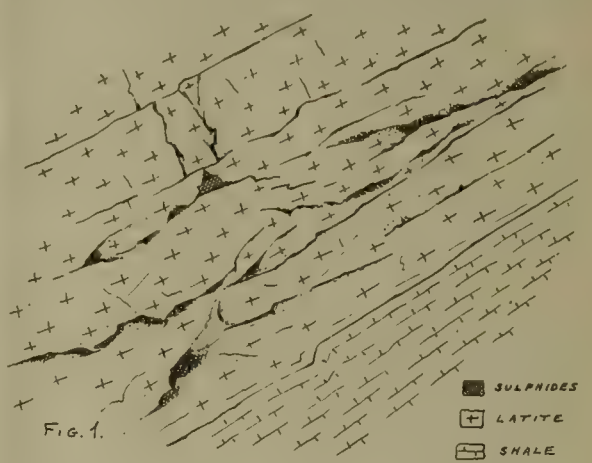


FIG. 1.

all in dacite, and did not reach the latite. The Combination ore reached down to 480 ft., that is, as far as the contact between the dacite and the latite. It was a nearly vertical vein; approaching the contact it flattened and then faded away. The Mohawk and Red Top orebodies are in a vein that dips at 40°, which is steeper than the contact between the two eruptives, but it follows their contact for 100 ft. on the dip and then penetrates the latite until the shale is reached, where the vein follows this lower contact also. The dacite is supposed to be intrusive into the latite, the upper portion of which has been eroded. The varying dips suggest a domical structure. The lower contact is the less regular, for the latite follows the irregularities of the eroded shale surface, the best ore being found where the vein is traversing the depressions in this old surface.

The deepest of the Consolidated company's shafts is the Grizzly Bear, which is down to 1400 ft. Water is being pumped out of the mine, through the Merger shaft, on adjoining property, at the rate of 220,000 gal. per dry.

Reviewing the story of the mine, it appears that ore is found in largest masses in the bends of the lode-channel where it traverses dacite. The distribution of ore is as irregular as the strike of the lode, which is no single vein, but a complex vein-system. The original boundaries of the fissuring are largely obliterated by silicification, so that 'walls' are rare, and delusive. Post-mineral faults are uncommon; only one extensive fault of this character, having a throw of 60 to 100 ft., is to be noted. The dip ranges from 30 to 45°, becoming almost horizontal in the Jumbo Extension workings where the vein reaches the shale.

The orebodies of the Combination were the most satisfactory, and they made the best showing at surface. They can be identified with the junction of the Reilly and Combination fissures, the ore extending from vein to vein. One of the rich Mohawk stopes struck 'wash' or drift 125 ft. from the surface, so that ore to that depth had probably been removed by erosion—a fortune thrown away, by Nature.

Going underground, I asked how ore was distinguished from rock. It is done by making numerous assays. The staff takes 1200 samples for assay daily. It is practically impossible to distinguish between rich ore and barren rock except in this way. Occasionally indications are noted, but they are unsafe guides. Dark streaks across the texture of the dacite and abundant alunite are mentioned as signs of richness, but the best is a line of brecciation, from one or two inches to a foot wide.

Just above the 600-ft. level of the Mohawk, I saw where the lode strikes the latite and flattens at the contact. Here a bulge of dacite into the latite terminates the orebody. Deeper the vein cuts through the latite; in this rock the orebodies, such as have been found, are rich but not so wide, although quite as long. The latite breaks cleanly but less readily, for it is finer textured than the porphyritic dacite.

On the 1000-ft. level, at a point 400 ft. west of the Grizzly Bear shaft, the visitor will see abundant green stains, indicating the presence of copper. However, much of the green discoloration seen in the mine is iron sulphate. Whether iron or copper, this sulphate is an important matter from the metallurgical standpoint. Not until the workings reached 930 ft. did the copper appear in quantity sufficient to interfere with cyanidation. The base ore is shipped to the smelters; it contains 2 oz. gold, 20 oz. silver, and 7% copper, as chalcocite and chalcopyrite. From 400 to 500 tons of such ore is being shipped from an orebody 150 ft. long and 15 ft. wide. This copper ore is characterized by the presence of famatinite, a sulph-antimonate of copper, allied to enargite, and named after an unhappy mine in the Argentine.

The lode finally strikes the shale and conforms to it, following the contact with the latite, although in places the fissuring extends into the shale itself. The rich ore is marked by needles of bismuthinite. However, plenty of bismuthinite has been found, for example, in the upper workings of the Jumbo Extension, without the accompaniment of rich ore. I saw the stoping of one of the rich veins; from 1 to 8 inches wide, averaging about 4 in., but requiring a stope 3 ft. wide, from the breaking of which the coarse waste is picked out, leaving ore assaying 2 oz. gold, 10 oz. silver, and 3% copper. A chalcocite impregnation as seen in the southeast end of the 1300-ft. level of the Grizzly Bear is shown in the accompanying sketch. Near the 1000-ft. station of the Claremont shaft, a piece of shale 10 ft. long and 3 or 4 ft. wide is seen enclosed by the latite.

These deeper workings yield patches of rich ore, but the showing is quite different from the bonanza zone nearer the surface. In the heart of the mine the orebodies were big and rich. For instance, a mass of quartz 2000 ft. long and 150 ft. wide was traversed by many veins, so that it was necessary to test it with numerous cross-cuts. One orebody yielding 60,000 tons was extracted from this mass of quartz, which reminds one of the silicious outcrops so prominent in the early days of the district before the surface had been either mined or covered with buildings.

The workings are hot, particularly the upper and older stopes, where the oxidation of the sulphides and the kaolinization of the feldspar is most pronounced. A temperature of 95 to 100°F. is reached, until free ventilation is established.

The structural geology of the shale is seen best in the Jumbo Extension, the mine that has been the subject of so much gossip, speculation, and litigation. It lies north, or on the dip, of the Goldfield Consolidated. The first ore of any consequence to the Jumbo Ex. (as it is usually known) was struck by lessees on the 790-ft. level, but it was patchy. They cut it again at 860 ft., but it was small, so they sunk the shaft to 1017 ft. and drove a level eastward, but not nearly far enough, so they failed to intersect it on the dip. Before stopping their search for the orebody, they drove a cross-cut southward to the Claremont line, thinking to cut some ore supposed to be coming down in that direction. They failed to find anything and 'quit.' The lessees having ceased to work, E. S. Van Dyke took charge for the company and extended the east drift on the 1017-ft. level, but he was unable to finish the exploration owing to a change of control, which passed to Charles S. Sprague. Under his general management, J. K. Turner, as engineer, and L. L. Dillinger, as foreman, ran the east drift 150 ft. beyond the point where the lessees had stopped it and started a raise (called Raise A) that penetrated good ore at 80 ft. above the level and 460 ft. east of the shaft. They then made other raises and subsequently extended the level itself to the present face, 950 ft. east of the shaft.

This, of course, was intelligent mining. It was based on a proper observation of the dip of the ore, which here lies at a flat angle. On the other hand, the work done by the lessees illustrates how some miners will ignore the aid of the surveyor and grope underground hopelessly, disdaining the aid of technical science.

The 1017-ft. level is in shale, for the most part, but

for some length it is underlain by a silicious rock that may be either alaskite or quartzite, probably the former. The drift had not yet reached the ore on its dip, although the face seemed to be on the edge of the latite-shale contact at the time of my visit. In this mine the lode can be seen in the latite, on the contact, and within the shale. The last phase is shown where the old shale surface rises, as a hump, into the overlying latite. Along a given cross-section the lode becomes duplicated, the lower part following the contact while the upper, 16 to 20 ft. away, penetrates the latite. Ore has been found in shale 75 ft.

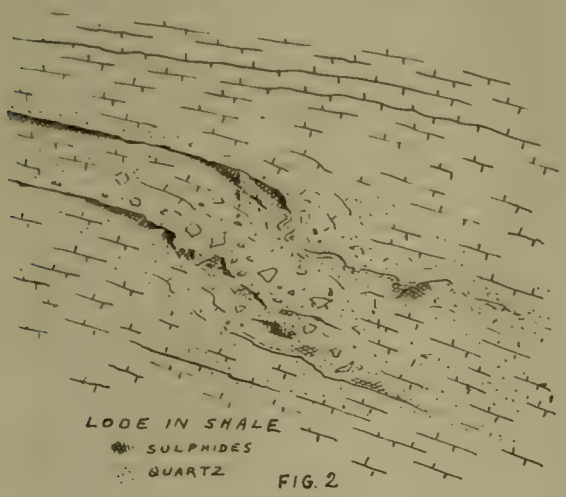


FIG. 2

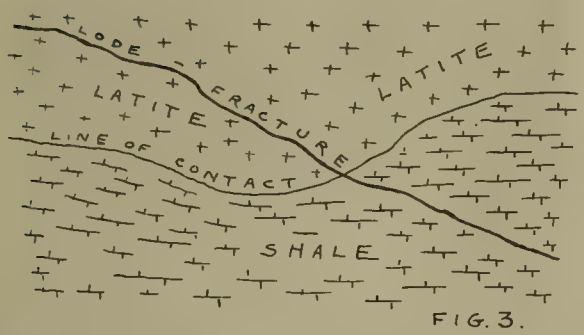


FIG. 3.

below the contact. How far it will extend into the basal formation can only be determined by further mining.

These deeper developments are exceedingly interesting. What they presage, I do not know. The evidence does not suffice to indicate the prospects of deeper mining. In most cases, in other districts, the passage of a vein-fissure from an eruptive to a sedimentary rock is not favorable. On the other hand, the lime-shale is a relatively soluble rock and as such affords a matrix suggesting the possibility of finding large replacement deposits of ore. Such orebodies as have been found are rich, although small when compared with those stoped in the dacite. When the existing complex of cross-purpose and litigation has been disentangled, we may expect to see a vigorous campaign of deepening exploration in several mines, notably the Jumbo Extension, Merger Mines, and Atlanta. The evidence to date indicates that such exploratory work is likely to be fairly productive.

Postscript. In regard to my notes on the milling methods, given in the second article of this series, I would like to add that Mr. Bosqui, in his original scheme of treatment, did not contemplate the local reduction of the concentrate. This was evolved by Mr. Hutchinson after Mr. Bosqui's retirement and departure to South Africa. The supplementary cost therefore was not included in the estimate of $2.50 per ton. However, since 1912 the tailing-loss from the treatment of concentrate has been included in the mill-tailing. The total cost of milling, including the treatment of concentrate, was $1.88 during the year 1914. Excluding the cost of treating concentrate, the milling was done for $1.606 per ton. For the first five months of the current year, the combined cost has been $1.70, and the milling alone (excluding treatment of concentrate) $1.40 only per ton.

My reference to the prospective exhaustion of the ore reserves in the Goldfield Consolidated mines has, it appears, been taken too literally. The latest official report gives the reserve at 142,000 tons, and I have no reason to doubt the correctness of this estimate, made by such an engineer as Albert Burch, general manager up to the end of 1914. Moreover, the accumulation of tailing, now available for re-treatment, amounts to 2,000,000 tons, as stated in my second article.

As regards the tangle of conflicting interests and apex litigation, it is pleasant to record that during the past month much of the confusion has been cleared by a reasonable give-and-take on both sides of the chief controversy. This has been chronicled in our editorial columns. As far as can be learned at the time of writing, a further pacification is on foot, involving the purchase of Claude Smith's interest in the Merger Mines by Messrs. Wingfield and Erickson, who appear to have buried the hatchet.

The Motor-Truck at Tonopah

The ore from the West End mine, at Tonopah, is hauled to the old Midway mill, recently remodeled, in Pierce-Arrow motor-trucks. This method has been found economical. It is a suggestion of the 'jitney' in mining, and is of practical interest. By courtesy of the manager, John W. Chandler, we are enabled to give the details:

The distance is half a mile, or one mile for the round trip, loaded with 5 tons of ore per car going and empty returning. The truck itself, when empty, weighs 8750 lb. The road is of ordinary macadam, having an average grade of 5% and a maximum of 8½%. The truck makes 28 trips per day, requiring 15 minutes for each trip. Only 1 minute is consumed in loading. The consumption of distillate is ⅓ gal. per mile; and the consumption of oil, 1 pint per day. The driver is paid $5 and the helper $4 per shift of 8 hours. The cost of repairs is $75 per month, and the cost of hauling $450 to $500. Thus the cost of hauling is 55 cents per trip and 12½ cents per ton. Distillate costs 15 cents and oil 65 cents per gallon. The expense for tires is 6 cents per mile. Hard rubber tires are used.

Advancement of Mining in Colorado

By GEORGE J. BANCROFT

When the question is asked what advancement has been made in mining in Colorado within the month, the minds of both questioner and questionee turn unconsciously to discoveries of profitable ore. This mental attitude is no doubt due to the fact that the daily press seldom speaks of any other feature of the mining industry. It is like painting one spoke of a wheel a brilliant red and leaving all the others a sombre black. The eye unconsciously follows the red spoke, in spite of the fact that every spoke in the wheel is of equal importance.

In my opinion the most important advance in mining now being effected in Colorado is of a psychological nature. It is an intangible 'something' that has possessed the minds of our mining men. It might be called the 'Get together spirit.' Never before in the history of the state have conditions been more ripe for serious litigation than they are today, but instead of litigation we are having consolidations and compromises.

During the past few months many important discoveries have been made at extreme depth. These discoveries are the logical result of the deep shafts and long tunnels, which during recent years have gradually been forced into the depths of the earth. For a time the results of these many great endeavors seemed relatively negative. Of late, however, the insiduous prying of the prospector's pick has revealed many important orebodies.

As discovery after discovery was announced, the knowing ones began to look up the question of apices. With mining claims 50 to 300 ft. wide and discoveries being made in virgin ground 1500 to 2000 ft. from the surface, one can see at a glance the possibilities for serious apex quarrels. Celebrated mining attorneys and expert witnesses began to wear the expectant look that a horse assumes when the lock to the oats-bin is rattled. I want to say, in passing, however, that these same celebrated attorneys and experts have caught the psychological infection and have worked hard to bring about compromises and consolidations, the consummations of which eliminated the possibility of drawing down big fees for litigation.

This new-born disposition to get together and avoid fights, seems to me one of the most important steps that we, in Colorado, have taken in recent years. It is not, exclusively, a feature of the past month, or the past few months, but of late we have seen several pronounced manifestations of this spirit, as, for instance, in the consolidation of the Vindicator and Golden Cycle, the consolidation of the Portland and Stratton's Independence, and the Carbonate Queen consolidation. Many other deals have been made in a quiet way and many more important ones are nearing consummation. The fact that there have been so few important mining lawsuits in the last year is the best proof of this mental change.

Opportunities were never more prolific for the locking of legal horns. Consider, for instance, the recent discoveries in the long adits in Clear Creek county. Many of these discoveries are from 1500 to 2000 ft. from the outcrops as measured on the dip of the veins. The older claims in that county are only 50 ft. wide. Most of the rest are 150 ft. wide. The vein systems are complex. A better condition for serious litigation could not be imagined, but, thus far, a spirit of fair-minded friendliness has so pervaded the atmosphere that many of the biggest wrinkles have already been ironed out and others are gradually yielding to the same process of smoothing.

The same atmosphere pervades Cripple Creek. It is reported that E. E. Chase has recently effected the settlement of a ticklish situation between the Stratton Estate and one of its neighbors. A. E. Carlton used to

MAP OF COLORADO, SHOWING PRINCIPAL MINING AREAS.

be noted for his activity and success in mining litigation, nowadays he is bending his powerful energies to eliminate such fights. He was the moving spirit in the Vindicator-Golden Cycle consolidation, and he is said to have made material progress on a consolidation that will settle for all time a dozen impending conflicts.

In Leadville the same spirit prevails, as evidenced by the owners of the Down Town mines getting together on a pumping project. In the San Juan the stronger companies have been buying up neighboring ground, particularly where apex questions were threatened.

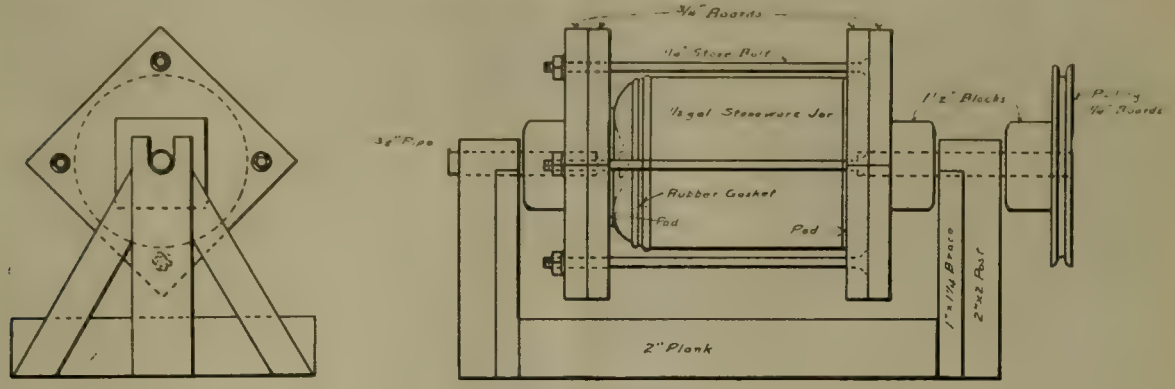
The discovery of a new ore-shoot, which may or may not produce a few tens of thousands of dollars, is heralded abroad through the land. The discovery that we can get along with a very small fraction of the litigation that formerly burdened the industry is worth many hundreds of thousands of dollars annually and is in my opinion one of the most important discoveries made in Colorado in recent times.

[Mr. Bancroft will henceforth contribute a monthly review of mining affairs in Colorado.—EDITOR.]

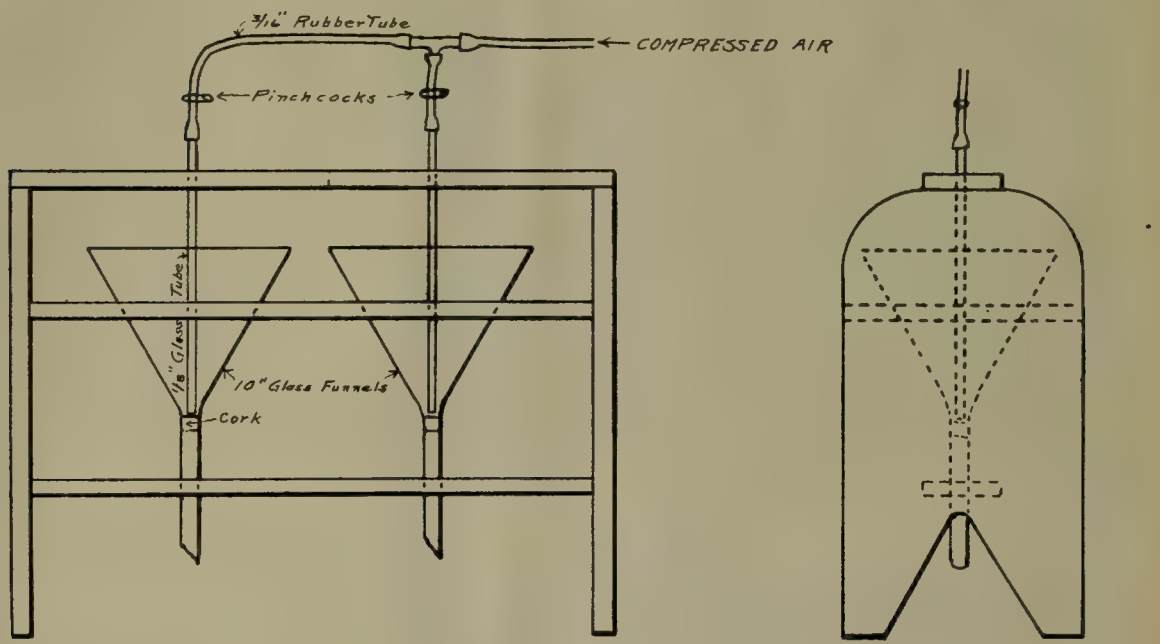
Home-Made Apparatus for Cyanide-Tests

By HORACE F. LUNT

The necessity for making cyanide tests often arises in places where there is no regular apparatus available for the purpose and where the amount of testing to be done does not warrant the expenditure necessary to purchase it. The apparatus described below was made and successfully used in such a case in making tests on 10 assay-ton lots of ore.



LABORATORY TUBE-MILL.

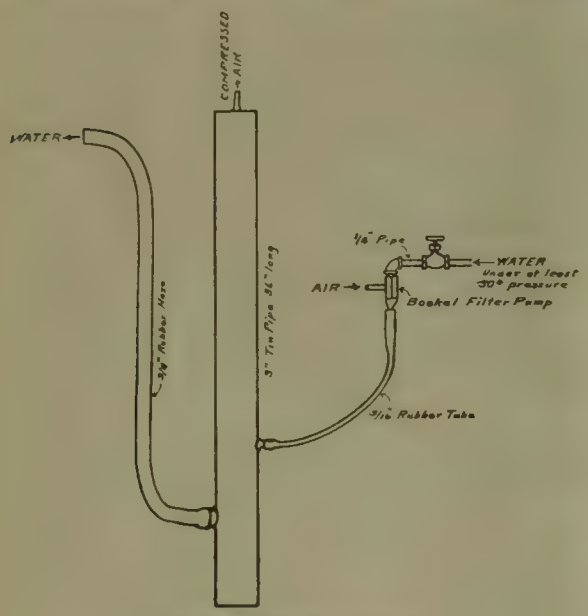


LABORATORY AGITATION-VATS.

The tube-mill is a half-gallon stoneware jar, commonly known as a 'butter-crock,' fitted into a revolving frame. The ends of the frame are made of two ¾-inch boards, nailed together, with the grain of one running at right angles to that of the other, to give stiffness and prevent warping. Quarter-inch stove-bolts clamp the jar into the frame and hold the cover on the jar. Rubber or cloth pads between the jar and the frame prevent unequal strains that might crack the jar. Blocks about 1½ in. thick nailed to the outside of the ends help to hold firmly the trunnions which are made of ⅜ in. pipe. The driving-pulley illustrated was made for round belting. It consists of three pieces of ¼-in. board nailed together and to a block. It is mounted on the end of one trunnion and serves as a base for the frame when taking it apart to remove the jar. The pulley should be fastened to the trunnion by a wooden screw passing through the block and into a hole in the pipe. The support is made of wood as shown. It should be fastened together with screws, as nails are apt to work loose. It is not heavy enough to hold itself in place when the mill is in operation, but must be nailed or screwed down.

The mill should be about half-full of pebbles 1½ to 2-in. diam. and should run at 50 to 55 r.p.m.

The construction of the air-compressor is clearly shown in the illustration. The vacuum-pump draws in air, which, with the water, enters the barrel of the compressor, where the air separates out from the water and is drawn off under pressure. The water-outlet should be lower than the top of the barrel and of ample size, so that there will be no danger of forcing water through the compressed-air outlet. Such a compressor of the



LABORATORY AIR-COMPRESSOR.

size shown will furnish sufficient air for two agitation-vats, as described below.

The agitation-vats are 10-in. glass funnels, corked at the upper end of the stems. Compressed air is introduced just above the corks by small glass tubes, as shown. The tubes can be moved in the board that supports them and the board itself can be removed when it is desired to take the funnels from the frame. The shape of the funnel, and the fact that it is transparent, makes it an ideal vessel for agitation tests.

A vacuum-filter can be made by tying a piece of filter-cloth over the top of a glass funnel, making it air-tight with paraffin, and attaching a rubber tube from the vacuum-pump to the stem.

OPERATIONS at the San Francisco Mint in May were as follows: gold received, 363,778 oz. fine, and silver 73,171 oz. The metals were worth $7,556,546. Coinage executed was valued at $175,950, including $4000 gold dollars and $6000 silver half dollars at the Exposition plant. Coin, bullion, etc., on hand at the end of the month was worth $285,149,236.61. The Mint at the Exposition contains a melting-furnace, rolls, annealing-furnace, minting-machine, scales, samples of gold and silver bars, and currency.

Cornish Mining

By W. J. LORING

The photographs shown herewith were taken some time ago by me, while on a visit to the county of Cornwall. No. 1 and 3 show in considerable detail a 16-stamp mill, operating on a very low-grade tin deposit.

No. 2 shows the old Cornish method of saving slimed tin at the East Pool Agar, which is situated between Redruth and Camborne, or more properly speaking, at the town of Carn Brea. This method has since been replaced by more modern concentrating plant, with a material improvement in extraction as well as in cost of operation.

No. 1 and 3 illustrate the 16-head mill with its old Cornish square wooden stamp, shod with cast-iron wearing members. These mills are fast being replaced by more modern methods for crushing.

No. 3 shows the method of operation, which consists of a 20-ft. overshot water-wheel, mounted on the cam-shaft. The cam-shaft is made of hollow sections of cast-iron, bolted together by means of flanges, and is about 20 inches in diameter. There are bearings at each end of this shaft, but in some mills bearings are more frequent. In this case it will be noted that 16 stamps are working between bearings.

The cams are forged iron let into holes cast in the cam-shaft. Each stamp has from four to six cams or lifters, which are set opposite the stamp to be lifted. The tappets are forged iron with a square hole that fits the stem one way while it is slightly larger the other way, it is fastened to the stem by means of a wedge, or key-driven between the stem and tappet opposite the cam-shaft.

The mortar-boxes are without bottoms, but are provided with means for changing screens in rather a modern fashion. The bottomless mortars are bedded in earth or gravel while the ore to be crushed forms the bottom. Therefore the only wearing members are the cast-iron heads or shoes, which are about 7 by 10 to 12 in. fastened to the wooden stem. When a wearing-block is worn out it is replaced, but it can never be worn out in the same sense as is the modern stamp-shoe, as will be readily understood, hence the great waste of scrap-iron as compared with the modern stamp.

The mill under consideration was running at about 23 drops per minute and crushing about ¾ of a ton per 24 hours at the time of my visit.

It may be understood that for a concentrating ore carrying tin, which is very heavy as well as very soft, much more so in fact than the gangue, this method would create a considerable amount of slimed tin.

The ore being treated at the time of my visit was said to return 3 lb. black tin per ton. Tin concentrate in Cornwall may be estimated at about 68% metallic tin.

Tin at £160, or $800, per long ton would be worth 19 pence, or 38 cents, per pound of tin. The recovery in this case was therefore 2.04 lb. tin per ton, say, 21 lb. at 38c. = 76c. per ton.

I was informed that a good living was earned by the

owners, who were all working miners, as a result of these operations.

The above is certainly a record, all things considered, for the equipment is of the crudest possible sort.

No. 2 shows the method of recovering slimed tin. This has been replaced, as I have said, by a more up-to-date method. The method shown here consists of tables of dressed wood, with the grain across the table. The tables are in series, each about 7 by 8 ft., set at a grade of $\frac{1}{2}$ to $\frac{3}{4}$ in. per foot. They are operated in the same way as the Gates and other canvas slime-strakes in California. Girls are usually employed at this work, one being shown in the picture.

Many improvements have been made at this mine since Bewick, Moreing & Co. reconstructed the company three years ago, with the result that the extraction has been increased 11%, while the total cost of operation has been reduced from 24s. to 17s. per ton. A vigorous development policy has been established, while salaries have been increased. Additions to staff, such as assayers and samplers have been made, accounting for 4s. per ton; still the total cost is only 17s. per ton.

By using the old method the cost would be at the rate of 13s. per ton, but this would be impracticable. By adding 4s. per ton by means of added staff, and more up-to-date methods, an actual saving of 7s. per ton has been made. This is a fair argument in favor of, not only up-to-date methods, but fair pay for fair services rendered, and proves the theory that low wages are not always the most economical at the end of the month.

SUPERSTITIONS and deep-rooted ideas are alike tenacious and require both time and effort for their effacement. The calling of the coal miner has long been regarded as being inherently dangerous and requiring a certain amount of recklessness and bravado. The man who would not, on occasion at least, take a chance was not a good miner. And this idea has prevailed since mining began. The movement for greater security to life and limb, therefore, is one which has to combat, not only existing physical conditions, but all the precedent, precept, and prejudice of the past. It is no wonder, then, that progress is slow, and that it often appears, even to the most sanguine, that a point has or soon will be reached beyond which material headway cannot reasonably be made. This is, however, only a feeling common to all movements toward betterment. An 80-ton locomotive was once considered as being about the largest that would ever be commercially successful. Just as the difficulties in the way of heavier rolling stock on the railroads lay not so much in the materials employed as in the preconceived ideas of the builders, so the barriers to greater safety in mining lie in the mental attitude of those concerned rather than in existing conditions.—*Frank H. Knowland.*

PICTURES OF CORNISH MINING.

The Shui-Kou-Shan Mine in Hunan, China

By H. Y. LIANG

INTRODUCTORY. The Shui-kou-shan mining district is in the Changlin prefecture of the province of Hunan, about 46 miles south from Hung-chou-fu, on the south or left bank of the Hsiang river, at an altitude of 1600 ft. above sea-level. The Hsiang river is navigable throughout the year, either by steamers of shallow draft, or by native junks, to lake Tung-ting, which has an outlet to the Yangtse river. There is a narrow-gauge railroad connecting the mine with the river-bank. When the Canton-Hankow railway is completed this mine will have direct railway connection with both those cities.

The Shui-kou-shan mine has been worked continuously for the past 200 years by the primitive methods practised by the natives of the district. On account of the crude methods and equipment employed, the mines were never worked to any great depth, and until recently there has been no extensive development.

In 1896 the governor of the province, Cheng Pao-chung, heard of the richness of this deposit and appointed Mr. Liau as the first director of the mine. At the same time Government funds were set aside for developing the mine. Mr. Liau being only a scholar, was not able to make a success at mining because of his lack of mining knowledge and experience. It was found necessary to employ local miners who had some practical experience. They sank another shaft at a place called Hsi-chiu-chang, and fortunately succeeded in striking the orebody at a depth of about 300 ft. As the shaft increased in depth, considerable difficulty was found in hoisting ore to the surface. In 1905 T. P. Sha was appointed mining engineer, and sank an inclined shaft on the south side of Hsi-chiu-chang. He also built a hoisting-plant and a pumping-station. The maximum capacity of this hoisting-plant is 200 tons per day. A sorting-house, an ore-dressing plant, and a narrow-gauge railway were soon built. At present a second vertical shaft and a new ore-dressing plant are under construction. The new plant will be completed within two years, and the total output of the mine will then be doubled.

The mine is at 26°40′ north latitude and 112°40′ east longitude. The climate is mild, the maximum temperature in summer being 104°F. and the minimum during winter 40°F. Under these conditions work can be carried on almost throughout the year.

GEOLOGY. The rocks of the Shui-kou-shan district are granite and limestone, the ore occurring near the contact. The granite is much altered by weathering. The rocks have been so metamorphosed by the mineralizing agencies which produced the ore deposits that but few of their original characteristics are distinguishable.

The granite is traversed by joints and shear-planes, which are easily seen in fresh exposures, and which form characteristic fissure-systems. The orebody is deposited as a linked vein parallel with the joints. The ore has been extracted for a length of about 1000 ft. along the strike from the southeast to northwest dipping to the northeast 80°. The characteristic fossils found are trilobites, corals, starfish, graptolites, etc. The geological horizons are Silurian and Devonian.

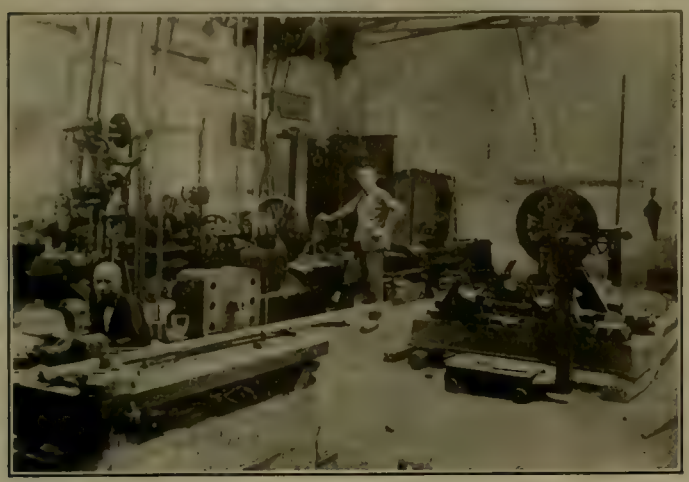
The ore is a mixture of galena, zinc-blende, and pyrite, and the gangue minerals are calcite, granite, with some dolomite. As it comes from the shaft the ore has the following average analysis:

Shaft.	Lead, %	Zinc, %	Silver, oz.
No. 1	33.90	29.40	21.2
No. 2	19.10	29.40	18.0
No. 3	23.40	23.70	18.0

PART OF HUNAN PROVINCE.

DEVELOPMENT. There are now two shafts in operation: one, called Hsi-chiu-chang, is only worked by native methods and is about 600 ft. deep: the other is an inclined shaft with a slope-length of about 800 ft., at an angle of 51°. It just reaches the third level. The size of this shaft inside the framing is 9 by 10½ ft., and the head-frame is built of 10-in. pine timber. A 50-hp. hoisting-engine has been erected at the mouth of the shaft and there is a vertical winze from the third to the fourth level with a 15-hp. hoisting-engine installed underground. The depth of the winze is about 150 ft. The length of the

drifts in the present workings varies from 600 to 900 ft. and the ore developed amounts to about 200,000 tons. The width of the orebody is 45 to 60 ft. Another vertical shaft has been started to the west, and has reached a depth of 100 ft. This will be continued until the orebody is reached at a depth of 600 ft. The size of this shaft is 9 by 15 ft. and it is divided into three compartments. The head-frame is made of 10 by 12-in. Oregon pine.



THE MACHINE SHOP.

In developing the mine practically no timbering was required in the drifts and crosscuts. In the orebodies, after putting in stulls over the drifts and placing chutes at proper intervals, stoping was continued without timbering, only enough ore being drawn to allow room for stoping operations. Therefore in the most productive part of the mine there is at all times a large tonnage of broken ore in the stopes. Square sets are used only where it is necessary, the excavations being filled with waste as the stoping progresses. The stoping method used is practically a combination of under-hand stoping and filling. As the depth of the mine increases, a large amount of water has to be handled. There are three pumping-stations underground and ten pumps have so far been installed. Power is furnished by six boilers having a capacity of 600 hp., which furnish steam for hoisting-plant, compressed-air plant, pumps, and electric-lighting equipment. Rock-drills as well as hand-drills are used. Oil lamps are used instead of electric lights in some parts of the workings. Ventilation underground is entirely by natural draught.

MILLING. The ore from the mine is separated by two methods: by hand, and in the ore-dressing plant. The hand-method is the native way of working, it is as follows: First the lumps of galena and zinc-blende are separated by workmen and broken by hammers. Then the smaller particles of galena, zinc-blende, and pyrite are separated by panning. This is done in round wooden barrels with bamboo sieves. The barrel is filled with water and the sieve, placed therein, is filled with ore, which is worked by two hands with a circular motion. The particles of galena and zinc-blende are thus separated quite thoroughly and the result attained by this process is nearly the same as with the ore-dressing plant. However, the hand-process is very slow, so an ore-dressing plant had to be built in order to take care of the increasing output of the mine. The treatment is as follows. The ore from the mine is screened in a trommel with 2½-in. holes, the over-size is crushed and the combined under-size and crushed over-size then passes over a picking belt, on which coarse clean ore and waste are picked out. The ore then passes to trommels which grade it into sizes that go to their corresponding jigs. The jig tailing goes to waste, but the middling is re-crushed by rolls, screened, and sent to the fine jigs. The tailing of these goes to waste, the middling is sent over Wilfley tables, which make concentrate and a tailing which goes to waste. No attempt has yet been made to recover lead and zinc lost in the coarse tailing.

As has been stated already, the final products obtained by hand-concentration and the ore-dressing plant are much alike. Their average analysis is shown in the table below.

JIGS IN CONCENTRATOR.

	Lead, %	Zinc, %	Silver, oz.
Coarse lead ore: (1)	73.3	4.7	29.8
(2)	58.3	11.4	22.5
Coarse zinc ore	2.3	53.4	3.8
Fine lead ore	74.8	6.6	24.4
Fine zinc ore	4.7	36.2	3.8

These five products are made by the native method.

	Lead, %	Zinc, %	Silver, oz.
Fine lead ore	73.3	7.7	29.5
Fine zinc ore	10.4	30.5	5.1

ORGANIZATION. The officers of the mine are organized

into two distinct departments and each department has its own building. One department goes by the name of the Head Office and the other is called the General Mining Office. The Head Office is divided into three departments: transportation, supplies, and miscellaneous. The General Mining Office is divided into five departments, including prospecting, mining, ore-dressing, assaying, surveying, and machinery. Each department has its own staff of officials with its own head in charge.

PRODUCTION. It is not worth while to attempt to estimate the output in the early days of the mine, but since 1905, when the hoisting-engine was erected, records have been kept and the output is given in the table below. As the rock-drills are just now coming into use a great increase in the output may be expected in the next few years.

	Galena. Tons.	Zinc-blende. Tons.	Sulphur. Tons.
1896	503	678	105
1897	807	1,832	155
1898	1,882	1,888	200
1899	3,036	4,571	104
1900	2,791	5,822	205
1901	2,260	4,806	216
1902	3,627	5,721	252
1903	3,690	5,307	85
1904	2,342	5,558	58
1905	2,079	5,187	59
1906	1,792	6,662	47
1907	1,973	10,011	34
1908	2,910	8,134	39
1909	3,088	8,483	83
1910	2,553	7,787	44
1911	4,035	9,798	97
1912	2,987	9,444	339
1913	3,164	10,319	182
1914	7,625	22,875	None
Total	53,164	134,875	2,304

LABOR. The total number of workmen is about 5000, most of whom are from the surrounding district. The scale of pay varies greatly, the highest being for underground work. The following table gives the rates of pay:

	Rate per day.		Rate per day.
Drillers	₱0.24	Bricklayers, No. 3 grade	₱0.16
Pump attendants	0.14	Painters	0.16
Common laborers	0.14	Machinists, No. 1 grade	1.50
Carpenters, No. 1 grade	0.24	" No. 2 "	1.20
" No. 2 "	0.20	" No. 3 "	0.90
" No. 3 "	0.16	" No. 4 "	0.60
Bamboo workers	0.16	" No. 5 "	0.30
Laborers	0.12	Ore-dressers, No. 1 grade	0.18
Bricklayers, No. 1 grade	0.20	" " No. 2 "	0.16
" No. 2 "	0.18	" " No. 3 "	0.14

The underground laborers work 8 hours per day, surface laborers work 10 hours per day.

TRANSPORTATION. From the mine the ore was transported formerly to Sung-pe (the bank of the Hsiang river) a distance of about 4⅔ miles by coolies at a cost of ₱1 per ton. In 1912 a single-track narrow-gauge railway was built, reducing the distance to 10 li or 3⅓ miles. The train makes 10 trips per day and has entirely displaced the coolies with all the attendant trouble. The distance by water from Sung-pe to Changsha is about 200 miles, and the ore is transported in native junks carrying cargoes of 20 to 120 tons each at a cost of about ₱1 per ton. In the spring and summer, when the river is high, transportation is very easy, the time being about four days; but in the autumn and winter, when the water is low there is great difficulty on account of the shallowness of the river. When the new developments are completed and the output increased, the mining company intends to build a number of shallow draught launches and transport as much ore as possible in the spring and summer.

GENERAL DATA. There formerly was in operation at Changsha a modern lead-smelting works, but for some reason or other it has ceased to work and the lead and zinc ore is at present sold abroad.

The police force was organized in 1912 and 70 policemen are now employed; formerly the protection of the mine was in the hands of soldiers. The police have also to undertake the work of sanitary inspection in order to safeguard the health of the people. The force is divided into groups of seven men each, under a petty officer, and the whole force is under the control of the Chief Officer of Police. They are drilled every other day for two hours and have one day in the lecture room under a trainer.

As machinists are the most important workmen, a mechanical training school was opened in 1912. There are 40 students, who are trained under a practical mechanical engineer. A series of lectures in English, Mathematics, Mechanical Drawing, and Chinese Literature is given, the course lasting three years.

Close to the Shui-kou-shan mine, at about a distance of one mile, is the Tsia Gung Chung coal mine, which was opened in 1913. The seam of bituminous coal is about one foot thick, the output per day varies between 20 and 40 tons. The coal seam is bedded in red sandstone. Prospecting work is being done through an inclined shaft at an angle of 35°, sunk at right angles to the seam in order to intersect other seams. If this coal mine is developed it will be able to cover the demand of the Shui-kou-shan mine and will decrease the present expense for fuel.

THE Eastern Pioneer Company, Ltd., which obtained extensive mining rights in Ssu-chuan through the Pritchard Morgan concession, has made arrangements with a strong financial group, consisting of S. Pearson & Son, Ltd., the Central Mining, and the British and Chinese Corporations, Ltd., to take over the control and operation of the companies' rights and interests. Fuller details will be given later.

OUTPUT of the power-plants at Panama in February amounted to 2,873,136 kw.-hours, of which the Gatun hydro-electric plant produced 2,785,830 kw.-hours. The Balboa air-compressor plant produced 129,438,628 cu. ft. of free air, compressed to 105 pounds.

DREDGING done in the Canal Zone in February totaled 1,142,448 cu. yd. This included earth, rock, gravel, and sand.

Determination of Gold in Blister Copper

By ROWLAND KING

In this method most of the copper is slagged with an excess of litharge; a large part of the remaining copper is removed by a double scorification, and the final traces eliminated by cupellation. The sample of copper borings should be thoroughly mixed on a rubber cloth and finally spread out to form a thin layer; by means of a small steel spatula a ½ A.T. (assay-ton) portion is weighed out on an analytical balance. This portion is divided roughly among five 20-gram Battersea crucibles. Into each crucible is weighed 0.8 gm. of pure flowers of sulphur; the copper and sulphur are thoroughly mixed in the crucibles and covered with from 8 to 10 A.T. of the following stock flux: PbO, 88%; Na_2CO_3, 3%; K_2CO_3, 3%; and SiO_2, 6%. The whole is then given a light cover of salt.

The crucibles are charged into a muffle-furnace which is at a low temperature and the heat gradually raised until at the end of 35 minutes the fusion is complete. Some of the excess slag may be decanted before pouring into molds. After allowing the slag to cool, the lead button may be broken free. Care should be taken at this point to see that no lead adheres to the slag; if a film of lead does remain on the slag it may be scraped off and beaten into the button. It is neither necessary nor desirable that the lead be beaten into the shape of a cube. The button at this stage should weigh about 20 grams.

Into a 3-inch Bartlett-shaped scorifier, previously heated in the muffle, the five lead buttons are placed, followed by one gram of silica. The muffle-door is closed until scorification has started; it is then removed and a good scorification temperature maintained until the slag closes over the lead; raise the temperature for a few minutes, remove the scorifier, and carefully decant the slag until the lead again shows; return the scorifier to the muffle and continue the scorification until the 'eye' of lead is about ¼-inch diameter. Raise the temperature for a few minutes and pour into a shallow mold; examine the empty scorifier for shots and particles of lead that may have stayed behind. After the pour has become quite cold the lead may be broken free. Examine the slag for adhering lead; in case there is some, it should be scraped free and added to the button, also any shots of lead that may have been found in the scorifier. After cleaning the lead of slag and beating it into the shape of a cube it should weigh about 10 gm. and be soft and quite free from copper.

The use of a good manufactured cupel is to be recommended. Bone-ash cupels, unless made with great care, are found to give slightly lower results; furthermore they are not so uniform. The Morganite patent cupel, size E, gives good satisfaction for this work. The dóre buttons, after cleaning, are parted for one hour in a water-bath in a mixture of seven parts of water to one of nitric acid; the acid is then decanted, the bead washed thoroughly with hot water, covered with concentrated nitric acid, and parted in a water-bath for half an hour. Thoroughly wash with hot water, dry, anneal, and weigh the gold. The final bead will represent ½ A.T. of the copper borings.

Silver results by this method will be found to be low, due to the excess of litharge flux used, but the results for gold will compare favorably with any method known to me. The method as given has been in use in one of the large Western smelters for a number of years. Credit is due to B. M. Snyder for the original scheme.

Novel Method of Hauling Ore Cars

An ingenious method of mine-haulage has been adopted at the Presidio mine, near Shafter, Texas. When E. M. Gleim, superintendent of the company, decided to install some kind of power method for transporting the ore from the mine to the mill, he hit upon the idea of converting a Ford automobile into a gasoline-motor, equipped with steel flange-wheels so that it could run upon the track of the tramway. He put the scheme into effect more than a year ago, and it has proved a great success, he says. The maximum grade of the railroad upon which the motor runs is about 3%. The converted car pulls three 2-ton side-dumping ore-cars, or a total load of about 16,500 lb., without difficulty. The cost of operation, including maintenance, is nominal.

HAULING MINE-CARS WITH A FORD MOTOR.

WEATHERING is more intense in tropical regions than in temperate climates, and proceeds more rapidly and to greater depths. There is also, in certain regions, a difference in the residual products.

CONCENTRATES

Readers of the MINING AND SCIENTIFIC PRESS are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

LEAD SULPHATE has now little value as a paint material, for it has been superseded by sublimed white lead.

EXPLOSIVES of high disruptive or shattering force are preferable in driving tunnels, sinking shafts, and in metal mining.

OXIDATION of ore to a vertical depth of 1550 ft. by means of meteoric waters is recorded at the Lonely Reef mine in Rhodesia.

MAGNESIUM is prepared electrolytically by passing a current through fused magnesium chloride, using some potassium chloride as flux.

PLATA is Spanish for silver; therefore silver-plate is redundant. The true meaning lingers in 'plate,' used as a synonym for silver ware.

TOOLS used in tamping gopher-holes must be made only of wood. Where boxes or receptacles are necessary, the metal used in construction must be copper.

POTASSIUM NITRATE is only found in nature to a limited extent; it is ordinarily prepared from sodium nitrate (Chile saltpetre) by a double decomposition with potassium chloride.

CALCIUM in the elemental form is made by the electrolysis of fused calcium chloride. It separates from the bath in the form of a rod, which is withdrawn as fast as it is formed.

SUITABILITY of clays for certain manufactures may be determined by submitting cones of the material to different temperatures, whereby the shrinkage, fusing point, and hardness are shown.

LOWERING OF VAPOR-PRESSURE on the dissolving of a substance in water can be conveniently measured by passing air through three saturators containing respectively water, the solution, and water. The amount of moisture in the air stream leaving each saturator is measured by absorption, and the vapor-pressure determined by computation. It is not necessary to know the volume of air used, the exact temperature, nor the exact vapor-pressure of the solvent.

MOLYBDENUM is derived almost entirely from the sulphide, molybdenite. While this mineral is widely distributed in nature, the major part of the world's production comes from Australia, notably Queensland.

POLVERDE, the name of one of the Jumbo Extension claims, at Goldfield, comes from the Spanish *palo verde*, meaning a green tree, and referring to the tree that served as a distinguishing mark near the location monument.

CARAT is a term derived from the Greek word for a hard leguminous seed. At the present time the seed of a leguminous plant, the *rati*, is used in India by native goldsmiths for weighing gold. A carat equals 200 milligrams.

ORES mined in southwestern Wisconsin are those of lead, zinc, and iron. The ores occur either in crevices, joints, and openings, or in disseminated form. The sulphide of iron and zinc-blende are usually associated, making clean separation difficult.

LOW-GRADE CYANIDE, made from cyanamid, is produced by the Cyanamid Company of America, with head offices at Knoxville, Tennessee. It is proposed to use this as a substitute for pure cyanide in gold and silver recovery, as, per pound of cyanide content, it is cheaper.

AMALGALINE is a metallic ribbon used for joining lead pipes or sheets. It is made from foil 0.05 mm. thick, composed of an alloy of tin with bismuth, antimony, and zinc. It is covered with a coating of stearine, vaseline, and methylated spirit, to prevent the formation of oxide.

LAMP-BLACK and soil when dry and finely powdered are difficult to wet. Two German investigators have shown experimentally that this is caused by the presence of a sheath of air about the particles, and not by the

presence of oily substances. In other words, it is a phenomenon of surface tension.

Potash found near Amarillo, Texas, is not a brine, but a solid. In one well, 875 to 925 ft. deep, there was 9.23% potash, expressed as percentage of the soluble portion; in another, 1700 ft., there was 10.5 per cent.

Nitroglycerin is formed from nitric acid and glycerin according to the following reaction:

$$C_3H_5(OH)_3 + 3HNO_3 = C_3H_5(NO_3)_3 + 3H_2O.$$

The term is a misnomer, as the product is a true nitrate, and not a substitution product of glycerin.

Powder-magazines should be fitted with lightning conductors. In England and Germany this is enforced by law, although no definite arrangement is prescribed. The Germans use vertical copper rods of high electric conductivity near the building. They are 36 to 80 ft. high.

Cost of bringing the Government Gold Mining Areas (Modderfontein) Consolidated Co., on the Rand, to the producing stage late in 1914 amounted to approximately $7,680,000. Ore reserves are estimated at 2,451,581 tons, averaging $5.80 per ton. The mill has a monthly capacity of 50,000 tons.

Tungsten ores often contain gold and silver, but scheelite ores especially are likely to slime badly in crushing, and the recovery of the gold and silver is attended with the loss of a large amount of the tungsten. Unless the ore contains over 3 or 4 oz. gold per ton it is not usually profitable to attempt to save it.

Where rock has been drilled for blasting, and consists of strata having variations in hardness and structure, it is advantageous to use more than one kind of powder in the same drill-hole. That part of the hole in the hardest rock is loaded with an explosive having a high rate of detonation. Less strong powder is charged into the other part of the hole.

Portland cement is all-important in concrete making. The U. S. Geological Survey states that the output in 1914 totaled 88,230,170 bbl. In 1913 it was 92,097,131 bbl. The average price of cement shipped was 92.7c. per barrel. Stocks in the country amount to 12,893,863 bbl. California and Washington made 7,092,458 bbl. Stocks in these states total 988,429 barrels.

Nickel, when present in ores, may be detected by the blow-pipe, but the method is not very satisfactory when the amount of nickel is small, as the large amount of other elements that may be present are likely to obscure the nickel reaction. The most sensitive test is that with dimethylglyoxime. If a little of this reagent is added to a solution containing nickel, then ammonia to slightly alkaline reaction, and the solution boiled a red crystalline nickel salt of dimethylglyoxime is formed. In this way 1 part of nickel in 400,000 parts of water may be detected. If much cobalt is present hydrogen peroxide must be added after the ammonia and the excess boiled out before adding the dimethylglyoxime.

Linseed oil is sometimes adulterated with mineral oils or non-drying oils, such as soya-bean oil. The presence of the former is easily detected, as they remain in the unsaponifiable residue obtained in the course of an ordinary analysis; the presence of the latter may be inferred from low specific gravity and iodine tests.

Capacity of Blake rock-crushers may be computed as approximately equal to 2 tons per 24 hr. per square inch of feed-opening, when crushing to pass a 2-in. ring, the speed of the crusher being 275 revolutions per minute. For example, an 8 by 10-in. crusher will have a capacity 8 by 10 by 2 = 160 tons per 24 hours, or approximately 7 tons per hour.

Sodium carbonate was obtained, previous to 1791, from natural deposits and the ashes of marine plants. The Leblanc process, invented in 1791, enables it to be made from common salt. The sulphate is first formed, is reduced to the sulphide, and is then converted into the carbonate by lime carbonate. This was displaced by the Solvay (ammonia-soda) process in 1863.

Carnotite from Colorado and Utah, containing from 1.5 to 33% U_3O_8 has been tested by the U. S. Bureau of Mines to determine the radium-uranium ratio. Results showed that the ratio is identical with that of pitchblende in all large quantities of well-sampled ore. This appears to be true regardless of the locality of the deposit or composition of the ore. There is no justification for regarding the radium-uranium ratio in commercial quantities of carnotite as being low or in any way abnormal. In well-sampled carnotite the uranium content of which is accurately known, the radium content is not less than in the proportion of 1 part radium to 3,000,000 parts of metallic uranium.

The pitchblende of Cornwall occurs mostly as one of the minerals of the copper deposits, though it occurs also with tin and other deposits, according to R. A. F. Penrose. With it, in addition to the copper, iron, and other commoner materials, are generally associated the rarer minerals of the region, such as native bismuth, nickel, and cobalt, sometimes lead and silver, arsenic in the form of mispickel, and fluorspar. Other uranium minerals are sometimes associated, such as autunite, torbernite, zippeite, uraconite (uranochre), and other compounds, probably the products of the alteration of pitchblende. In fact, all the ores near the surface are altered, and the pitchblende is likely to be coated with, or even entirely replaced by, alteration products; but below, the black pitchblende appears, associated with sulphides and other unaltered minerals.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

LONDON

SPELTER: FUTURE IN AUSTRALIA, ENGLAND, GERMANY, AND THE UNITED STATES.—NEW SUPPLY FROM SIBERIA.—MOLYBDENUM. —TIN.

Zinc men would find much to interest them in London these days. Prices of metal are high, as will have been noted from the daily quotations, and there is a lively scramble for supplies. At the same time the major interest is in the future, the re-adjustment of smelting conditions, and trade relations that will occur during or following the War. It is hardly likely that Australian zinc ores will find their way again in large quantities to Germany. Even if the existing contracts be held unbroken, their remaining life is not long, and if the War ended tomorrow, resumption of normal trade currents would be slow. There is a strong feeling favorable to the establishment of British smelting works to treat Australian ores, but so far nothing definite or practical has resulted. The reason is that, speaking broadly, the cost of zinc smelting in Germany, Great Britain, and the United States is about the same. Also it is not a particularly profitable industry. To transfer therefore to England that part of the German spelter industry that has been founded on use of foreign ores, demands something more than mere sentiment. The Germans gave ship subsidies for a period long enough to get the business going, and German plants, as is well known, enjoy special export rates on the German railroads. It has so far proved impossible to get an English subsidy to throw the current of zinc concentrate to Great Britain, while the railway haulage is here too small a factor to matter. England affords a large permanent market for spelter, but a protective tariff, which naturally occurs to an American in this connection, is politically unthinkable for the present at least. There are two possible lines of development. The United States may, by establishing seacoast plants and smelting in bond, capture the trade. If so, American capital will need to be forthcoming to the extent of $20,000,000 to $30,000,000, serious readjustment must be made in steamer lines, a market must be found for a largely increased output of sulphuric acid, and probably a market for wool developed. Concentrate and wool form a heaven-born combination for steamers comparable to pig iron and coke. But what is to form return cargo to Australia so as to permit the low freight rates that are essential? These form interesting subjects for speculation. In the meantime trial shipments of concentrate have been made to the United States. On the terms of purchase these shipments should show a profit, since the price of spelter has gone up, and the Americans get the increase beyond £30 per ton. It is far from certain that Australians will be willing to sell heavily on the basis of the existing contracts. The second possibility is the re-establishment of the Belgian zinc-smelting industry. Before the War Belgium was producing about 220,000 tons of spelter per year, exporting most of it. Up to the present the plants at Liege and elsewhere in Belgium have been little injured. Indeed, a number have been kept in commission, though at a reduced rate of output. Since there is a large surplus of spelter within the German lines, this has been done mainly with the purpose of affording work to a part of the staff and workmen. The Germans have forbidden the export of this metal, and there is accordingly a growing stock to be reckoned with. Many of the Belgian works are controlled by German firms, but the English are counting upon succeeding to this position of dominance at the end of the War in one way or another. It is impossible to say what may happen to the existing works when the Germans leave Belgium. If they remain as they are, resumption of production will be relatively easy and prompt. If they are destroyed, it is probable that English capital will be promptly provided for their re-building, since nothing seems more certain than that commercial ties between Belgium and England will be closer hereafter.

Russia in the meantime affords an open field for the employment of British capital in zinc smelting, as in many other industries. The Irtysh Corporation, controlled by the Russo-Asiatic in which H. C. Hoover, R. Gilman Brown, D. P. Mitchell and other Americans are prominent, is now building a zinc smelter in the Altai country to treat ore from the Ridder mine. Two blocks, the first of 14, are being erected this season. The plant is thoroughly modern and includes considerable American equipment, as well as the best American practice. L. Radkin, who has gone to Ekibastus to superintend operations, was recently manager for the Sandoval Zinc Co., at Sandoval, Illinois. Since there is a Russian tariff of almost one cent per pound on spelter and a rapidly growing market, the new enterprise should be successful from the first. The initial production will be about 24 tons of spelter per day. The ore treated is a complex mixture of sulphides. The retort residue is to receive further treatment along the lines developed at Bartlesville, Oklahoma, in connection with Butte & Superior ores, described in the MINING AND SCIENTIFIC PRESS in 1914 by E. H. Leslie.

Minor metals attract considerable attention nowadays. The necessity for speed in lathe-work in connection with armament contracts, has made a large demand for tungsten steel, and prices for tungsten ores have accordingly been soaring. Molybdenum, which may be used for the same purpose, has also been

IN NIGERIA, WEST AFRICA.

in demand, but prices have recently broken badly. The explanation offered is that the principal demand has been from France, where molybdenum is used as a stabilizer in the manufacture of high explosives. At the beginning of the War there was a panic over possible shortage of supply, and prices were run up above their proper level. Now that the supply is assured they have receded. As a matter of fact it is not even certain that the material is necessary in explosive work, but everyone is too busy to study the matter now, and no one can afford to take chances.

Nigerian tin share transactions have been few. The Anglo-Continental company estimates an output of 400 tons in 1915. Drilling shows about 6014 tons. Tin ore from Nigeria arriving in England in April totaled 916 tons, equal to 641 tons metal.

All of the reports of Rand companies for 1914 have been issued. They are always of interest. In the next letter the Crown Mines will be discussed.

CRIPPLE CREEK, COLORADO

GOLD OUTPUT. — DRAINAGE ADIT. — INDEPENDENCE LEASES.— MERGER RUMORS.—LOCAL FEELING.

The following is the output of the district for May, as compiled from the reports of the mills and smelters:

Plants.	Tons.	Per ton.	Total value.
Smelters	4,750	$55.00	$261,250
Golden Cycle	30,000	23.00	690,000
Portland (valley)	12,000	19.50	234,000
Portland (district)	19,450	2.96	57,572
Stratton's Independence	8,387	2.78	23,314
Free Coinage	2,252	4.00	9,008
Dante	2,000	2.00	4,000
Wild Horse	1,000	3.50	3,500
Total	79,839	$16.06	$1,282,644

A water-course giving about 2000 gal. per minute was cut on May 29 in the breast of the Roosevelt drainage adit, a short distance west of the Elkton shaft, at a depth of about 1800 ft. The flow from the portal of the adit is now nearly 12,000 gal. per minute. Were it not that this is the wet season of the year, and considerable surface water is running, a decided lowering of the water-level in many of the mines would be apparent. Work is progressing rapidly in the face. As the formation is gradually changing from granite to breccia, fast work will be accomplished, as the ground will break more easily.

It is now fairly definitely understood that the Portland company will continue to lease the Independence after it takes it over. Many applications are already on file for blocks of ground. The system in use will be the 'split-check.' It is hoped that considerable development will be undertaken. Arrangements are being made to handle the Portland No. 1 dump at the Independence mill, where the tonnage treated each month will be greatly increased. The Portland thus once more takes its place as the big mine of the district, and good earnings and dividends are assured for several years to come.

There has been no further news concerning the proposed Vindicator-U. G. M., etc., merger this week, though the general impression is that something is on foot and that an announcement may be made any time. Since the Portland-Independence deal was so quietly put through, the public has been alert all the time, and would not be unduly startled if other mergers were sprung.

The general tone of the district is optimistic. Leasing is increasing, and the low-grade mills assure a continued era of prosperity. More men are gradually finding work both with lessees and companies. Dump-leasing is calling for a number of men during the summer season and, in general, June should be a big month.

JOPLIN, MISSOURI

ORE PRODUCTION — LOWER LEVEL MINE. — STOTTS CITY DISTRICT. — ACTIVITY AT AURORA.

Shipments of blende from over 20 districts of the region are nearly 6000 tons per week. The grade is averaging about 57% metallic zinc, and 3 or 4% iron. In some of the districts the ore is even better than 60% with no iron. Non-lead-bearing ores are in greatest demand, and command the highest price. Webb City continues to be the heaviest producer with a weekly shipment of over 1,300 tons of blende. Joplin is second, and Miami, Oklahoma, third.

At Sarcoxie, 20 miles east of Joplin, the Bearcat Mining Co. has been re-organized, and is now operating under the name of the Lower Level Mining Co. As the name implies, new work is being conducted at a greater depth than previously. The mine was not successfully operated for any great length of time by former companies, but the present owner believes it has an orebody that will prove profitable, especially at the present price of zinc ore. When the mine was operated before, zinc ore was selling for only $40. In the new company are J. W. Boyd, on whose land the mine is situated; J. J. Stephenson, of Pittsburg, Kansas; and George Spiva and Sam Tamblyn, of Joplin. Two shafts are into ore, one at the mill where work is conducted at a depth of 278 ft., and one 300 ft. southwest of the mill where operations are at 160 to 200 ft. The ore in the upper ground occurs in white flint, and in the lower ground in dark selvage. The mill is the largest in the Sarcoxie district. It has a capacity of 400 tons per shift.

Stotts City, 18 miles northeast of Joplin, is enjoying a revival of mining that already has resulted in one large new concentrating plant. The mill is being built by Grant Hart and Loren Seneker, who have 200 acres of the Hill land under lease, 1½ miles south of Stotts City. They sank a number of drill-holes which showed zinc ore from a depth of 140 to 200 ft. The formation was so nearly uniform in appearance, judged by the clippings from the various drill-holes, that a shaft was sunk and drifts have been extended into the ore. It is reported to be exceptionally good. The plant is to have a capacity of 300 tons per shift. G. F. Cole & Co. are drilling, with fair success, on the Hill land, ½ mile west of Stotts City. The members of the company are from Grand Junction, Colorado. Friedman & Co., of Springfield, Missouri, are drilling on the Elliott land, 3 miles southwest of Stotts City, and have cut fairly good 'shines,' but no ore rich enough to warrant the sinking of a shaft. Efforts are being made by W. G. Nealy, J. W. Downing, and others of Stotts City to locate the lost run of ore at the old Stotts City mines, which were such heavy producers several years ago. A fissure vein of ore which was being mined at that time suddenly came up against a blank wall of limestone. Geologists say that the discontinuance of the run was occasioned by the faulting of the ground, and that the continuance will be found on one side or the other from the former workings. Several drill-holes have been put down in both directions, but the orebody has not yet been found.

Aurora, 40 miles east of Joplin, is the scene of more activity than has been seen there since 1912. It is now producing five carloads of calamine each week. It soon will be shipping blende, as work is being resumed at several of the old deep mines where good deposits of sphalerite were found. Drill strikes of importance have been made on the W. T. Flournoy land, two miles northeast of Aurora by Mr. Flournoy, Larry Brunk, C. A. Gott, Bert Gardner, H. R. Raitinger, Al Ruppell, Otto Schmook, and John Alexander. A contract for the construction of a concentrating plant of 150-ton capacity per shift has been let. The mill will be ready by the time the new shaft, 5½ by 7½ ft. in the clear, is in ore. The drill-clippings were considered as rich as any ever found in the Aurora district. Ore in the first hole was cut at 87 ft., and continued to 152½ ft. The average blende content was between 7 and 8%.

In the second hole the ore was cut at 85 ft. and continued to 155 ft. It assayed 9%. Other holes sunk farther away failed to show the ore, but the extent of the deposit as revealed in the first two holes leads the operators to believe that they have a sufficiently large formation to warrant the construction of a mill. Three eight-hour shifts are sinking the shaft.

PLATTEVILLE, WISCONSIN

ZINC ORE CONDITIONS IN MAY.—PRODUCERS AND SMELTERS.—'SPELTER-TRUST.'—PRODUCTION.—DISTRICT OPERATIONS.

May was one of the most sensational periods ever experienced in the zinc and lead-mining industry in southwest Wisconsin. The month ended with a Federal government investigation of the spelter situation. With such high prices for spelter it might be inferred that zinc ore would keep step with the rise; but the contrary was true. Wisconsin zinc miners are to a great extent handicapped by the fact that the output of their mines varies from extremely low to high-standard commercial spelter ore. Buyers showed no inclination during the month whatsoever to submit bids on the medium and inferior grades, instructions apparently from headquarters to all seeking ore restricting buying to high-grade ore exclusively. Many of the larger operators tied up under contract arrangements were bitter and loud in their denunciation of settlements based on certain journal quotations, claiming there was one basis for the producer of zinc ore and another for the smelter, who is the only one making money out of the present situation. On the part of the zinc-ore miners there appeared no disposition to curtail production. With no demand for the lower grades, a surplus rapidly accumulated. On June 1 this was found by actual observation to exceed 8000 tons, the largest stock ever held. To add to the discomfiture of miners, their demands for better prices was met with the drastic response of 9000 tons of Australian zinc concentrate from Broken Hill. The first of this reached Kansas and Oklahoma smelters about the middle of May. These shipments, it was announced, were only the forerunners of a steady flow of Australian ore into this country. The Broken Hill districts produce annually about 500,000 tons of about 50% concentrate, which formerly went to Belgium and Germany. Mining men argue that if shipments from Australia continue in volume, they will paralyze, if not utterly destroy zinc mining in the United States. And as if this were not sufficient to harrass and discourage producers of zinc-ore, smelter-agents intimated boldly that the production in the United States was 1000 tons in excess weekly of that necessary for smelter requirements. Regardless of all unpleasant annoyances, Wisconsin for the first time in 20 years witnessed the introduction into the field of buying interests operating exclusively in the Missouri districts. Notably active were agents for the Edgar Zinc, Lanyon Zinc, and Picher Lead companies, all demanding high-grade product. Under the spur of accelerated competition, prices for zinc ore advanced, closing the month on a basis of $75 per ton, for 60% metal content. The Picher Lead Co.'s buyer yielded concessions on lead up to 2 points; iron, 3 points, and lime in quantity. Local buyers representing Illinois smelters long resident in the field were quick to meet the figures offered by the 'stranger' to the city, much to the delight of ore-producers. Their contention of a 'spelter-trust' seems to have been well carried, on these later advances still $5 to $10 per ton under current quotations obtaining in the last days of the month in the Missouri zinc region. Agents of the Department of Justice, acting under orders of Attorney-General Gregory in charge of anti-trust litigation, made diligent inquiries among iron and steel consumers and Western zinc-ore producers. Complaint was made at the Department by Missouri congressmen. Ore producers claimed that certain smelters were forcing down the price of raw product which they buy, despite the advancing price of the finished product which they sell. A request for the names of complainants was refused. The Government agents gathered evidence which tended to show clearly that the high price of spelter is artificial, and cannot be explained solely by large exports from this country. If sufficient evidence can be obtained it was said that the Department will start anti-trust proceedings. To one acquainted with the investigations formerly conducted in the zinc industry, it is needless to say that the one now being made will go the way of all the others, a premature and obscure burial.

According to the best informed mining men in the region, there is now only one satisfactory solution out of the present predicament for low-grade producers; that is the more general introduction into the field of calciners and electro-static separating-plants. Most of the zinc ore out of the field during May came from the latter. They have been working night and day. The maximum capacity represented in the field is inadequate to handle present production.

While spelter continued to hold the center of the stage, lead was not slow in claiming attention during the month, and made substantial gains after remaining all through April at $4.20 per cwt. St. Louis; this price being advanced to $4.90 May 29. Sellers then reported a large number of inquiries and demands that involved shipments as far ahead as next September. Sales and shipments were light. A fair tonnage is stored.

Pyrite was in better demand at better prices, and separating-stations unloaded a quantity of fines, while coarse ore from the breakers came in greater quantity than for some months.

Producers of carbonate of zinc ore witnessed astonishingly high quotations, 40% ore ranging from $40 to $50 per ton. No offers were made. Shipments were light. In this branch of the industry, unusual activity was shown in the northern districts of the region where several thousand tons of finished product lies in bins awaiting offerings. The advent of warm spring weather nerved miners to go ahead and clean up last winter's mine-run material.

Shipments of ore were as follows: zinc, 23,018,000; lead, 1,098,100 lb.; and pyrite, 3,145,060 pounds.

A brief survey of the more important events in the region by districts is as follows: The New Jersey Zinc Co. finished up in the Highland district, leaving five complete power and milling-plants to their fate. The lands held by the company will be cut into small tracts, and sub-let to local miners.——Contracts between operators and the New Jersey Zinc Co. which expired during the month were not renewed. Miners will turn to hand-cobbing ore in order to make high-grade ore, which alone is in demand.——At Linden many new mines are being developed.——The Mineral Point Public Service Co. increased its power capacity and began extending its transmission-lines north to the most northern areas of the region.——The Wisconsin Zinc Co. developed a new mine at Platteville, known as the East End; the Klar-Piquette Mining Co. resumed operations after two years' idleness; and the Edgar Zinc Co. entered the field by buying at this point.——The Campbell Separating plant at Cuba was started. Increased deliveries were made from here of high-grade ore exclusively.——The Benton district reported large discoveries of zinc ore at several points through mining and drilling. The Vinegar Hill Zinc Co. ushered in a new producer with new equipment. It is to be known as the Kittoe. The Hird mine was unwatered after a two years' fight to get into the ground, and the main shaft was being sunk to ore toward the end of the month. The Indian Mound Mining Co. introduced a new mine to be known hereafter as the Monroe. Longhenry Bros. financed a new property and started breaking ore. The Fields Mining & Milling Co., of Chicago, completed a new $60,000 power and concentrating equipment. They started men underground on a discovery which it is estimated will produce 1500 to 2000 tons of concentrate per month.——The Champion mine at New Diggings produced 450 tons per week. At the end of the month it had stored 2500 tons of concentrate.——The Wisconsin Zinc Co. developed a new mine on the Winskill land near Shullsburg, and completed a new 200-ton plant. It was producing 200 tons of ore per week, which was being stored in bin. The

Cleveland Mining Co. introduced a new producer with a new modern equipment, and was making 150 tons of ore per week which was being shipped to the Mineral Point Zinc Co. The Federal mine had a good deal of ore in new ground and was shipping four cars per week, besides storing some.——Richard Stovall was made field superintendent for the New Jersey Zinc Co., with headquarters at Galena, Illinois.——A score of drilling machines were active in the southern districts of the region throughout the month with fairly good results. One important development was reported by the Wisconsin Zinc Co. on the Sally Waters property at New Diggings.——Several new mines were being developed in the Galena district from which large returns are expected.

[The value of mine output of silver, copper, lead, and zinc in Wisconsin for the calendar year 1914 was $3,291,437. The corresponding value for 1913 was $3,536,528, according to the U. S. Geological Survey. Lead concentrate sold declined from 2532 tons, valued at $125,197, in 1913, to 2028 tons, valued at $85,196, in 1914. The sphalerite concentrate sold increased in quantity from 95,540 tons to 108,535 tons. The value of the sphalerite concentrate was only $1,924,126 in 1914, compared with $2,053,341 in 1913. The quantity of the zinc carbonate concentrate sold declined from 3123 tons to 2787 tons. The metal content of the galena concentrate was 372 tons less than in 1913. The recoverable zinc content of the sphalerite and zinc carbonate concentrates increased 1003 tons over that of 1913, but the value was $198,794 less. The average tenor of the sphalerite ore marketed was nearly 3% lower in 1914 than in 1913, and the average price paid for the concentrate was $3.83 per ton less. The Benton district was again the largest producer of both lead and zinc concentrates, followed by Hazel Green and Livingston. All three districts produced more ore in 1914 than in 1913. The U. S. Bureau of Mines has issued Technical Paper 95, compiled by Clarence A. Wright, describing mining and milling in Wisconsin. An abstract will appear in another issue of the PRESS.

The Wisconsin Geological and Natural History Survey at Madison has recently published Bulletin No. XLI, Economic Series No. 18. This is entitled 'A Study of Methods of Mine Valuation and Assessments,' with special reference to the zinc mines of southwest Wisconsin, by W. L. Uglow. This interesting discussion covers 73 pages. The nine chapters include the following discussions: purpose of the paper, taxation of mining property; peculiar conditions in the zinc district which have an important influence on the problem of valuation and assessment; the hypothetical zinc mine, basis of subsequent discussion; significance of the term 'full cash value' or 'rational valuation,' from the point of view of the general property system of taxation; the standard *ad valorem* method; the Finlay *ad valorem* method; the Arizona and Colorado methods; gross receipts and tonnage-tax method; Wyoming, South Carolina, Nevada, British Columbia, and Ontario systems; the equated-income method; general comparison of the salient features of the Finlay and equated-income methods; and a general conclusion. This is no place for a discussion of such an important subject, but mine operators will find it useful for taxation reference.—EDITOR.]

ROCHESTER, NEVADA

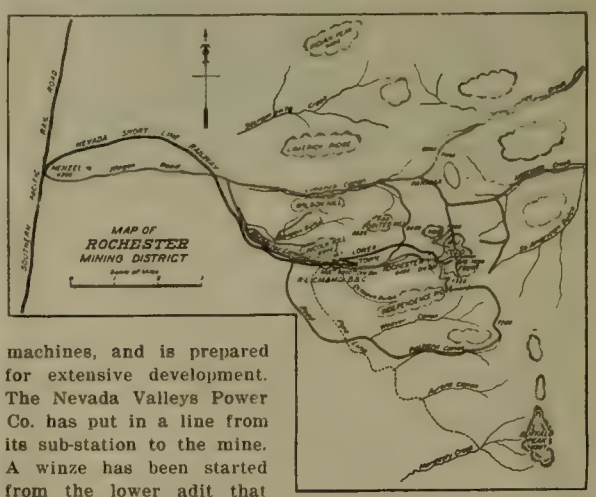
GENERAL CONDITIONS.—NEW MILL.—ROCHESTER CONSOLIDATED.—ORIGINAL ROCHESTER, LINCOLN HILL COMPANIES.—LIMERICK CAÑON AND BUENA DISTRICTS.

This district is quiet. It seems to have settled down to the stoping of ore opened in the leases, which will occupy the new mill for more than a year. There does not seem to be much new business in sight, although there are numerous promising prospects. The owners have been so loth to sell that capital seems to have become tired of coming in to look at them and try to negotiate for the properties. The lessees were so much in debt that the starting of the mill and payment for about $80,000 worth of ore has not had any visible effect on the money conditions here. Possibly somewhat later there may be more life developed.

The custom mill is treating from 110 to 120 tons per day. Two shipments of bullion have been made, the first of 59 bars, of an estimated value of $32,500, and the second of 38 bars of $26,600. Ore comes from the Codd, Big Four, and Four Jays leases on the Rochester Mines Co.'s ground on Nenzel hill, and the Cole-Huntington, Colligan, and Stoker leases on the Rochester Weaver ground. These two companies have arranged a consolidation to be known as the Rochester Consolidated Mines Co., as mentioned in the PRESS. The Weaver ground is to the south of the Rochester Mines, and on the southern slope of Nenzel hill. The ore in the Weaver contains much more gold than the leases to the north, although the Codd lease has some gold in the lower levels.

The Rochester Mines Co. has started an adit in the ground of the Original Rochester Co. by permission, to cut its vein. The adit starts from near the orebins, and 1000 ft. of driving is expected to cut ore at a depth of 1600 ft. on the dip of the vein, which dips with the hill.

The Lincoln Hill M. & M. Co. has optioned a controlling interest in its shares to New York people, who have made a first payment. The company has purchased a compressor and six



machines, and is prepared for extensive development. The Nevada Valleys Power Co. has put in a line from its sub-station to the mine. A winze has been started from the lower adit that will be sunk to a depth of 200 ft. In cutting the station for this winze a cross-vein was found containing a small streak of rich ore, and three feet of soft vein-matter which averages $18 per ton. A new wagon-road is being built from the mine to the mill. It will be much shorter than the road now in use, and will have a good average grade.

The Nonpareil mine has a shipment of high-grade ore ready to send to the Lincoln Hill mill for treatment.——The Abe Lincoln No. 2 has opened a small vein of good ore. So has the Casey Jones.——Lessees are extracting shipping ore from the claim west of the Packard.——Good ore is also being opened in claims north of the Packard.

The owners of claims in upper Limerick cañon are starting work for the season, both at the placers and veins. Just across the ridge near Indian creek, some promising gold veins are being opened. W. F. Rice, George Smith, Edward Beal, and J. M. Savage have secured locations on two veins that are showing considerable improvement with development.

In the Buena district further work is encouraging. The veins are showing persistence with depth. The large bodies of good milling ore have induced several companies to take options, with the probability that one or two mills may be installed this season.

The consolidation of the Rochester Mines and Rochester Weaver companies should result in more economical work at these properties.—Rich ore is coming from the Packard still.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press.

ALASKA

Fairbanks

According to W. J. Maloney, territorial mine inspector, the outlook in the Fairbanks district for the current season is better than last year. There is more activity everywhere.—— The erection of a telephone line from Fairbanks to Tolovana is contemplated.

Juneau

A 3000-ft. adit is to be driven at the Alaska Gold Belt company's property at Sheep Creek basin. Arthur Reandeau will be in charge.——A Hardinge conical ball-mill is to be installed in the 700-Ft. mill of the Alaska United.

Ketchikan

The copper deposits of the Ketchikan district were known to the Russians before the acquisition of the Territory by the United States. There was a crude attempt to develop them as early as 1880. It was not until 1901, however, that systematic mining was begun and not until 1905 that a large annual output was made. Up to the end of 1913 the copper mines of the Ketchikan district had produced about 22,640,000 lb., valued at $3,760,000, and $500,000 worth of gold and silver. Most of the mines of the district lie at or near tidewater. There is an abundance of timber, and the relief favors the undercutting of the orebodies. While there are as yet only a few producing mines, there are many undeveloped copper prospects which give promise of containing commercial orebodies. Many of the copper deposits show an irregularity of occurrence that is unfavorable to cheap exploitation, but otherwise the conditions are favorable to low mining costs.

A report on the mineral deposits of the Ketchikan district was published by the U. S. Geological Survey in 1902, and a more complete account was issued in 1908. Meanwhile, in view of the important mining development, a more detailed study was entered upon by C. W. Wright, of the Survey. The results of this work, which covered the most productive part of the field, have just been made public by the Survey in a report by Mr. Wright entitled 'Geology and Ore Deposits of Copper Mountain and Kasaan Peninsula, Alaska' (Professional Paper 87). This report is accompanied by detailed geologic and topographic maps, and includes descriptions of the copper deposits and their geologic occurrence. It deals primarily with the copper ores, which are at present the most important mineral deposits of the two areas examined. However, there is also much iron ore which is undeveloped except incidentally to copper mining.

Seward

Construction of the railroad from Seward to Fairbanks has attracted many men to the former district. There are said to be 1500 men at Ship Creek, where the Government has established a supply-base for the line. Only about 100 are employed there. Not over 500 will be needed this year.

ARIZONA

The mineral deposits of the Santa Rita and Patagonia mountains are described by Frank C. Schrader and James M. Hill in Bulletin 582 of the U. S. Geological Survey. With maps, illustrations, and index the work covers 373 pages. The area is in the southeast part of the state, in Pima and Santa Cruz mountains. The country is desert, and is at a general elevation of 4800 ft. It is 20 miles southeast of Tucson, and 30 miles west of Bisbee. Two railroads operate partly in the district. The rainfall averages about 14 in. per year. The summer is hot, winter mild, climate healthy. Several cañons contain plenty of timber. Mining has been done there since 16th century. Since then, work has been irregular, of later years due to the metal markets. Yet a great deal of development has been accomplished. From 1903 to 1912, inclusive, 178,108 tons of ore yielded gold, silver, copper, lead, and zinc worth $1,068,582. Copper accounted for over half of this amount. Previous to 1903 the production is considered to have been large. The deposits of the area described are principally fissure veins, and replacement or contact-metamorphic deposits containing gold, silver, copper, lead, zinc, tungsten, and molybdenum. Sulphides generally begin to appear rather near the surface, but the lower limit of the oxidized zone is irregular and ranges from less than 100 to 300 ft. below the surface. Water occurs in most of the mines, and the ground water-level in general stands at depths of about 250 ft. The deposits represent at least two distinct periods of mineralization, and occur in two sharply contrasted groups that differ considerably in age. The report gives considerable detail of the principal properties and other interesting points.

Cochise County

The report of the Commonwealth Mining & Milling Co. for the eight months ended December 31, 1914, has been issued. Edgar A. Collins, general superintendent, reported as follows: estimated reserves total 96,167 tons, assaying $4.95 per ton. This is a decrease compared with the previous report. Only 10% of the development footage was in profitable material. At the same time the outlook is encouraging. Extensive prospecting is under way on No. 3, 5, 7, and 8 levels. This is important work. The mine makes 1350 gal. of water per minute. The mill treated 70,560 tons of ore averaging $5.167 per ton. Residue contained $1.028 per ton. Total revenue was $299,274. Costs totaled $3.663 and profit 57.2c. per ton, equal to $40,386. Capital expenditure and interest left a deficit of $5042. C. Phillips is mine foreman, F. A. Voorhees mill superintendent, E. Hinrichs master mechanic, and F. L. Bryant secretary-treasurer.

Gila County

(Special Correspondence.)—The Scorpion shaft of the Inspiration is producing about 1000 tons of ore per day. A steel and concrete miners' change-house is to be erected. This will be near the main west shaft. It will contain a first-aid room. The coarse-crushing plant is ready for work. It consists of four large gyratories and eight 48-in. Symons disc-crushers. Heavy pan-conveyors feed the former machines, belt-conveyors the latter. Magnets will extract pieces of steel from the ore. Two inclined 36-in. conveyors will deliver the ⅞-in. ore to the Webster Gulch storage-bins of 25,000-ton capacity.

The Iron Cap is sending four carloads of ore per week to the El Paso smelter.——The Arizona Commercial sends 175 tons daily to the Old Dominion smelter. Development at 1200 and 1300 ft. is satisfactory.——In May the Gibson mine yielded about 200 tons of ore. Lessees G. Zapp and L. Riddle extracted 40 tons of 38.18% copper ore. Other lessees are doing well. The district around the Gibson is highly promising.

Miami, May 28.

Mohave County

(Special Correspondence.)—The United Eastern mine in the Gold Roads district is a highly promising prospect. The shaft is in andesite; it cut a vein dipping about 75° north at a depth

of about 200 ft. The mineralization was not very strong at this point and the values were low. At a depth of a little over 300 ft. there was some five to seven feet of ore carrying $12 to $15 in gold, and a depth of 460 ft. there was a little in excess of 20 ft. of ore averaging slightly under $30 in gold, and at a depth of about 560 ft. there was a width of 22 ft. averaging somewhat over $30 in gold. The mineralization is much stronger on the 460-ft. level than on the 200-ft. level. The vein material is largely calcite with more or less quartz and a varying percentage of andesite from the walls. The amount of andesite is much greater at the 200-ft. level and 300-ft. level than at greater depth. Driving has been started within the last few days, on the 565-ft. level.

Kingman, June 7.

CALIFORNIA

The mines and mineral resources of Imperial and San Diego counties are discussed in a bulletin issued by the State Mining Bureau. It contains 113 pages with illustrations, and was prepared by Frederick J. H. Merrill. Imperial county has no great variety of minerals, but its deposits of crystalline limestone and clay promise a great supply of building material. Its output of metals may be important in the near future. The gold deposits are in the southeast corner. They are in the northwest extension of the gold belt of the Altar district of Sonora, Mexico. In the Cargo Muchacho range are the Golden Cross and American Girl mines. An extensive plant is on the former. The latter is treating about 75 tons per day. Placer ground occurs in the Picacho district. The principal deposit of marble occurs at Coyote mountain. The gypsum deposit covers about 800 acres in the northwest edge of the Fish Creek mountains. Other minerals of this county are discussed.—— San Diego county has an area of 4221 square miles. The physiography is diversified. Parallel ranges of granite have a southeast trend. Gold has been found in many districts of the county. The main area extends south 45 miles from the Montezuma district, east of Warner's, to the Mexican boundary. The focus of mineralization appears to have been near Julian and Banner. Districts are discussed in the following geographic order; northern border, Montezuma or Rice, Grapevine, Mesa Grande, Escondido Ballena, Julian, Granite Mountain, Oriflamme, Stonewall, Boulder Creek, Deer Park, Pine Valley, Descanso, Dulzura, and Mexican Border. The Julian area has a large past production. Considerable space is devoted to building stone, clay, gems, and the occurrence of other metals.

Calaveras County

(Special Correspondence.)—E. J. Carter, for many years with F. A. Heinze in the Coeur d'Alene, Idaho, and J. S. Rear, of British Columbia, have bonded the Columbia mine, between the Utica and Melones mines, near Angels. They are increasing the capacity of their mill, installing Chilean mill, compressor, motors, and hoist. The plant eventually is to treat 500 tons per day. A wide orebody occurs in the mine.

Angels, June 7.

Kern County

In the case of Mrs. Ella de Pauw, former wife of John Singleton, who wished W. Chapman deposed as executor of the Singleton estate, and her present husband, Cornelius de Pauw, placed in control of the Yellow Aster property, the Superior Court of Ventura county would not allow it.

Nevada County

Two teams from this county will enter the first-aid and rescue contests to be held at the Exposition in September.

San Francisco County

The U. S. Bureau of Mines calls attention of miners to the mine in the Palace of Mines and Metallurgy at the Exposition. This was described in the PRESS of May 1. It is an instructive exhibit. A mine-rescue station is in full working order. Mining men may receive first-aid instruction free from 9 to 11 a.m. Rescue classes are held in the afternoon. Six classes would cover the course of training. E. Steidle is in charge of the department.

Shasta County

Two furnaces have been blown-in at the Noble Electric Steel Co.'s plant at Heroult. Ferro-manganese will be produced. A mine near Ukiah, Mendocino county, is supplying manganese ore.—— Fire at Kennett last week burned about $35,000 worth of buildings.

Sonoma County

It is reported that the Great Eastern quicksilver mine near Guerneville is to be re-opened in charge of F. P. Thomas. It has not been worked since 1906.

Trinity County

The Carrville district is reported to be very active.——The mill at the Strode mine is working continuously.——Work is to be resumed at the Bell mine and mill.——The Trinity Development Co. is diamond-drilling placer ground along Coffee creek and the Trinity river.——The Alta Bert dredge is working on adjacent ground near Trinity Center.——Hydraulicking has been resumed at the Schlonberg claims, 20 miles from Carrville. Snow and ice interfere with regular work.——At the Lagrange mine, 10 sluice-boxes were washed away by the heavy rain. There is plenty of water for the season.

11-CU. FT. BOAT OF THE TRINITY GOLD DREDGING CO. ON TRINITY RIVER, NEAR MOUTH OF JENNINGS GULCH.

Tuolumne County

(Special Correspondence.)—The Jamestown mining district is more active than in many years past. Properties that have been dormant for years will ship ore this season. It is estimated that the production for 1915 will be a record. California as well as Eastern capital is being spent freely in this region. Reports of mining engineers are generally favorable.

Within the past few weeks there has resulted, with the reopening of the old Santa Ysabel Mining & Milling Co.'s property at Stent and Quartz, a development that is worthy of favorable comment. The claims are being operated by the Nyman Consolidated Mines Co., recently organized under the laws of California. Ore extraction has begun from the Knox and Boyle vein on the 300, 400, and 600-ft. levels. It is proposed to open two other large orebodies in the next month or so on the Miller and Holmes claim, and on the Nyman claims. The property, including more than 100 acres, is situated two miles south of Jamestown. The five claims have produced over $1,500,000. The new owners of the property have been enabled to take advantage of considerable development done in the past, and are proceeding in accordance with the recommendations furnished in a report by Chas. E. Shafer and F. G. Mudgett. Mr. Shafer was formerly manager of the Harvard mines at Jamestown, and Mr. Mudgett has been examining the mines and conditions in the Jamestown district for the past several years. Recent assays show a good average value from a large available tonnage of ore. The property is fully

equipped with modern machinery, and has a 40-stamp mill. Ten stamps are working two shifts. Control of the property is vested in a company directed by A. L. Trowbridge, C. E. Shafer, R. W. Barrett, D. H. Duncanson, and F. G. Mudgett.

Jamestown, June 2.

COLORADO

Clear Creek County

Slime concentration by flotation has been successfully tried at the Hudson at Idaho Springs. As a result a flotation plant is to be installed. S. P. Warren is in charge.

Ouray County

In April the Camp Bird mill treated 2432 tons of ore. The estimated profit was $40,320. A report for the quarter ended March 31 has been issued. Development amounted to 629 ft. There are 18,288 tons of ore broken in stopes. Work at No. 5½, 6, 7, and 8 levels disclosed nothing of importance. No. 3 shaft was sunk 102 ft. to 1006 ft. below the collar. A station was cut at No. 9 for the pumps. These will lift water 1000 ft. The maximum capacity is 700 gal. per minute. Installation was expected to be finished late in May. Cross-cutting to the vein would then be resumed. The mill treated 7963 tons. Bullion and concentrate realized $252,063. Working expenses totaled $93,046. The profit, including $72,000 from Santa Gertrudis, Mexico, was $216,000.

IDAHO

Lemhi County

The Pittsburg-Idaho company at Gilmore is to increase its shipments to 1750 tons of ore per month. Development at 400, 500, and 600 ft. has opened over 20,000 tons of high-grade ore.

Shoshone County (Coeur d'Alene)

Work was resumed at the National copper mine at Mullan on May 31. A shaft is to be sunk on the lode. Diamond-drilling cut ore 130 ft. below the main lower adit. The property has been idle since last year.——The Montana-Idaho Copper Co. has issued a report regarding the Monitor mine. Since the summer of 1910, when forest fires destroyed the surface plant, the mine has not been operated. The main shaft collapsed and filled with water. A railroad has been constructed through the district, making transport cheaper. To raise funds, this company was formed with enough capital to buy the Monitor and other properties along the course of the proposed adit, and for their development. The capital is 6000 shares at $100 each. Buildings have been erected, also a small water-power plant, compressor, and the adit was in about 300 ft. late in May. At a depth of about 1800 ft. the Monitor vein should be cut.——It is rumored that a deadlock exists between the American Smelting & Refining Co. and the Hercules company over the latter's ore contract. As a result the mine and mill have been closed.——Work has been resumed at the Amador mine. A 100-ton mill is to be built. S. L. Shonts and Oscar Nordquist, of Wallace, are in control.——There is renewed activity on Pine creek. Promising mines are the Douglas, Constitution, Carbonate, Northern Light, Highland Surprise, and the Antimony-Silver.

MICHIGAN

Houghton County (The Copper Country)

It is estimated that the May copper output of the region totaled approximately 25,000,000 lb. This does not include the White Pine yield.——The Allouez production is to be raised to 1,000,000 lb. per month.——The Franklin is increasing its extraction of ore from the Allouez lode.——More conical-mills are to be added to the Champion mill. An 800-hp. turbo-generator is also to be installed.——Work has been resumed at the Winona. The output of ore will be about 600 tons per day, stamped in its own mill.——The Tamarack, Jr., shaft-house and rock-crusher were burned on June 2, probably by an incendiary. The mine was closed 15 years ago.

MONTANA

Fergus County

A cyanide plant is to be erected at the Spotted Horse mine at Maiden in the Judith mountains. Lessees have opened a good deal of ore down to 585 ft.——A $150,000 tipple and washer is being constructed by the Cottonwood Coal Co. near Windham. The Great Northern railway purchases the output of coal. Over 190 men are employed.

Jefferson County

During April the Boston & Montana Development Co. at Elkhorn advanced its adit 4½ ft. per day. It is in 1875 ft. Small veins have been cut. The formation is getting softer and is heavily mineralized. One vein should be cut at 2000 feet.

Lewis and Clark County

Unusual activity prevails in the Marysville district near Helena, including the Scratch Gravel hills, Unionville, and Blue Cloud. Work at the Shannon, Bald Butte, Franklin, Purnell, Whitlatch Union, Morning Star, and others is encouraging. The Helena Mining Bureau continues its activities.

Silverbow County

At 2500 ft. in the Davis-Daly mine, 10 ft. of 7% copper ore has been cut. It also contains a good deal of silver. A 1300-cu. ft. capacity compressor is being installed.——At 3000 ft. in the North Butte the Edith May vein is opening well.

NEVADA

According to F. M. Manson, of the Western Ore Purchasing Co., Nevada mines and mining districts are more lively than they have been in years, and more ore is being shipped than for a long time.

Douglas County

(Special Correspondence.)—A leaching plant is being erected at the Ruby Hill Gold & Copper Co.'s mine in the Pinenut district. Well-known Nevada men are in control. M. R. McColloms is in charge.

Gardnerville, June 1.

Esmeralda County

(Special Correspondence.)—Tests are being made on an elaborate scale to devise a process to treat profitably the low-grade ore, down to $5 per ton, of the Goldfield district. These experiments are said to be encouraging. Metallurgists will arrive here shortly from the East to conduct tests on a larger scale. The discovery of such a process would be of vital importance to Goldfield, as there is available a large tonnage of gold-silver-copper ore, containing from $5 to $12 per ton, in the Mohawk, Laguna, Red Top, Clermont, and Grizzly Bear mines of the Goldfield Consolidated, as well as in the Atlanta, Jumbo Extension, and other ground. Tests with the refractory ores of the district by oil-flotation have not so far been entirely satisfactory.

Since it has been determined that the lodes of the district penetrate the shale, after extending for considerable distances along the surface of the shale, interest will naturally be directed to the conditions existing at the contact of the shale and granite and the possibility that the lodes may be found to penetrate the latter.

Development work is supplying all ore shipped by the Jumbo Extension company. Shipments to the Western Ore Purchasing Co.'s sampler are maintained at 45 tons per day, the value being $60 to $70 per ton.

Reports that an apex suit was to be brought against the Atlanta by the Florence company are denied on the highest authority. Walter E. Wiley, who lately represented the Booth company in its apex controversy with the Jumbo Extension and other companies, has been here during the past week. It is reported that he was engaged in preparing a report upon which to base a side-line agreement between the two companies.

In the Gold Mountain district, 35 miles south of Goldfield,

work will be started by the Nevada Co-operative Mines Co. on the property acquired from the Nevada Empress company.

The Pioneer Consolidated Mines Co. has resumed operations on its property in the Pioneer district, 55 miles south of Goldfield.

Goldfield, June 7.

The estimated production of the Goldfield Consolidated Mines Co. in May is as follows:

Ore mined, tons	32,277
Gross extraction	$334,000
Operating expense	174,000
Net realization	160,000

Between May 15 and June 1 the Atlanta Mines Co. shipped 550 tons of $20 to $30 ore to the Western Ore Purchasing Co. ——One car of ore per day is being shipped from the Jumbo Extension. The shoot at 880 ft. is 350 ft. long, averaging $40 per ton. The drift has been stopped in low-grade ore.——Encouraging results are being obtained at 700 and 800 ft. in the Oro.——A cross-cut from the winze below 500 ft. in the Sandstorm Kendall has cut $44 ore.

An examination of the Southwestern mine, formerly the Great Western, at Hornsilver, 28 miles from Goldfield, shows that $246,000 worth of silver-gold ore exists. Work has been done to a depth of 445 ft. A 50-ton mill is recommended.

Humboldt County

(Special Correspondence.)—Willard is having the usual ups and downs of a new gold centre. The past 30 days have seen the settling of disputes of claim-boundaries and adjusting differences of ownership.——There are about 20 sets of lessees at work; seven are shipping ore. Practically all have free gold as shown by panning. Ed. Orr got an assay of $984.50 from a quartz seam, and he also got a sample of $7 from across 13 ft. of his lode.——Jack Borland has 450 sacks of shipping ore. He has 18 in. of $120 ore that shows coarse free gold.——Lessees at the Sheepherder's Dream continue to bring in 'picture rock.' ——High-grade ore has been opened in the Venture claim, which is worked under lease and bond by Denver people. This discovery extends the area of the district east about 3000 ft. ——The Hunter-Borland adit is in 60 ft. in shipping ore. Their bin is completed, as well as the wagon-road up the gulch.—— The Oddie lease is sinking the shaft with two shifts. It will cut the vein on its dip.——The nearness of the railroad makes it possible to ship ore as low as $15 per ton at a profit. The telephone-line is now working. The Nevada Valleys Power Co. has surveyed a line to here, and promises to install a transformer in the near future.

Lovelock, June 7.

(Special Correspondence.)—There is not much to write about in the new Willard district. There are a number of good surface indications. They seem to be little gash-veins, rich near the top, but with little promise for depth. Other observers seem to see much more. For a while lessees will probably make some money.

Willard, May 29.

Last week block No. 2 of the Honey Bee was acquired by E. Malley, ex-Governor Oddie, G. Cole, and Jim Butler. The shaft is being sunk and should cut the vein at 100 ft.——The Honey Bee company is driving a cross-cut adit to prospect the ground. ——The Sargent lease is down 35 ft.——Good headway is being made in the Finland claims.——The town is quiet. Business people are optimistic.

The above correspondence and news gives three views on the Willard district. So far the deposits seem to be small.

A clean-up from a six days' run at the Seven Troughs Coalition mill yielded $5300. A dividend of 2½c. per share, equal to $37,500, was paid last week.

Lyon County

The Mason Valley company's smelter at Thompson may be blown-in on June 15.——The Nevada-Douglas, Bluestone, and Western Nevada mines are working full time. On May 29, 1913, F. May was injured at the Nevada-Douglas. He is now suing the company for $40,000.

Nye County

Mines at Tonopah last week produced 10,645 tons of ore valued at $217,570.——At 1350 ft. in the Extension the Murray vein was cut last week.——The Jim Butler company has purchased the Ophir King claim east and south of its property. ——Two sets of lessees are working in an old part of the Montana.

White Pine County

(Special Correspondence.)—The Nevada Consolidated is working at full capacity. Power shortage prevents a larger output. The flotation-agitators require a large amount of

EASTERN NEVADA AND WESTERN UTAH.

electric power. This limits the capacity of the concentrator, which is driven by motors. The new engines will remedy this. It will be two months before underground mining at the Ruth mine can be commenced. A small force is preparing to mine by the system used at the Ray mine, Arizona. There are a number of lessees working in the district, and at other places in the county. There is more mining activity than for several years.

From reliable information it appears that the new district of Volcano, 15 miles northeast of Tonopah, will make good. At two points, two miles apart, lessees are sacking ore of a minimum grade of $240 per ton, mostly gold. It is thought that with depth silver will predominate.

Ely, May 28.

UTAH

The increased price of lead means over $200,000 per month additional earnings to Utah lead-silver producers. These mines yield about 7500 tons of metal per month. The important districts are Bingham, Park City, Tintic, and Beaver.

Coal production of this state in 1914 totaled 3,103,036 short tons worth $4,935,454, according to the U. S. Geological Survey. This was a decrease of 141,792 tons, due to less business on the railroads and at smelters. There were 4112 men employed in coal mines. They averaged 3.6 tons each per working day.

Beaver County

The report of the Cedar Talisman Consolidated Mines Co. for the year ended March 31, 1915, shows that the revenue totaled $14,964. Expenses were $10,720. Development has opened a large tonnage of lead and zinc ores. Four cars of the latter netted $4000.

Piute County

As soon as the Mineral Products Co. can obtain right-of-way

for the tramway from Marysvale to the alunite deposit at Edna crater, the mineral will be developed. Over $100,000 has been spent by the company. The alunite contains up to 13% potash. Bauxite also occurs there. H. H. MacDowell is vice-president.

SALT LAKE COUNTY

Ore is now being hauled from the Alta Con. mine to Wasatch.——Eight feet per day is being driven in the cross-cut of the Emma copper mine. Small veins have been cut, and a good development is expected at any time.——The Albion company has started cross-cutting for the Greeley fissure at the quartzite-limestone contact. Part of the Quincy adit is being re-timbered.——The South Hecla has commenced shipping 15% lead ore.

SUMMIT COUNTY

In Bulletin 581-E of the U. S. Geological Survey, Carroll H. Wegemann describes the Coalville coalfield. This district is 30 miles northeast of Salt Lake City, near Coalville. High-grade bituminous coal has been mined for over 50 years. Three beds are worked at present. They are involved in extensive rock folding, and are broken by faults of considerable magnitude. The operating mines are large and well equipped.

A Callow flotation plant is to be installed in the Silver King Coalition mill at Park City. The present concentrating plant is treating 250 tons per day. This will be increased to 600 tons with the new equipment.

WASHINGTON COUNTY

About 85 men are now employed in the Goldstrike district. The new road from Modena, on the Salt Lake Route, is complete. Rich ore has been cut in the Sentor claims of the Goldstrike Con. company.

CANADA

BRITISH COLUMBIA

During the week ended May 29 the Trail smelter received 6941 tons of ore, including some from Washington mines. For the year the total is 177,035 tons.——A lease has been taken on the Blue Bird at Rossland by E. L. Tate, of Spokane. The mine promises to develop well.——The Tonopah Belmont company, of Nevada, has arranged for an extension of its option on the gold mine at Surf inlet. A lower adit has not yet cut the shoot opened above.——The Quatsino Copper Co. has been formed with a capital of 1,000,000 $5 shares. It will develop a property an Vancouver island.

ONTARIO

The report of the International Nickel Co. for the year ended March 31, 1915, contains the following: the net income was $7,230,760, against $6,566,786 in 1913. Out of the balance of $5,598,071, dividends amounting to $5,288,694 were paid. The year commenced with a surplus of $5,006,247, and ended with $5,315,624. When the War started the company's business was considerably affected, but since the end of 1914 there has been an increasing demand for the product.

MEXICO

HIDALGO

In April the Santa Gertrudis mill treated 13,228 tons, yielding a profit of $27,360.

PERU

(Special Correspondence.)—La Cotabambas Auraria is the largest gold producer in Peru. It yields about $25,000 per month. This is recovered from amalgamation plates of a 10-stamp mill. A small cyanide leaching plant consists of 8 tanks, 12 ft. diameter by 4 ft. high. It treats about 12 tons per day. The company has ordered a Dorr classifier, 2 Huntington mills for regrinding, 2 Dorr thickeners, 2 Parral tanks, rotary-blower, stock-tanks, pumps, etc., necessary to treat 20 tons per day, by agitation. In case the extraction obtained by the new installation is equal to that obtained in preliminary tests, the company will immediately order additional machinery requisite to treat 100 tons per day.

Cuzco, May 1.

PERSONAL

W. MOTHERWELL is here from Miami.

O. B. PERRY is at the St. Francis hotel.

H. W. HARDINGE was at Juneau recently.

JOHN B. FARISH is due at Denver from New York.

BEN. S. REVETT has returned hither from Colorado.

A. C. LAWSON has gone to Alaska and will return in July.

JOHN T. REID will return from New York to Nevada about June 15.

F. SATCHELL CLARKE, of Vancouver, B. C., was here during the week.

C. M. HERON is examining placer ground along the Sacramento river.

WILLIAM MACKENZIE has returned to Santa Paula, California, from Nevada.

T. B. CROWE, S. J. CONNOLLY, and J. M. TAYLOR, of Cripple Creek, are at the Plaza hotel.

H. FOSTER BAIN has been elected a member of the Institution of Mining and Metallurgy, London.

W. A. ESTABROOK will be retained as superintendent of concentrator at the Washoe plant, Montana.

JOHN D. RYAN has been elected president of the Anaconda Copper Co., B. B. THAYER becoming first vice-president.

I. NAGAZUMI, of the mining department of the Imperial University at Kyushu, Japan, is in Montana. He has also been in Utah.

MAX ROESLER is the first recipient of the Emmons Memorial Fellowship. Since February he has been instructor in geology at Yale.

M. E. PURCELL, superintendent of the Consolidated Mining & Smelting Co.'s Centre Star-War Eagle group of mines at Rossland, B. C., is expected in San Francisco.

E. S. BARDWELL, who has been in charge of the Anaconda company's exhibit at the Exposition, has returned to the Boston & Montana reduction works at Great Falls.

RALPH HAYDEN, formerly superintendent of slime plants, has been appointed superintendent of the re-grinding and flotation plants at the Washoe Reduction Works, Anaconda.

FERDINAND MCCANN has been examining the mill at La Cotabambas Auraria property, Peru. He is in charge of erection of new plant, and will be there till about the end of this year.

A. E. WIGGIN, formerly concentration engineer, has been appointed superintendent of concentration and will have charge of all concentrating operations of the Anaconda company in Montana.

C. R. WRAITH, who was formerly employed as a chemist in the laboratory at the Washoe Reduction Works, has been placed in charge of the Anaconda company's exhibit at the Exposition.

C. E. WEED has been appointed underground mining superintendent at the Lake mine. Mr. Weed is a graduate of the Michigan College of Mines and for several years has been mining superintendent at the Victoria mine.

Obituary

PATRICK CLARK, well known in the Coeur d'Alene, Idaho, died of heart-failure at Spokane on June 7.

JOSEPH WEISSBEIN was burned to death in a house at the Pittsburg mine, Nevada City, on June 5. Foul play is suspected.

W. M. JOHNSTON died in Chicago on May 13, aged 69. He was president of the mining machinery firm of W. M. Johnston & Co., who have been in business in Chicago for the past quarter of a century. As a mining man he was well known throughout the western states, Alaska, and Mexico.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets

Metal Prices

San Francisco, June 10.

Antimony	35 —35¾
Electrolytic copper	19¼—19½
Pig lead	6.25— 7.20
Quicksilver (flask)	$90.00
Spelter	25 —25¼
Tin	39½—41
Zinc-dust, 100-kg. zinc-lined cases	27½

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, June 10.—Domestic buying of copper is active; lead is strong with recent advances; excitement in spelter is diminishing, but the market is strong.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
June 3	49.25	Apr. 28	50.60
" 4	49.12	May 5	50.33
" 5	49.25	" 12	50.06
" 6 Sunday		" 19	49.93
" 7	49.37	" 26	49.77
" 8	49.50	June 2	49.40
" 9	49.62	" 9	49.35

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	....
Feb.	57.63	48.45	Aug.	54 35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58 52	50.25	Oct.	51.12	....
May	58.21	49.87	Nov.	49.12	....
June	56.43	....	Dec.	49.27	....

After showing signs of weakness, silver is slowly increasing in price. On June 5 about 430,000 oz. left San Francisco for China. Writing May 20, Samuel Montagu & Co. states that a burst of activity from the Indian Bazaars coming on a somewhat depleted market, caused an upward movement. For a long time they had not been keen on silver speculation. The governing idea seems to be that a substantial advance in price is likely to accompany the cessation of war.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
June 3	5.00	Apr. 28	4.23
" 4	5.20	May 5	4.20
" 5	5.20	" 12	4.20
" 6 Sunday		" 19	4.20
" 7	5.50	" 26	4.20
" 8	5.75	June 2	4.40
" 9	6.00	" 9	5.44

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3 80	....
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	....	Dec.	3.80	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
June 3	19.00	Apr. 28	17.93
" 4	19.12	May 5	18 63
" 5	19 25	" 12	18.75
" 6 Sunday		" 19	18.68
" 7	19.62	" 26	18.50
" 8	19.62	June 2	18 67
" 9	19.75	" 9	19.39

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13 60	July	13.26	....
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13 60	....	Dec.	12.75	....

Exports during the week ended May 22 totaled 15,183,075 lb., valued at $2,614,010. France took 6,394,056 lb., England, 3,989,690 lb.; Italy, 2,804,214 lb.; Denmark, 985,620 lb.; and Russia, 448,489 pounds.

The Amalgamated Copper Co. was dissolved on June 9. It reports as follows for the 16 months ended April 30, 1915: Income and dividends, $8,647,012; interest, $1,034,404; taxes, $80,387; office, $184,932; net income, $7,347,288; and dividends paid (five), $6,924,955. The year 1914 started with a balance of $23,639,139. The period ended with $21,753,153. Total assets are $177,577,835. Profits to date total $113,032,300. Of this, $91,279,147 was paid in dividends.

Production of the Lake Superior mines in May was about 25,500,000 lb., worth $5,100,000.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
May 13	75.00	May 27	75.00
" 20	75.00	June 2	80.00
		" 9	90.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60.00	Aug.	80.00	....
Mch.	39 00	78.00	Sept.	76.25	....
Apr.	38.90	77.50	Oct.	53.00	....
May	39 00	75.00	Nov.	55.00	....
June	38.60	....	Dec.	53.10	....

Stocks of quicksilver are reported to be very low. The entrance of Italy into the War may affect the market. That country produces about 29,000 flasks per year, and it is certain that exports cannot be made from there. The Nevada Cinnabar Co., Ione, on May 29 shipped 310 flasks East. The condensers are to be cleaned out, and from 600 to 1000 flasks is expected.

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
June 3	25.50	Apr. 28	11.04
" 4	26.00	May 5	12.21
" 5	26.00	" 12	14.33
" 6 Sunday		" 19	15.08
" 7	26.50	" 26	17.79
" 8	26.50	June 2	22.10
" 9	26.50	" 9	26.17

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	5.22	9.05	Aug.	4.45	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9 78	Oct.	4.75	....
May	4.91	17.03	Nov.	5.01	....
June	4.84	....	Dec.	5.40	....

Letters from our correspondents in Missouri and Wisconsin appear in this issue, and reflect the local situation of the zinc industry. The Missouri-Kansas-Oklahoma region is excited. Concentrate, 60% metal, rose to $112 per ton. The output of blende, calamine, and lead for the week ended June 6 was valued at $762,320, a record. For the year it totals $9,032,798. Smelting companies at Bartlesville raised wages 15% on June 4. Some miners at Joplin struck on June 6, demanding higher wages. Machine-men received an increase from $3.75 to $4.25 per shift. Many companies advanced wages voluntarily.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915
Jan.	37.85	34.40	July	31.60	....
Feb.	39.76	37.23	Aug.	50.20	....
Mch.	38.10	48.76	Sept.	33 10	....
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	39.28	Nov.	33.51	....
June	30.72	....	Dec.	33.60	....

On June 9 tin was 40c. per pound.

Eastern Metal Market

New York, June 4.

All of the metals are strong and show a tendency to advance. Since May 25 a series of advances in lead totaled $20 per ton and brought the price per pound to 5.20c. A depletion of stocks due to the War demand is the best explanation obtainable. Spelter is higher than ever and its price, as one consumer has expressed it, seems to be whatever the holder wants to ask. Copper is firmer, and more activity has prevailed. Spot tin is plentiful. The May deliveries were next to the record as regards quantity.

Makers of brass valves, fittings, and supplies, who are large consumers of the metals, seen at the convention of the American Supply and Machinery Manufacturers' Association at Philadelphia this week, expressed the opinion that the prices of spelter and antimony have passed the bounds of reason. Some of them have been hard hit, while others, for instance a maker of brass valves, have not been seriously affected, inasmuch as they had ample stocks. A maker of anti-friction metal, of which spelter is the base, said he was not only asking for extension of time in which to make deliveries to automobile manufacturers, but said the size of the deliveries were far under normal. This man looks for 25c. copper. With regard to spelter, one consumer, who gives its price range June 3 as 24.20 to 25.20c., says he understands that the United States government has obtained options on a good part of the production. There had been rumors that the Government was negotiating with one or two large producers.

COPPER

The market has continued quiet, although a little increased interest on the part of domestic consumers has been shown in the last two days, and prices have stiffened. From 18.50c. cash, New York, quotations for electrolytic have advanced to 18.87½ to 19c. cash, on prompt shipments, these being the quotations June 4. A few sales at the higher price are reported. There is less re-sale metal offered. A feeling on the part of some consumers is that prices are destined to go higher, and those who have not covered their requirements are making inquiry. The exports in May totaled 28,884 tons, against 32,077 tons in the same month last year, a fairly good showing, considering all conditions. Of the May exports, 13,416 tons went to France, 8643 tons to the United Kingdom, 4261 tons to Italy, 1449 tons to Sweden, and smaller shipments to other countries. The exports since January 1, exclusive of those at Southern and Pacific ports for May, amounted to 119,546 tons, against 184,312 tons in the same period of 1914, a decrease of about 65,000 tons. Lake prices range from 19 to 23c., with the higher grades nominal, inasmuch as they cannot be obtained for early delivery.

LEAD

The daily advances announced by the American Smelting & Refining Co. in the past few days have caused a swerving of interest in the lead market. The company's quotation is for 50-ton lots. The quotation was advanced on May 27 from 4.30c., New York, to 4.40c. Then followed these changes: 28th to 4.50c., 29th to 4.75c., June 1 to 4.90c. And June 3 the predicted rise to 5c. was announced. On June 4 the largest made its price 5.20c. per pound. The early advances served to arouse interest, and buyers followed the market to 4.90c. and beyond. In the week, more business was done than at any time in two months. An authority in the trade is of the opinion that the War demand has finally depleted the reserve-stocks of the metal. The independent producers, in particular, are believed to be well sold-up ahead. Meanwhile there have been some large inquiries on which the independent producers apparently could not quote.

SPELTER

The market has continued to advance in leaps and bounds, and, so far as prices go, has reached a most uncertain stage. Quotations for prompt shipments range all the way from 26.50 to 27.50c. This week some re-sale metal has appeared, and it is said that some of the offerings are made by consumers who have found substitutes, and are seeking to turn their spelter stocks into cash. Offerings are said to have been made also by some of the smaller manufacturers of galvanized sheets who have withdrawn their ordinary product from the market. There has followed, in consequence, an increased production of black sheets and the prices of these are weaker. The base price of sheet-zinc was advanced June 1 to 26c. f.o.b. mill. Makers of galvanized pipe this week advanced their prices $10 per ton. With the scarcity of spelter and the high prices the volume of business, of course, had gradually been growing less, but the scarcity is the chief restriction to activity at this time. As matters now stand, consumers are in reality bidding the market up on themselves. Sales into next year have been made at 17c. The makers of sheet-brass continue to decline to accept business, and the withdrawal of base prices by the American Brass Co. is still effective. Outside of the War demand there is but little doing in the way of new business with the brass mills.

TIN

Contrary to the trend of other metals, tin has pursued a course of weakness, although greater strength developed today and the quotation (June 4) is 38.12½c. A peculiar feature of the market is that futures have been higher, relatively than nearby deliveries, which may be accounted for by the element of uncertainty for the future which is now felt in all the markets. Some good business has been done in the past few days, both spot and future deliveries being taken, while June and July shipment from the East were in favor. A point in the situation which consumers do not like is that future deliveries are not guaranteed. August delivery has sold at 37c. The statistics for May are interesting, inasmuch as the deliveries into consumption amounted to 5600 tons, the second largest month on record. In the month there was a decrease of 1139 tons in the total visible supply. The total visible on June 1 amounted to 14,646 tons, more than half of which is en route to, or in stock in, this country. There is now afloat 5640 tons. In the first five months of this year deliveries into domestic consumption totaled 17,675 tons, a decrease of 1775 tons compared with the same period last year. On June 3 the steamer *Westward Ho* arrived at New York with 475 tons from Penang, 50 tons from Singapore, and 220 tons from Batavia, thereby adding another large arrival to an already notable list.

ANTIMONY

There is no feature to report, except that the market remains firm, with offerings few. Chinese and Japanese are quoted at 35 to 38 cents.

ALUMINUM

There is a good demand, with quotations at 27 to 28c. There is a good deal of looking around for sheets, which are nominal at 32 to 34 cents.

Exports of metals, June 1 to 5, were as follows: copper, 3725; lead, 1638; and spelter, 135 tons.

Control of the spelter market was discussed by Paul A. Ewert, of Joplin, Missouri, before zinc-ore producers at Webb City recently. There are approximately 120,000 retorts in the United States. Of these, 87,000 are owned or controlled by what is known as the 'Big Five' group of smelting companies. Therefore he said they determine the price of the metal produced.

COMPANY REPORTS

RIO TINTO COPPER COMPANY, LTD.

During 1914 this English company operating in Spain only sold 48,193,600 lb. of copper, against 81,356,800 lb. in 1913. After paying all expenses and adding £185,872 from the previous year, there were £923,251 available, compared with £1,913,769. From a net balance of £899,399, two preference dividends absorbed £81,250. A distribution of 35 shillings ($8.40) per share on the ordinary shares amounted to £656,250. The surplus carried forward was £162,439. Operations are now at the rate of four days per week.

ISLE ROYALE COPPER COMPANY

This Michigan company was unfortunate in 1914, in that it suffered from the effects of the miners' strike in 1913, the copper market, and the loss of its mill by fire at the end of 1914. The plant is now being rebuilt. Results were as follows:

	1914.	1913.	1912.
'Rock' stamped, tons	474,349	314,679	531,105
Copper sold, pounds	6,601,235	3,870,974	7,782,078
Price received, cents per lb..	13.16	15.29	16.66
Cost, cents per lb.....	13.05	18.81	11.89
Total income .....$	885,888	$ 649,946	$1,395,636
Operating profit	38,442	128,313	430,045
Dividend	.....	150,000	.....
Surplus at end of year	199,815	175,441	557,743

COPPER RANGE CONSOLIDATED COMPANY

This Michigan company controls the Baltic, Champion, and Trimountain mines and works. Owing to the copper market, the properties were operated at 50% capacity from early in August 1914 to January 4, 1915. They are now at full production. The past three years compare as follows:

	1914.	1913.	1912.
Ore crushed, tons.....	1,216,538	984,287	1,784,402
Copper produced, pounds..	27,857,457	24,852,026	37,584,647
Revenue .....$	3,726,389	$3,707,091	$6,084,202
Operating profit	871,049	1,054,511	2,422,364
Deductions	412,395	345,698	709,802
Net income	494,600	490,533	1,692,566

Only half of the Champion copper output is included in the profit. The actual production on which the Copper Range company derived profit was 19,953,854 lb. Assets exceed liabilities by $1,105,226.

BROKEN HILL SOUTH SILVER MINING COMPANY

The report of this company for the second half of 1914 affords interesting reading, on account of the effect of the War on this lead-silver-zinc district of Australia. The manager, W. E. Wainwright, reported as follows:

The stoppage amounted to 56 days. Development was considerably curtailed, and totaled 3549 ft., including 698 ft. of diamond-drilling. Ore raised amounted to 111,891 tons, compared with 172,421 tons, averaging 15.3% lead, 7.1 oz. silver, and 14.2% zinc. Filling dumped underground totaled 25,698 tons. The 825, 970, 1070, and 1170-ft. levels produced 10.8, 21.8, 37.3, and 19.4% of the ore mined. The 1270-ft. level yielded 252 tons, and a wide body of ore has been cut at this depth. At 1470 ft. a pump cistern is being excavated near No. 1 shaft. Ore reserves remain at about 3,350,000 tons.

The mill treated 112,750 tons of ore, yielding 20,375 tons of concentrate, assaying 64.9% lead, 21.6 oz. silver, and 8.3% zinc, and 69,943 tons of zinc tailing averaging 3.1% lead, 3.3 oz. silver, and 16.9% zinc. Metal content of the lead concentrate was 13,229 tons lead, 440,817 oz. silver, and 1696 tons zinc, against 19,679, 632,010, and 2034 respectively in the previous half year.

Costs were as follows: mining, $3.11; filling stopes, 20c., development, 59c.; and treatment, $1, a total of $4.90 per ton, a reduction of 22 cents. The revenue from mill products was £185,468, of which £69,252 was profit, against £349,095 and £163,480 respectively in the former period. The balance at June 30 was £143,682, and at December 31, £232,648.

The rainfall was 5.28 in., and water consumed amounted to 26,675,000 gallons.

UNITED STATES SMELTING, REFINING & MINING COMPANY

According to the president of this company, W. G. Sharp, the year 1914 was one of difficulty in many respects. The European war created a business disturbance which affected materially all departments of the company's activities. These included the Mammoth Copper mine in California, the Utah company, producing coal, and the silver properties at Pachuca, Mexico. The staff left the Real del Monte mine and mill in April and returned in September. It has been difficult to get supplies, and the tonnage treated in December was 570 tons per day. At present it is 1400, against a capacity of 2000 tons. It is impossible to forecast future Mexican conditions, but if operations can continue to be conducted on the present scale, the Pachuca properties can be depended on for a substantial contribution to the net earnings during the current year even if silver remains at its present low level of 48c. per ounce. It is a pleasure to note that during all the unsettled conditions in Mexico the properties and employees have always been respected, so that there has never been and property damage or interference with the employees.

Metal output during the past three years was as follows:

	1914.	1913.	1912.
Copper, pounds 17,946,659		20,239,973	21,152,620
Lead, pounds 64,443,260		58,116,504	56,385,769
Silver, ounces	9,936,237	13,089,708	12,059,829
Gold ounces	124,719	148,372	140,183

The average price received for the different metals during the year compared with prices of previous years:

	1914.	1913.	1912.
Copper, cents per pound.....13.404		15.433	16.237
Lead, cents per pound.....	3.827	4.396	4.529
Silver, cents per ounce.....55.564		60.503	61.291

The net profit for the year amounted to $2,265,641, compared with $3,585,586 in 1913. Adding the previous balance of $4,478,842, made $6,744,484 available. Out of this, $1,702,221 was paid in dividends to the preferred shareholders, and $526,671 on common stock, leaving a balance of $4,515,591. Assets include ore and matte, $1,252,012; supplies, $1,461,779; and metal in ore and on hand, $4,472,246, all increases on the previous year.

TAMARACK MINING COMPANY

During five months of 1914 this Michigan company's property was shut down. It is now producing again. The past three years' work is summarized in the following table:

	1914.	1913.	1912.
'Rock' stamped, tons	57,410	227,563	421,385
Refined copper yield, pounds.	1,074,808	4,168,743	7,908,745
Metal sold, pounds	1,074,808	3,852,040	7,298,205
Average price, cents per lb..	12.80	15.45	16.56
Revenue from copper .....$	137,600	$ 642,713	$1,300,238
Cost, cents per pound.....	29.08	16.60	13.15
Loss on operations, including all charges	174,944	48,373	*260,044
Balance of assets	895,993	1,070,938	1,120,861

*Profit.

Work on the re-crushing plant, to treat old tailing in the lake, is well ahead. It is 99 by 240 ft., and will contain 32 Hardinge conical pebble-mills, and 92 Wilfley tables.

BOOK REVIEWS

DIRECT-ACTING STEAM PUMPS. By Frank F. Nickel. McGraw-Hill Book Co., Inc., New York. P. 254. Index. Illustrated. For sale by *Mining and Scientific Press*, San Francisco. Price, $3.

While the development of the centrifugal pump and its generally greater fuel economy has resulted in the displacement of the direct-acting pump in some cases, there remains, nevertheless, a large field of usefulness for the latter type of pump. The present volume, after tracing the historical development of the direct-acting pump, devotes a chapter to the consideration of the factors affecting performance and efficiency. The various types of pumps are then discussed. Pump-end details and steam-end details each have a chapter devoted to them. The selection of a particular type of pump to suit given service conditions is then discussed. Short chapters are devoted to the duty and to the operation and adjustment of direct-acting pumps. The appendix contains data on the friction head when pumping certain kinds of petroleum.

PRACTICAL OIL GEOLOGY. By Dorsey Hager. P. 141. Ill., index. McGraw-Hill Book Co., Inc., New York. For sale by *Mining and Scientific Press*, San Francisco. Price, $2.

For many years the relations between the geologist and the 'practical' oil-man have resembled either armed neutrality or actual warfare. Like most other warfare, this has been caused by misunderstandings on both sides, while the extravagant claims of the extremists in both camps have tended to widen the breach. The present volume partakes more or less of the nature of an attempt by a geologist to extend the olive-branch to those on the opposing side. After discussing the theories of the origin of petroleum, its physical and chemical properties are briefly considered. The elementary facts of structurel geology and stratigraphy are considered and the value to the oil-man of a knowledge of these facts is clearly shown, both as regards the initiation of operations in 'wild-cat' territory and the placing of wells in both 'wild-cat' and proved fields. The book also treats briefly of some of the commoner problems in well-drilling and in maintaining production, and particularly the problem of combatting water. While there are occasional sweeping statements to be found in the book, which might mislead the novice, in general it will be found of value to those interested in the oil industry.

TUNNELING. By Eugene Lauchli. P. 230. Ill., index. McGraw-Hill Book Co., Inc., New York. For sale by *Mining and Scientific Press*, San Francisco. Price, $3.

In few branches of engineering has there been as much progress in the past few years as in tunneling. Improved kinds of machinery for drilling and for the removal of excavated materials have followed rapidly upon each other until records for speed in tunneling are broken almost as often as records for speed of automobiles. With improved machinery has also come more careful study of geological conditions with a view to predicting the formation, pressure, and temperature in long mountain tunnels, making possible the successful completion of tunnel projects that would have been doubtful at least a few years ago. The methods of driving tunnels of small cross-section and also of driving railroad tunnels of moderate length are discussed, but the driving of long tunnels is given the fullest treatment. The methods of removing excavated materials, and of ventilation in long tunnels are carefully considered. So also is the question of rock-pressure as affecting the lining of deeply-overlaid tunnels. Driving tunnels through soft materials by compressed air and by other methods is also considered.

RECENT PUBLICATIONS

THE PITCHBLENDE OF CORNWALL, ENGLAND. By R. A. F. Penrose, Jr. P. 11. Reprint from *Economic Geology*, March 1915.

THE SYSTEM ANORTHITE-FORSTERITE-SILICA. By Olaf Andersen. P. 47. Illustrated. Reprint from *The American Journal of Science*, April 1915.

CRYSTALLIZATION-DIFFERENTIATION IN SILICATE LIQUIDS. By N. L. Bowen. P. 17. Reprint from *The American Journal of Science*, February 1915.

THE POLYPORACEAE OF WISCONSIN. By J. J. Newman. Bulletin 33. Wisconsin Geological and Natural History Survey. P. 206. 25 plates. Madison, 1914.

COAL FIELDS OF PIERCE COUNTY, WASHINGTON. By Joseph Daniels. Bulletin 10. Washington Geological Survey. P. 146. Ill., maps, chart, index. Olympia, 1914.

ANNUAL REPORT OF THE DIRECTOR OF THE GEOPHYSICAL LABORATORY OF THE CARNEGIE INSTITUTION OF WASHINGTON. Abstracts from Year Book 13. P. 24. Abstracts from this publication have been made for the 'Concentrates' page of the *Press*.

ANNUAL REPORT of the inspector of mines, W. H. Harvey, for St. Louis county, Minnesota, July 1, 1913, to June 30, 1914. P. 62. Eveleth, 1914. This report contains a lot of interesting matter. The district produced 27,409,441 tons of iron ore in 1914.

ELECTRIC CENTRAL STATION OPERATION IN IOWA. By F. A. Fish and H. W. Wagner. Bulletin 38. Engineering Experiment Station of Iowa State College of Agriculture and Mechanic Arts. P. 164. Ill., index. Ames, 1915. In 1912 there were 223 stations in Iowa, with an output of 67,166,647 kw.-hours.

Department of Mines, Ottawa, Canada, 1915:

CLAY DEPOSITS NEAR MCMURRAY, ALBERTA. By Sydney C. Ells. Bulletin 10. P. 15.

INVESTIGATION OF THE PEAT BOGS AND PEAT INDUSTRY OF CANADA, 1911-12. By A. v. Anrep. Bulletin 9. P. 47. Ill., 19 plates, maps, charts, plans, index.

MINERAL PRODUCTION OF CANADA, 1913. Compiled by John McLeish. P. 363. Chart. The output was $145,634,812.

University of Illinois, Urbana, 1915:

THE EFFECT OF BORON UPON THE MAGNETIC AND OTHER PROPERTIES OF ELECTROLYTIC IRON MELTED IN VACUO. By Trygve D. Yensen. Bulletin 77. P. 19. Illustrated. This bulletin is the second of a series dealing with the magnetic, electrical, mechanical, chemical, and metallurgical properties of iron melted in a vacuum furnace. It was shown in Bulletin 72 that iron of an exceptionally good magnetic quality could be produced in such a furnace. No. 77 gives the results obtained by adding boron to pure iron. Small percentages of boron added are shown to improve the iron slightly, while boron added in sufficient amount to leave a measurable quantity combined with the iron has a decidedly detrimental effect upon the magnetic properties. The crystalline structure of the alloys is shown by means of numerous photographs.

COAL RESOURCES OF DISTRICT 1 (LONGWALL). By Gilbert H. Cady, K. D. White, and others. Bulletin 10. In co-operation with the U. S. Geological Survey. P. 149. Ill., plans, maps, index.

COAL RESOURCES OF DISTRICT VII. (Coal No. 6 west of Duquoin incline.) By Fred H. Kay, K. D. White, and others. Bulletin 11. P. 233. Ill., maps, charts, index.

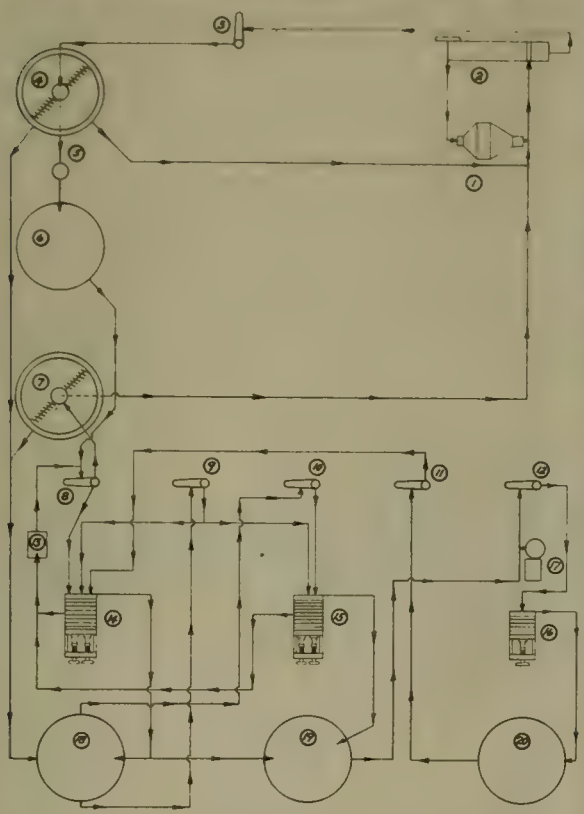
New Machines and Devices

Information based on letters and catalogues from manufacturers

Cyanidation at the Exposition

Excepting a crusher, a complete cyanide plant is at work in the Palace of Mines and Metallurgy at the Exposition. It consists of the following:

The Hardinge Conical Mill Co. operates an 18-in. by 4 ft. 6-in. conical pebble-mill. A Westinghouse 25-hp. motor drives it at 30 r.p.m. by means of flexible coupling and herringbone gear. The usual scoop-feed is attached. In closed-circuit with the



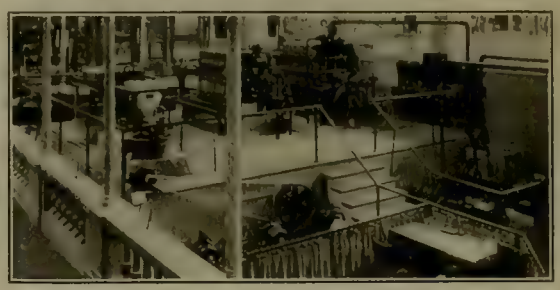
LEGEND

(1) 4½ ft. by 18-in. Hardinge mill. (2) Quarter-size simplex Dorr classifier. (3) 1½-in. single-stage centrifugal pump. (4) 8 by 6-ft. Dorr thickener. (5) No. 2 diaphragm pump. (6) 8 by 6-ft. Dorr agitator. (7) 8 by 6-ft. Dorr thickener. (8) 3-in. single-stage centrifugal slime pump. (9) 2-in. 4-stage centrifugal pump. (10) 2-in. single-stage centrifugal pump. (11) 1-in. 3-stage centrifugal pump. (12) 1-in. 3-stage centrifugal pump. (13) 24 by 30 by 30-in. sump. (14) 10-frame Merrill 3 by 4-ft. sluicing-slime filter-press. (15) 20-frame Merrill 3½ by 3½-ft. sluicing-clarifying filter-press. (16) 10-frame Merrill 36-in. triangular-agitating precipitation-press. (17) Merrill precipitant feeder and grinder. (18) 8 by 4½-ft. unclarified solution tank. (19) 8 by 4½-ft. clarified solution tank. (20) 8 by 4½-ft. barren solution tank.

mill is a ¼-size simplex Dorr classifier. A Byron Jackson 2-in. centrifugal pump lifts pulp to a thickener.

In the Dorr Cyanide Machinery Co.'s part of the installation, Homestake slime is used. There is a 6-ft. deep by 8-ft. diameter ordinary thickener, with diaphragm pump discharge. The thickener has an overload alarm and lifting device. The tank works at one revolution in four minutes. From the thickener the slime goes to a 6 by 8-ft. agitator. This works at 3 r.p.m. Agitator slime is pumped to a Merrill press for filtration. Tailing from the latter is pumped to another thickener for water recovery.

The Merrill Metallurgical Co. has installed an extensive plant. Slime from the agitator mentioned is pumped to a 10-frame, 2½-in. cake (36 by 48-in.) automatically-sluiced slime-press. It has a capacity of 30 tons per day with average pulp. Time occupied in filling is 5 to 7 minutes; washing, 10 to 15 minutes; and discharging, 10 minutes. Reciprocating gear moves the sluicing-pipe for discharging through a maximum of 220°. A clarifying-press takes the thickener (mentioned) overflow. This is a 20-frame, 1-in. cake, 42 by 42-in. automatically-sluiced press. It is a new type of clarifier, and is of 600-ton capacity. The new features are thinner frames, and central motor-driven sluicing-pipe. Clarified solution is next



FILTER-PRESS PLANT.

brought into contact with zinc-dust from a precipitant-feeder and thence to an agitator, pumped through a precipitation-press. The speed of the feeder is regulated by cone pulleys. The precipitant and gold solution meet in the suction pipe between the pump and solution tank. The press has 10 frames, 2 in. wide, and is known as a triangular agitation precipitation filter-press. It has a capacity of 125 tons of solution per day. Five Byron Jackson one to four-stage pumps, direct connected to Westinghouse motors, producing up to 100-lb. pressure for sluicing, are used in the Merrill plant.

Pumps, Crushers, and Steel at the Exposition

In the Palace of Machinery at the Exposition, Harron, Rickard & McCone, of San Francisco, have the largest individual space. Some of the exhibits are as follows:

Two Aldrich mine pumps. Both are similar in design, triplex, valves being very accessible, glands easily packed, adjustable guides, bearings adjustable, cast-steel herringbone gear, occupy little space, and are motor driven, using a flexible coupling. One pump has plungers 7½ by 10 in., 7-in. suction and 8-in. discharge. It is driven by a 75-hp. Westinghouse motor. With a 500-ft. lift it pumps 300 gal. per minute, showing 84% efficiency. The other machine has 2½ by 7-in. plungers. Driven by a 20-hp. General Electric motor it can lift 35 gal. per minute from a depth of 1500 feet.

Sturtevant duplex ring-roll mills are exhibited. The rollers work in a grooved ring. A pressure of 20,000 to 60,000 lb. is attained. The No. 2 duplex weighs 25 tons. Rolls are 10 by 18 in. The ring speed is 64 r.p.m. Seventy to 90 hp. is required. Reducing to 20 mesh the capacity is 15 to 20 tons per hour dry crushing. The Sturtevant 'Newaygo' screen has large ca-

pacity. It will handle 1¼ to 180-mesh product. It will pass 11 tons per hour through 20, and ¾ ton through 100 mesh.

Laboratory and sample crushers are shown. They are easily accessible for cleaning.

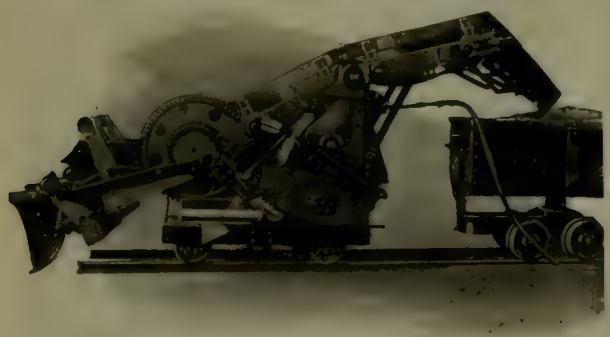
Mining shovels and barrows of best make are on view. A complete 3½-in. Keystone drill is ready for boring to 400 ft. in rock, and 600 ft. in softer ground.

A 300-hp. Cochrane water-feed heater, with a meter guaranteed to 1½%, is of interest to steam users.

The well known Toledo mining steel is displayed, including a beautifully finished collection of hammers, chisels, sections of drill steel, etc., in a case. An interesting exhibit is made by the Carborundum Co. of Niagara Falls. The variety of purposes to which this artificial abrasive is put is surprising.

Underground Shoveling-Machine

The Halby shoveling-machine, manufactured by the Lake Shore Engine Works, Marquette, Michigan, is of a new design. It has been operated successfully for six months in one of the iron mines of northern Michigan. It costs $6.37 to work the



HALBY SHOVELING-MACHINE.

machine an 8-hr. shift. If 200 tons of ore were loaded per shift, the cost is 3.18c. per ton. Hand labor would cost about 10.2c. per ton. In the Judson mine at Alpha the machine works in an 8 by 8-ft. drift. Under normal conditions it fills a two-ton car in 1½ minutes. About 200 cu. ft. of air per minute is required when loading. Gasoline or electricity can also be used. The machine is 15 ft. long (can be shortened to 10 ft.), 5 ft. 4 in. high, and 4 ft. wide, and weighs 7500 lb. It can load 40 tons of heavy ore per hour if necessary.

Commercial Paragraphs

Beaudry motor-driven hammers are described in a 7-page booklet issued by BEAUDRY & CO., INC., Boston.

The SULLIVAN MACHINERY CO. announces that its Juneau, Alaska, office is now in the Forrest building. Burt B. Brewster is in charge.

A new laboratory and office building is being erected by the TROPENAS CONVERTER CO., New York, at Brooklyn. An experimental plant is contemplated.

A 5 by 7-ft. adjustable quick-discharge tube-mill and Wood's type wet-screen of CHALMERS & WILLIAMS make are being installed by the Washita Lead & Zinc Co., Davis, Oklahoma.

Bulletin 221 of the LINK-BELT CO., Chicago, describes the patented circular storage-system for coal, gravel, rock, etc. The system is especially economical for storing over 5000 tons of material.

A new mine telephone has recently been devised and is being placed on the market by L. T. WEISS, of New York. It has been tested in several mines for over a year, one being the property of the International Nickel Co., Ontario.

The TERRY STEAM TURBINE CO., Hartford, Connecticut, an-

office is at St. Paul. The Hawkins-Hamilton Co., Lynchburg, for the territory in Minnesota, North and South Dakota. His office is at St. Paul. Hhe Hawkins-Hamilton Co., Lynchburg, Virginia, represent the firm in this state.

Sprays for cooling condensing water, and washing and cooling air for turbo-generators, are discussed in Bulletins 101 and 151 of the SPRAY ENGINEERING CO., Boston. Sprays and ponds are shown in operation. This is an important subject for steam users.

Arthur Putnam Scott has recently been appointed head of the metallurgical department of the SNYDER ELECTRIC FURNACE CO., of Chicago. He graduated at McGill University, Canada, and has held positions with that institution, the Dominion Iron & Steel Co., and General Electric Company.

The NORDBERG MANUFACTURING CO., Milwaukee, Wisconsin, announces that E. W. Swartwout, formerly of the Chicago office, will be associated after June 1 with Mr. MacLaren in the New York office of the company. Enlarged offices have recently been taken in the new Equitable building, 120 Broadway, New York. The Chicago office will be in charge of John E. Lord.

Lucius F. Hallett, of Denver, owner of the Humboldt mine near Ward, Boulder county, Colorado, is replacing the stamps in the mill with new equipment ordered from the DENVER QUARTZ MILL & CRUSHER CO. This consists of one 8 by 12-in. Denver steel crusher, a No. 1 Denver ore-feeder, and a No. 1 Denver quartz-mill. The Humboldt ore contains iron pyrite and will be treated by amalgamation and concentration.

The steel plant of the INTERNATIONAL HIGH SPEED STEEL CO. at Rockaway, New Jersey, is now rapidly nearing completion. It is expected that it will be in full operation by the latter part of June. The product will be confined to the highest qualities of tool-steels, alloy-steels, high-speed steels of all shapes and sizes, solid octagon and cruciform, and hollow hexagon and round rock-drill steels, for which the company claims it has already achieved an enviable reputation in its famous 'Bulldog' brand.

Concentration of molybdenum ore is difficult. The molybdenite is soft and flaky, and in crushing the ore a great deal is reduced to a fine mesh, and is generally lost. The Ore Concentration Co., of London, states that this difficulty has been overcome in many instances by using the ELMORE process. This consists of a vacuum pan in which pulp, oil, and acid (if necessary) are mixed. The valuable minerals are floated off. Two plants in Norway are giving good results. Ore crushed to 30-mesh gave an average recovery of 91.7 per cent.

In *Catalogue* 8 of the AUTOMATIC STEAM TRAP & SPECIALTY CO., of Detroit, Michigan, the use of the Barton expansion automatic steam-trap is described. The makers claim the following: insures a steady, even distribution of heat; air-hammering is done away with; less fuel and more heat; will increase capacity of any heating plant while decreasing running expense; will overcome the lowering of temperature which naturally ensues as distance from heart of heating plant increases; will expel all water continually condensing in pipes; and is automatic in action, saving an engine and a safeguard against negligence.

The GENERAL ELECTRIC CO. has recently issued illustrated Bulletin No. 41,013, giving a detailed description of that company's direct-current commutating-pole motors, known as type RC. These motors are built with a frame of cast steel of medium weight with symmetrical section. They can be used with sliding-base that maintains a correct driving-alignment, which, with the adjustable shields, permit the installation of the motor on either the floor, wall, or ceiling. These motors may be equipped with covers, rendering them what is known as semi-inclosed, totally inclosed, or self-ventilated. They are wound for 115, 230, and 550 volts direct-current circuits, with permissible voltage range of from 110 to 125, 220, 250, and 500 to 600 volts.

Mining and Scientific Press

Edited by T. A. RICKARD

Volume 110 SAN FRANCISCO, JUNE 19, 1915 Number 25

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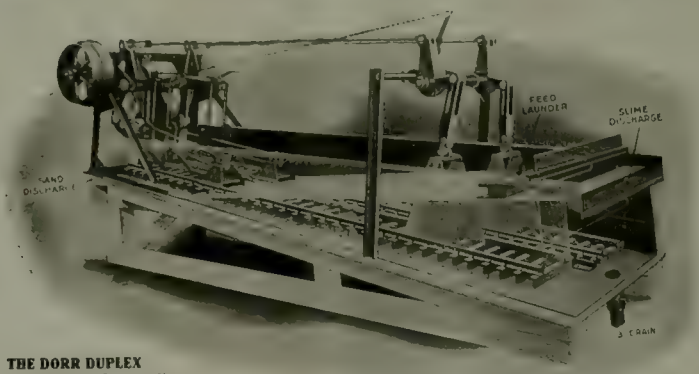
50  50

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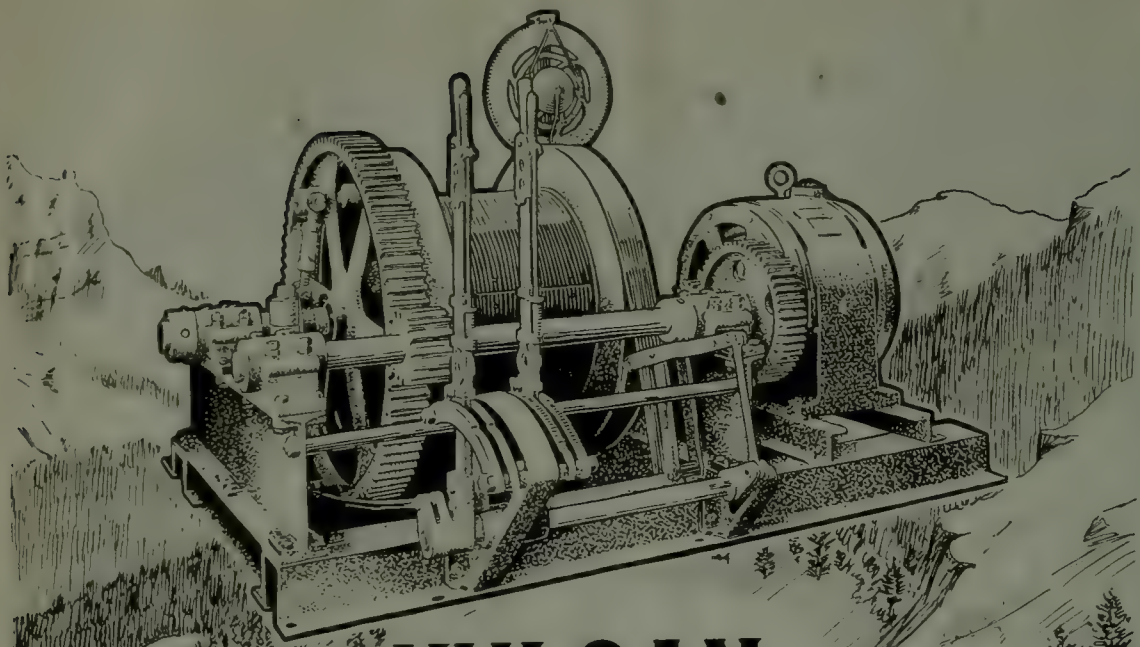

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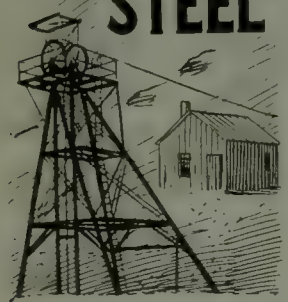

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SAN FRANCISCO, JUNE 19, 1915

Advertisers Index, Last Page
Buyers Directory—Page 30

TABLE OF CONTENTS

EDITORIAL

Page.

NOTES 935

THE BASE METALS 936
Effect of the War on their production.

THE MINE SAFETY CONFERENCE 937
A noteworthy progressive movement.

LEARN SPANISH, ALSO RUSSIAN 937
When Opportunity knocks she does not wait for an interpreter.

MINING LAW IN ALASKA 938
The local engineering society has aided in perfecting the revised code.

DISCUSSION

ASSAY OF ORE CONTAINING METALLICS.
By Richard Marsh 939
Loss by dusting should be taken into account.

MELONES MINING COMPANY.
By William G. Devereux 939
Correction of unauthorized statements regarding it.

SPECULATION IN MINES.
By T. F. Banigan 940
Elimination of the grafter and skilled direction of mining operations are essential.

CAPS AND FUSE.
By T. C. Purcell 941
Suggested use of black powder in caps.

AUTOMATIC DRESSING OF AMALGAMATED PLATES.
By Algernon Del Mar 941
The plates at the Duplex mill had insufficient inclination.

POSSIBILITIES OF THE MOTHER LODE IN DEPTH.
By John Daggett and J. T. Wheeler 941
A letter of historical interest.

EFFICIENCY OF TAMPING.
By H. C. Cutler 942
Criticism of an earlier article on this topic.

THE SEARCH FOR PLATINUM.
By Howard D. Gray 942
Considerable bodies of low-grade ore have been found at the Rambler mine, Wyoming.

ARTICLES

GRASS VALLEY RE-VISITED—I.
By T. A. Rickard 943
The two principal mines are characterized by continuity of operation and ownership, several smaller properties are doing well. Cast-iron and steel frames have been used in two of the mills, a new type of cam has given better results. Tailing at the Empire mill is passed through a terra-cotta pipe.

OIL EXHIBITS AT THE EXPOSITION 946
An excellent demonstration of the petroleum industry.

KAOLIN. Page.
By Wilson W. Hughes 947
That used in Europe was first brought from the United States, now we import nearly a million dollars worth annually. Kaolin is a hydrous silicate of aluminum, it must be free from impurities for most uses. It is purified by washing, this is combined with mining operations, the washed product is then dried in rather crude apparatus.

ZINC SMELTERS IN UNITED STATES 950
Five companies own 95,000 out of a total of 120,000 retorts in the United States. The ore-producers think this indicates that there is a 'Trust.'

THE TRANSVAAL AT THE EXPOSITION 951
The importance of the Rand as a gold mining district is well brought out by its exhibit.

CYANIDE PLANT AT KUSHIKINO, JAPAN 952
A miniature copy of the Goldfield Consolidated plant has been built at this mine, near Kagoshima, in Kyushu. The ore contains $5.50 gold per ton, and 1,000,000 tons are in reserve.

BEAVER LAKE DISTRICT, SASKATCHEWAN.
By Charles A. Banks 954
The region near Beaver Lake can be reached by railway. The first claims were staked in 1913. The deepest shaft has reached 70 ft., exposing 4 to 5 ft. of ore said to average $16 per ton in gold.

ERUPTIONS OF MT. LASSEN AND TERTIARY ERUPTIONS OF THE SIERRA NEVADA. *By H. W. Turner* 955
The recent eruptions have been of the nature of steam explosions. The hot fragments thrown out have melted the snow and given rise to mud-flows that have extended some distance from the crater.

SMELTING AT GREENWOOD, BRITISH COLUMBIA 956
Per furnace-day 674 tons of charge was smelted, using 13.52% of coke and yielding a 39.7% copper matte. Of the copper present in the ore 77.27% was recovered.

DEPARTMENTS

CONCENTRATES 957
REVIEW OF MINING 959
Lordsburg, New Mexico; Toronto, Ontario; Deadwood, South Dakota; London; Kalgoorlie, Western Australia.
THE MINING SUMMARY 963
PERSONAL 967
SCHOOLS AND SOCIETIES 967
THE MARKET PLACE:
Metal Prices 968
Eastern Metal Market 969
COMPANY REPORTS 970
Calumet & Hecla Mining Company; Round Mountain Mining Company.
MINING DECISIONS 970
BOOK REVIEWS 971
Valves and Valve-Gears, *By Franklin DeRonde Furman;* Good Roads Year-Book for 1915; Design of Steel Bridges, *By F. C. Kuntz.*
RECENT PUBLICATIONS 971
NEW MACHINES AND DEVICES:
A New Stoping Drill 972
Valves at the Exposition 972
Commercial Paragraphs 972

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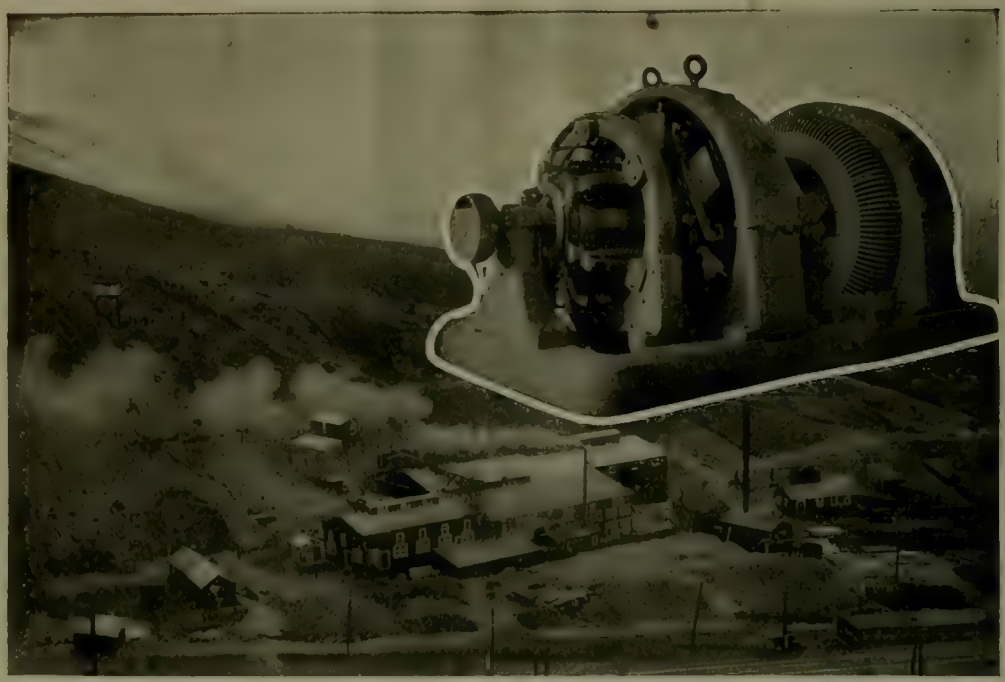

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5460

EDITORIAL

T. A. RICKARD - - - - Editor THOMAS T. READ - Associate Editor

"AND where do I come in?" says the silver miner. "Why don't they use silver bullets or silver-plate their shrapnel?" We sympathize. Silver is almost the only metal that has not risen, for gold in matters of this sort is *hors concours*.

OVERTURES looking to a settlement of an apex conflict over new discoveries of ore having failed between the Empire and North Star mining companies at Grass Valley, we regret to announce the probability of immediate litigation.

AUSTRALIA has placed an embargo on the export of zinc-dust. This went into effect on June 15. Some of it was coming here and some of it was going to South Africa. The embargo will affect the price here by decreasing competition for domestic product.

QUICKSILVER likewise has taken another jump, to over $90 per flask of 75 pounds. The Japanese are drawing on California, so also South Africa. Mining for quicksilver in California, Nevada, and Texas should profit thereby.

INDUSTRIAL corporations manufacturing munitions are making enormous profits and consuming great quantities of the base metals. It is estimated that these "converted arsenals" have obtained contracts already to supply $500,000,000 worth of material, of which as yet only $30,000,000 worth has been shipped.

IMMIGRATION to the United States during the first eight months of the present fiscal year made a net addition to the population of only 14,269, as against 601,000 in the corresponding period of the previous year. That is one of the important consequences of the War. Unemployment is diminishing; a scarcity of skilled labor is anticipated.

ALREADY the rise in metals has had a favorable effect on the shares of the big metal-producing enterprises such as the American Smelting & Refining, the Guggenheim Exploration, Federal Lead & Mining, United States Smelting, Refining & Mining, United States Reduction, New Jersey Zinc, and kindred companies. As yet it has not caused the starting of new undertakings in proportion to the improved outlook, but many of them are being incubated and will be in evidence shortly.

FLOTATION processes are gradually finding a place in treatment plants throughout the world. The annual report of the Seoul Mining Company, Korea, states that during 1914 a flotation plant was started in the Suan mill. Gold extraction was increased from 82 to 88%, and copper from 20 to 75%. The ore contains these metals and bismuth. There are many other mines in the world that have gold ore containing minerals interfering with cyanidation but removable by flotation.

LEAD was dull for three or four months previous to the last week in May. Thereupon the price increased by $50 per ton within three weeks. This was due to the disposal of an accumulation of the metal and the sudden demand in the manufacture of terne-plates or roofing-tin. The American Smelting & Refining Company has the whip-hand, for the independent smelters appear to have no lead to sell for delivery in the next two or three months. The St. Louis price has exceeded that quoted at New York, while under normal conditions the reverse obtains. This market, like that for the other base metals, is in an excited state and surprises may be expected.

GOVERNOR Hiram W. Johnson has signed the Maddux bill, intended to provide measures for protecting the oilfields against underground water. The new law places the matter under the jurisdiction of the State Mining Bureau, and compels the oil-operators to file all necessary data with the Bureau. Engineers are to be stationed in various localities, in order that proper facility be given for the operation of the law. Legislation upon the matter of water infiltration in the oil-sands of California has been agitated for a number of years, for the untold damage arising from this cause has long been recognized; but until this recent session of the legislature it seemed impossible to get the various op-

erators to agree upon the best means of regulation. The State Mining Bureau was requested to assist the oil industry, and its efforts have finally met with the hearty co-operation of all oil-operators, resulting in a means of regulation to which there has been no opposition, and through which great benefits to the industry should ensue.

GOLD production generally has not suffered from the War because so little of it is derived from Europe. Even the big mines of the Transvaal, owned by English, German, and French shareholders continue to produce their quota of the most necessary metal, despite the national conflict that compels the dividends of some of the shareholders to be set aside until peace is restored. In Rhodesia, West Africa, India, and Australia the output of gold is well maintained, thanks in part to the arrangements made by the British government for advancing 97% of the value of the gold upon its delivery at the local banks, and also the facilitating of cyanide shipments to the mines. On this continent gold production proceeds as usual and in Asiatic Russia the operations in the Lena and other gold-producing districts have been hindered only by an occasional shortage of labor due to mobilization. On the whole, the main sources of supply are not affected by the War, but new ventures are without the capital to make them active, and will continue to feel the lack of it, as regards London, for the British Treasury has placed an embargo on new issues. Therefore the total output of gold in the world will suffer decrease now and a more marked diminution later, for the reason stated and also because fresh enterprise will be diverted to the exploitation of the base metals, the price of which, relatively has been rapidly enhanced.

The Base Metals

The sensational rise of copper, antimony, and zinc has been followed by a vigorous spurt in the quotation for lead. These changes, all favorable to the miner, are largely the result of the War, in the waging of which enormous quantities of munitions are required. The demand for copper and zinc indicates the increased use of brass; the consumption of lead seems to need no explanation, for it is the metal generally associated with war; but in this case the obvious is not the fact. The consumption of lead in modern warfare is small, as compared with steel and brass. Lead has risen because it is being employed as a substitute for zinc, in the making of terne-plates or roofing-tin, instead of galvanized iron. Antimony is added to the lead in bullets to harden them. Subjoined are the prices of the principal base metals at three successive periods, namely, just before the War, during the collapse following the naval blockade, and on the day of this writing. The figures are eloquent. For further information we give the ratio of production and consumption of the principal base metals in the United States as compared with the grand totals of production and consumption in the whole world.

PRICE IN CENTS PER POUND

Metal.	July 3, 1914.	October 14, 1914.	June 14, 1915.
Copper	13.35	11.40	20.50
Lead	3.90	3.60	7.25
Zinc	4.75	4.55	26
Antimony	6.90	11.00	36
Tin	30.75	30.00	42.50

	Copper	Lead	Zinc	Antimony	Tin
Percentage of world's supply produced in U. S.	55	34	32	..	..
Percentage of world's production consumed in U. S.	37	33	26	40	43

It will be seen how enormous is both the absolute and the relative consumption of the three chief metals in this continental country, in which material civilization has been so highly developed. Two of the base metals are not produced in the United States in notable amount. Of antimony there is only about 2500 tons, obtained from the smelting of antimonial lead, mostly of foreign origin. The antimony of the world, amounting to about 20,000 tons per annum, comes chiefly from China and France. The supplies of the latter come from its south-eastern territory, outside the war area, while delivery of Chinese antimony has been hindered by the disorganization of transport. Mexico has recently become of importance in antimony production, and Canada has resources capable of making a considerable contribution of this metal. Of tin also it cannot be said that any noteworthy amount is produced in this country: only about 50 tons per annum, chiefly from Alaska, as against a world's production of 120,000 tons.

In normal times Germany consumes about one quarter, say, 250,000 tons, of the world's production of copper. As imports have stopped, it is presumed that Germany is employing a substitute and also using the manufactured copper in the country. England and France are buying copper freely. As for zinc, apart from the increased demand for making the brass used in munitions, the diminution in the supply of that metal from Australia has proved an important factor. The Broken Hill mines, which produce normally about 200,000 tons of zinc, or one-fifth of the world's output, are unable to market their produce because they are under contract to the Belgian and German smelters. Some of the Australian zinc concentrate has been shipped to this country, but the freight and duty are unfavorable, as well as the fact that a better grade of domestic material is available here for smelting. Meanwhile we note that the British government is to commandeer all the zinc produced in Great Britain—normally 60,000 tons per annum—and stop the use of it for galvanizing. On this side the United States Steel Corporation is starting to replace lead by zinc in galvanizing, making the terne-plates to which reference has already been made. Undoubtedly one of the effects of the War will be to stimulate the inventive faculty in substituting one metal for another in accordance with the exigencies of supply; some of these substitutions will be temporary, others may persist after peace has been restored. Extraordinary variations in price may favor the temporary use of one metal in the

place of another, but it is quite clear that the general demand for all of them is being enormously intensified by the War.

The question arises, will this demand stop on the termination of hostilities? As we see it, the demand will persist while hostilities continue and also during the interval that must elapse between the cessation of actual fighting and the final consummation of peace. During that interval each belligerent country will begin the work of re-organization, and as soon as peace is assured the great work of rehabilitation and restoration will be taken in hand. That will involve an enormous consumption of metals. Modern man needs food and clothing first, then the metals. The destruction of metallic products of all kinds, from domestic utensils to intricate machinery, has been intense in Belgium, Northern France, East Prussia, Poland, Galicia, Serbia, and other regions traversed by devastating armies. All of this will have to be replaced, besides which there is the probability that a good deal of old non-metallic material, now destroyed or yet to be destroyed, will be replaced by metallic products. As we see it, the next decade will be marked by an intensified demand for the base metals, causing a world-wide expansion in the mining of these metals. This country, as the great maker of munitions now and the great manufacturer of machinery during the first years after the War, will be called upon both to produce and to smelt the base metals on an enormous scale.

The Mine Safety Conference

An extremely interesting meeting was held in San Francisco last week. As most of our readers know, a workmen's compensation law has been enacted in California and an Industrial Accident Commission, consisting of Messrs. A. J. Pillsbury, Will J. French, and Harris Weinstock, has been organized to have jurisdiction over all industrial accidents in the state. The law creating this Commission is broad in its scope, so that it has power not only to compensate injured workmen, but also to take suitable steps to lessen the occurrence of accidents. In the performance of this duty it has caused to be devised the set of tentative mine-safety rules that we discussed editorially week before last. On Friday and Saturday, June 11 and 12, public hearings were held to discuss these rules, in order that they may be as satisfactory as possible before being put in force. The hearings were attended by 30 or 40 men, among them the managers of nearly all the most important mines in the state. The rules, which make a printed book of some 66 pages, were discussed seriatim, the conference extending over two days. Much valuable information was elicited and various different points of opinion were developed. We hope at a later date to be able to give details of the discussion, but there are several features of the meeting as a whole that deserve immediate comment. The most important is the spirit that animated the conference. It does credit to the mining profession that two or three dozen busy men should leave their mines and spend a couple of days in San Francisco for the purpose of devising the most satisfactory and efficient set of safety-rules, and not for the purpose of evading or defeating them. It was only in rare instances that any of the engineers present expressed the belief that the precautions proposed could not be enforced without serious financial damage to mining interests, and it was interesting to note that such objections were almost invariably made by the older men in attendance.

Another point of interest is that no representatives of the workmen were present at the conference. It might be supposed that the men who directly benefit by safety precautions would be the most interested in these rules, but the reverse is the case. The tentative set of regulations was drawn up by a committee of seven, three of whom were representative of miners' unions, but we understand that none of these three attended any of the meetings of the committee, their part in the work having been confined to correspondence. The altruistic character of the meeting also impressed the listener. None of the men present were advancing their own interests; they were considering the rights and needs of others. Frequently an operator would remark of some proposal that it was perfectly feasible at his own property, but it could not be done by some small operator who only employed a few men. Not a little discussion centred around the duties and rights of 'leasers.' Mr. C. M. Bradley, the legal advisor to the Commission, made it quite clear that they are not 'lessees' in the ordinary sense of the term and that their exact status will probably have to be determined by the courts. Much of importance hinges upon the question whether they are employees of the mine-owner or not, and this, as well as other points, will have to be elucidated. The California Metal Producers Association has taken a useful part in co-operating with the Commission with a view to establishing suitable regulations. It is certainly worthy of note that the mining industry in California is regulated by a Commission anxious to meet the needs and wishes of the operators, who in their turn are lending every effort to facilitate and perfect its work.

Learn Spanish, Also Russian

In a recent interview with an American journalist, the President of Peru, General Oscar R. Benavides, is reported to have said: "Urge the American people to insist that Spanish be taught in every high school in your land." That advice General Benavides, himself graduated from a well-known mining school, might give with particular emphasis to those about to begin the career of a mining engineer. In other departments of human activity, other languages may be dominant: in diplomacy, French; in many branches of trade, German; in the mercantile marine, English; but in the mining of the metals, omitting iron, the three languages necessary to the resourceful mining engineer are English, Spanish, and Russian. English, fortunately for those who speak it, is the official language of many of the principal min-

ing regions of the world, and more particularly of those countries from which comes three-quarters of the world's output of gold. Next in importance is Spanish, and the greater importance of it is inevitable as the vast mineral regions between the Rio Grande and Tierra del Fuego are given political stability and orderly government. In Brazil, of course, Portuguese is necessary; and Portuguese is not bad Spanish, as some people think. Undoubtedly the range of territory over which Spanish is the official language includes an enormous extent of country interesting to the miner. The graduates of our American mining schools should be impressed with the idea that a knowledge of that beautiful language is an accomplishment of the greatest practical value at the beginning of an era that promises to be marked by an industrial *rapprochement* between the Americas. Next, Russian. Unlike our own or the Spanish language, difficult to learn, Russian also is destined to be necessary to the accomplished engineer ready to be at the front of mining enterprise. Already several engineers, notably half a dozen Californians, have made their mark in the Anglo-American efforts to develop the mineral resources of Siberia. If they have succeeded, it is due largely to co-operation with the Russians themselves. Co-operation is impossible without the mutual understanding that is based on a linguistic medium of ideas. In order that the friendly co-operative development of the gold and the copper, the silver and the lead, deposits of Siberia may be accelerated after the War has ended it is necessary that American mining engineers, and English too, should learn Russian, to the extent, at least, of being able to dispense with an interpreter. No man can learn to understand the people of a country through the refractive medium of an official interpreter. We give this advice to the younger men; we give it also to some of the older, now left with spare time on their hands. Use any interval of comparative inaction to learn one of these two languages, if neither has been acquired; if one is already conquered, attack the other. When opportunity knocks at the door, she does not wait for an interpreter.

Mining Law in Alaska

On April 20, 1915, the legislature of Alaska revised its territorial mining code as adopted in 1913 at its first session. The revised code is more logically arranged. The 1913 law gave evidence of having been hastily prepared, while the 1915 enactment shows the result of deliberation. In the main, this law is patterned after the usual form of supplemental mining legislation adopted by most of the States and Territories of the West. The steps necessary to make valid lode and placer locations are fully outlined, and the new Act adds provisions for locating tunnel-rights and mill-site claims. The provisions of the 1913 Act requiring certain preliminary or discovery work have been eliminated. The drastic requirements for annual labor or assessment work are retained. These make it obligatory to file proof of labor if the validity of the location is to be preserved, and any false statement contained in these affidavits renders the party making them, or the party procuring them to be made, guilty of perjury or subornation of perjury and punishable by severe imprisonment. This feature is an attempt to enforce the salutary annual labor requirements of the general mining law, which in Alaska especially had become subject to gross evasion and laxity. Another abuse is corrected by a more elaborate section governing and limiting the location of claims under powers of attorney. This part of the new code is largely a re-incorporation of the Act of Congress covering the same subject, passed in 1912.

Some interesting provisions concerning annual labor merit attention. It is provided that the cost of the survey of mining claims by a United States Mineral Surveyor may be credited as annual assessment work. It will be interesting to see what view the Courts will take of this new provision, since it does not meet the test usually applied, namely, that the annual work or labor performed shall directly facilitate the extraction of mineral from the ground. Of course, it can be argued that this character of work is not more foreign to the case than the services of a watchman, which have been held by some Courts to be properly credited as annual labor. It is extremely doubtful, however, whether the Land Department will allow the costs of such survey-work to apply as patent improvements, even if the Courts should hold it satisfactory for the purpose of keeping the claim alive.

Another interesting provision is the requirement of the performance of $25 worth of annual labor on a mill-site claim, or in lieu thereof the payment of $25 annually to the Territorial Treasurer of Alaska, for the enactment of a similar provision has been suggested as applicable to mining claims, namely, the payment of $100 annually to some Government official in lieu of assessment work. The latter could only be accomplished by an act of Congress, but the mill-site provision in Alaska is not open to the same doubt, since the Federal mining law does not require annual labor to be performed on mill-sites.

Other changes in the new law are of minor importance. Taken as a whole, this new enactment is a step in the right direction, and is a material improvement over the Territorial Act of 1913. Such improvement is traceable to the fact that the terms of it, and its passage through the legislature, are due largely to the efforts of the Alaska Mining and Engineering Society, which debated the defects in the old regulations and suggested the changes necessary at two meetings to which the Joint Committee of the Senate and House on Mines and Mining was present by invitation. This is an example that other legislative committees might copy with advantage. The Engineering Society includes the mining engineers connected, as consultants or managers, with the more important mining operations in Alaska. Hence the discussion of the changes required in the existing law was of a most practical character. The result, as seen in the terms of the amended law, will commend themselves to experienced men.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment

Assay of Ore Containing Metallics

The Editor:

Sir—I have read with interest the article in your issue of April 24 on the assay of ore containing metallics, in which is given the method used at the Omaha plant of the American Smelting & Refining Company. As printed it reads as follows:

"The main point of the method lies in the fact that 10 assay-tons of the sample must be taken, bucked-down, and all its metallics must be reduced to find the total amount of gold and silver contained therein."

From the second example in the article I take the following:

"From 10 assay-tons there was secured 0.012 assay-ton of metallics which contained 97.83 mg. Au. The pulp assays 96.8 oz. Au per ton."

The calculation is as follows:

```
  10.000
   0.012
  -------
   9.988
  96.8
  -------
  79904
 59928
 89892
 -------
 966.8384
  97.83
 -------
 106.466
```

I wish to call attention to the fact that in this computation no allowance is made for loss of weight in bucking-down, which would range from 3 to 6% or even greater when the ore contained combined moisture. It would average at least 4%. In the case of 4% loss in the computation, presuming that the loss on the bucking-board was proportionally divided between pulp and metallics, the computation should be as follows:

```
Taken  10.000  A.T.
Loss    0.400  "
       -------
         9.600  "  on which to compute value
         0.012  "  metallics
       -------
         9.588  "  pulp
At       96.8
       -------
        76704
       57528
      86292
      -------
Contains 928.1184 mg. Au
Metallics 97.83
```

Contain 1025.948 mg. Au in 9.6 A.T. ore.

1025.948 divided by 9.6 equals 106.87 oz. gold per ton of ore.

In other words, the smelter in such cases would pay 0.404 oz. less gold per ton than was contained in the ore. By the method quoted in every case where the metallics enriched the assay the ore-buyer is benefited by the error of not computing loss of weight in bucking-down.

RICHARD MARSH.

Spokane, May 8.

[Our correspondent is apparently overlooking the fact that in smelter practice all samples are dried to constant weight before assaying. Loss by dusting would affect the gold content of the metallics, but would have no effect upon the results on the pulp. The error from dusting is probably of a less order of magnitude than the sampling errors.—EDITOR.]

Melones Mining Company

The Editor:

Sir—My attention has been called to a report on the Finnegan & Finnegan Extension mines, situated at Carson hill, Calaveras county, California, signed Edwin N. Hawkins, E.M., and dated Denver, Colorado, October 1, 1914.

This report contains several unfounded and erroneous statements regarding the Melones Mining Company, which operates the adjoining property, and as the management is quoted as authority for these statements, I wish to correct the false impression which they might cause.

The report states "It is estimated by the Melones company that they have ore reserves good for 75 years." The Melones company has never had ore reserves of this size at any time in its history and it would be absolutely impossible to ever have them. The company has had ore reserves in sight for as much as three years, but usually has only two years' supply blocked out.

It is further stated that "Pocket or nugget value of ore (not included in above or run-of-mine ore) is $150,000 or $200,000 annually." As a matter of fact the average annual returns from this source are about $1500, notwithstanding the fact that in 1911 one pocket was discovered which contained about $5000 in coarse gold. This is the only occurrence of the kind of importance which has been found since operations were started in 1903.

It is also said that "Present annual net profits of Melones company as stated by those in authority at mine and mill are $400,000." This is untrue; no one in authority ever made such a statement. The Melones Mining Company has never paid a dividend and has paid no

interest on its bonds since 1906; consequently its operations have been unprofitable.

The management of the Melones Mining Company cannot in fairness to itself or the public let statements of this character pass without correcting them.

WILLIAM G. DEVEREUX,
Manager Melones Mining Company.

San Francisco, June 3.

Speculation in Mines

The Editor:

Sir—I have read with interest the many articles published in the PRESS under the head of mining investment and prospecting. There are two things that affect the mining industry more vitally than all others:

(1) The eliminating of the grafter from mining and the enacting of adequate laws in mining states to protect the investor.

(2) The placing of mining operations into the hands of experienced and technical men where it properly belongs.

In regard to the first phase: There have been hundreds of thousands of dollars invested by people, the world over, who never knew what they were buying or what use was made of their money. To illustrate: In the camp of C— a promoter incorporated a company and sent glowing descriptions of property to Eastern stockholders. He had no mining property or assets of any kind. Upon receiving word of a visit from a client he promptly located some wild-cat claims and saved himself from imprisonment. In the same camp an engineer told me he was engaged to examine the Minnie mine by a wealthy manufacturer who had invested $30,000 in the property. It was supposed to have a working-shaft and be equipped with a hoisting-plant. From inquiries, no one in the district knew or even heard of the Minnie mine, but on looking up the county-records the engineer found it consisted of 10-ft. holes in a sagebrush flat, utterly worthless for mining or even grazing land.

The above investors thought they were buying mining stock and roundly condemned mining, while as a matter of fact, they bought individual stock incorporated for the purpose of paying the personal expenses of Joe Busch and Sam Jones.

Another form of operation is the incorporation of companies for the purpose of providing positions for managers and an office-staff. Very little goes into development; they are seldom mining men and sometimes go so far as to erect mills to extract metals from granite and other rocks. The only way it could possibly be made to pay would be to devise a method of putting gold into the rock to be treated. A stockholder in a company of this sort in Arizona asked a miner where the pay-streak was. The miner, laughing, replied it was back in Philadelphia; on returning the stockholder promptly shut the mine down.

In a Nevada camp Mr. ———, a promoter, had an excellent showing in a porphyry dike on the east side of a granite mountain easily and cheaply developed by shaft. He drove a long adit in barren granite on the west side of the mountain, drew a salary as manager, and let private contracts for work to the superintendent. He said that an adit is a satisfactory way of raising money from stockholders; you always had a mine ahead so long as you didn't hole through the other side of the mountain. Assessable stock is desirable, as salary is always forthcoming and no thought is ever given to opening a mine or making good the stockholder's investment.

Another form is the organization of companies for the purpose of gambling in shares on stock exchanges. This is less pernicious than the other two, as capable men are sometimes employed and good mines developed. All of these are outside the province of real mining, which has for its object the profitable development and extraction of ores and minerals.

Mining is an industry as honest as tilling the soil, when properly conducted. Frauds designed to extract money from the public under the name of mining should have been stopped years ago. It has retarded the development of mineral resources and absorbed capital that could be profitably used in legitimate mining and creating new wealth. A mining investment in the hands of capable and honest men is as safe and often more profitable than any other form of investment.

The second method of placing funds into the hands of inexperienced men is almost as great an economic waste as the first. Every district has monuments of ignorance in the shape of old mills, adits, and shafts. You are simply paying for some one's education, which is likely to be rather expensive and highly unprofitable.

It is a curious fact that if employment is sought as manager in any manufacturing or industrial branch outside mining, you are required to furnish evidence of qualification. For instance, a farm-hand with no experience applying for the job of captain of an ocean liner might be seriously questioned as to his sanity, but a drug-clerk or anyone that couldn't tell the difference between a chunk of ore and a cream-puff is supposed to be capable of opening and developing a mine where intricate questions of geology and metallurgical treatment of ore are involved.

I do not agree with the views of a brother prospector published in a recent article. Something that would help the mining industry is a change of attitude by the operator toward the engineer and a change of attitude by the engineer toward the prospect. The question put to the engineer should be: "Will the property warrant the expenditure of a given sum in development?" Not: "What will the property be worth when developed?" It is a physical impossibility for an engineer or anyone else to stand on the surface and tell what rock will assay one hundred or a thousand feet underground.

The experienced engineer and the trained geologist are better qualified than anyone to map out a plan of development and if the handicap of prospect valuation were removed many promising prospects now turned-down would be developed into dividend-paying mines. The practical mining man, miner, and prospector who understands the character of ore deposits on a property

often makes an efficient and successful manager, because he has local knowledge.

The prospector and engineer should work together in bringing out new properties. The engineer should take the place of the promoter, and investment be made direct through him. This would cut out fraudulent promotion, give efficient management, and accomplish the purpose of putting money directly into mining.

The majority of failures in mining and the commercial world are made by people who knew nothing about the business they entered. Bonanza orebodies will manage themselves, but the greatest quantity of the precious metals is now mined from low-grade ore that requires the services of experienced and technical men to make a profit. New discoveries and orebodies will be forthcoming as long as man digs and there are as great opportunities as ever for profit if mining is handled in a business-like way. In searching for new mines a distribution of risks over several properties is better than putting all the capital into one.

T. F. Banigan.

Goldfield, Nev., June 5.

Caps and Fuse

The Editor:

Sir—I wish to give a word of advice to those who are using caps and fuse. If they will use a little black gunpowder in the cap before putting in the fuse, they will have no miss-fires. I have used it many years and find it excellent. I have used caps, of which not more than three out of five would explode, but after using gunpowder there was no miss. I just have a little black powder in a cap-box and dip the cap in the powder, just enough to cover the fulminate, then insert the fuse and crimp the cap. I have even tried this after dipping the cap in water, and find it will explode. Please publish a piece in your paper, so others can see it. I am quite sure anyone that will try it will never do without it, and if they should have a miss, they can be sure that it is the fault of the fuse and they should give it plenty of time before going in, as it has been known that fuse will hold fire for 15 to 30 minutes.

T. C. Purcell.

Shawmut, Cal., June 9.

Automatic Dressing of Amalgamated Plates

The Editor:

Sir—In your issue of May 15, E. S. Boalich describes the method devised at the Duplex mill, at Searchlight, for automatically dressing plates by means of a traveling brush to rid the plates of the objectionable galena that settled thereon. The Editor suggests that more water should have been used to give a higher velocity to the pulp over the plates. Unfortunately, Mr. Boalich did not mention the grade of the plates, but he did mention that the gold was surprisingly free.

Recently I visited the Duplex mill, which is in ruins, and out of curiosity I measured the inclination of the tables and found them to have a grade of 1¾ in. per foot. The 10 stamps are light in weight, which accounts for their low capacity, even with plenty of water.

Searchlight is in a desert country where water is scarce and distillate is expensive, so that economy of water is of prime importance; all that used in the mills coming from the mines at a depth of 200 ft. or more, so that the suggestion of more water would hardly be justified. The conditions, in my opinion, required the plates to be of greater inclination, 2½ in. per foot being none too great. This would have given a greater velocity of pulp over the plates with less water and would no doubt have kept the galena in motion so that the automatic feature could have been dispensed with. The inventor's ingenuity was misdirected in complicating an otherwise simple operation. I have had considerable experience with gold-galena ores and have had no difficulty in keeping the galena in motion and the surface of the plates free to amalgamate. The objection to the automatic brushing of plates under a stream of pulp is that amalgam is liable to be dislodged and carried away with the current; if this were not so it would not be necessary to hang up the stamps while dressing plates.

Algernon Del Mar.

Los Angeles, May 20.

Possibilities of the Mother Lode in Depth

The Editor:

Sir—I have read with pleasure the several articles in the Press written by W. H. Storms, descriptive of the Keystone mine in Amador county. They have added very much to the interest I have always felt regarding that great representative of the Mother Lode formation in California, as I first visited it in 1872 with John W. Gashwiler, and in 1893, when I was superintendent of the San Francisco Mint, I gave O. C. Hewitt a position there. His service as superintendent of the old mine ended by its closing operations, and he passed the remaining days of his life in Government employ with satisfaction.

At my suggestion Mr. Hewitt obtained from the original locator of the Keystone mine, J. T. Wheeler, the following letter, which, as it adds some detail to Mr. Storms' account, may possess sufficient historical interest to justify its publication.

John Daggett.

Black Bear, May 28.

Pine Grove, August 19, 1896.

O. C. Hewitt, Esq.,
San Francisco.

Dear Sir:

In regard to quartz mining at Amador in the early days, I will do the best I can for you. The first location made was by Thomas Rickey on the north side of Amador creek and called the Original Amador Company. The next was on the south side of the creek by Herbert and Davidson, two preachers, and called the Spring Hill. The next location was the Granite State Co., and then the Pleasant Ridge Co., on what was then supposed

to be a parallel vein to the Spring Hill. These two claims in after times became the famous Keystone, from which so much gold has been taken. The Granite State Co. commenced near what is now known as the Eclipse shaft, and ran south 720 ft. Then came the Pleasant Ridge Co., but I do not know how much they claimed. The Granite State claims were located by myself; J. T. Wheeler, my brother Charles C. Wheeler, Jos. E. Leighton, John Grant, J. D. Goodrich, and T. S. Hoyt made up the company. One hundred and twenty feet in length by sixty feet in width was a claim. On one claim the croppings were heavy and rich. We hired Mexicans to build four arrastras for us, and by selecting the ore made it pay $100 per ton. We worked in this way a few months, when a party came over from Georgetown and after an examination made us a proposition to build us a 12-stamp mill for one-half of the property, which we accepted. This party included John Conness, Selucius Garfield, Mr. Robinson, and a Mr. Williams, all of Georgetown, California.

The mill was built and accepted. We crushed a good deal of ore, but we knew nothing of amalgamation, and no doubt lost more gold than we saved. Things went on in this way until the following summer, when my brother died of typhoid fever, and I got caught in a cave in the mine, had my leg broken and my foot badly crushed, which laid me up for 13 months. In the meantime the company got a few thousand dollars in debt, was attached, and sold out by the sheriff. A. H. Rose purchased the whole outfit. He was a member of the Pleasant Ridge Co. and in time became general manager of the Keystone.

For more than ten years, however, the Granite State Co. claims remained idle, until an old countryman named Domanick Burke made an arrangement with Rose for the sinking of a shaft and other work, which led to the opening up of a big body of rich ore between the old workings and the creek. From this orebody millions of dollars worth of gold have been taken, of which you know more than I do. A. H. Rose soon sold out to Gashwiler and McDonald for $102,000. Since then the Keystone company has obtained more ground, bought the Spring Hill and, I think, other claims, but with these matters I am not familiar.

Yours very truly,

J. T. WHEELER.

Efficiency of Tamping

The Editor:

Sir—The article on this subject by Edgar A. Collins in a recent issue of the PRESS, purporting to give results as obtained by him at the Commonwealth mine, is a good example of incomplete data concerning operation, that proves nothing. While not doubting for a minute that the stemming or tamping of holes increases the efficiency of the powder, I am unable to see, from the data given, where Mr. Collins has demonstrated this theory. The point of the whole matter is this: has he succeeded in breaking a greater amount of material with the same or a smaller amount of powder per ton? His experiments show a smaller amount of powder per hole, a greater number of holes, and no estimate of the amount of material broken. He does not state whether or not the holes were shallower in January, February, and March than those of the previous three months, and it is absolutely impossible to draw any conclusion from the data given. He also states that the holes may have been closer together, and if such was the fact, it would take, quite naturally, a smaller amount of powder per hole to break the ground. According to the figures given, if the same amount of ore was broken in January, February, and March as in the previous three months, he not only used 1418 pounds more of powder, but also expended 45 shifts of labor in gathering clay for tamping. Of course it may be possible that this is only a preliminary article by Mr. Collins and the full data will be given later.

H. C. CUTLER.

Reno, June 1.

[In consequence of Mr. Collins's article, the matter is now being tested on a systematic scale in one of the leading gold mines of California. We expect to publish the results in good time.—EDITOR.]

The Search for Platinum

The Editor:

Sir—I read with much interest your editorial on the search for platinum, in the issue of May 15, and particularly the reference to the Rambler mine. The Platinum Mining & Milling Co., incorporated lessees of the Rambler mine, has been working it for some time. The mill has been re-modeled and is working satisfactorily. During the first six months the dump alone was worked, there being a large quantity of platinum ore available from this source—sufficient for many months.

Within the last two months the mine has been unwatered. The limited development work done during that time has disclosed a large body of milling ore, apparently lying on the foot-wall, carrying considerable amounts of platinum and the platinum metals. The extent of this orebody is unknown as yet; at the present time it is exposed on three levels. The width varies considerably, but so far has, wherever cross-cut, exceeded eight feet. There is sufficient ore already developed to run the mill, which has a capacity of 50 tons per day, for a year. This is all platinum ore, although it carries considerable copper and some gold and silver. Until negotiations, now under way, for the marketing of the product are completed, I shall be unable to make public the assay-value of the ore and concentrate. However, instead of being exhausted, I believe I can safely say that the platinum deposit of the Rambler mine has scarcely been touched. The high-grade ore, found near the surface, was, as stated, quickly exhausted, but the main vein from which the ore will come has until recently been ignored by everyone that has ever worked the mine.

HOWARD D. GRAY.

Holmes, Wyoming, June 2.

Grass Valley Re-Visited—I

By T. A. RICKARD

When I went to Grass Valley the other day, I recalled the fact that it was 29 years since my first visit. At that time Emile R. Abadie was in charge of the North Star mill, and I remember being impressed by the contrast between the short quick drop and shallow mortars as compared with long slow drop and deep mortars of Gilpin county, Colorado, where I had been obtaining my first acquaintance with stamp-milling. That contrast provoked me to study the subject and to write a book* upon it, the first copy of which I saw at the Londonderry mine near Coolgardie, in Western Australia, in 1897. Inexperienced as I was in 1886, I noted a childish defect in sluice-plate in the Californian mills of that day was a legacy from the placer mine, as its name indicates. It is a 'sluice,' suited to the rapid passage of pulp, and of its precious contents, to the dump. The alluvial digger left his impress in the stamp-mill much too long. Now the millman turns to his old-time partner and tells him that his efforts to concentrate gold from amid a big volume of unsorted material is futile. He invites him to take a lesson from the experience of stamp-milling and concentration.†

Mines are wasting assets and mining communities are of uncertain vitality, normally. It is a delight therefore

GENERAL VIEW OF THE NORTH STAR MILL AND SHAFT.

the design of the amalgamating tables in the North Star mill. In front of the latter came an apron-plate 4 ft. 5 in. wide, equal to the full width of the mortar, but only 2½ ft. long; this narrowed so as to discharge onto a sluice-plate 12 ft. long, but only 22 in. wide, that is, one-half the width of the apron. The scouring action of the pulp had rubbed the sides of the amalgamated surface of the plate so as to lay bare the copper. Naturally the question was asked how the millman expected to catch fine gold under such conditions? When I revisited the mill in 1893 these foolish sluice-plates had been replaced by an apron 16 ft. long. In the interval the Rittinger shaking tables, made of copper and intended to catch escaping amalgam, had also been discarded; the same purpose being effected by the ampler lower surface of the apron-plate. Indeed, the narrow to find oneself among mines that seem to have the enduring quality of the widow's cruse of oil, and to revisit a settlement that appears permanently prosperous. The pretty town of Grass Valley was founded in the Golden Age; the first mining in 1849 was alluvial, but in June of the following year the first vein was discovered, and in October of the same year an outcrop of rich gold-bearing quartz on Gold Hill started vigorous prospecting. The first mill in the district was erected in January 1851, on the west bank of Wolf creek. The stamps consisted of tree-trunks shod with iron‡. From 1851 to 1866 the Grass Valley district yielded gold to the value of $23,000,000. From 1866 to 1915 the output

*'The Stamp-Milling of Gold Ores,' 1896.

†'The Metallurgy of Alluvial Mining,' by John M. Nicol, Mining and Scientific Press, May 29 and June 5, 1915.

‡'The Empire Mines, Past and Present,' by George W. Starr, Mining and Scientific Press, August 4, 1900.

has been fully $100,000,000 more. At the present time the mining activities of the district are largely identified with the operations of two big enterprises, the North Star and the Empire. Both represent consolidations and absorptions of smaller properties formerly well known. The Empire includes the Pennsylvania, which had previously swallowed the W. Y. O. D. and a number of claims adjacent to the Empire, also most of the mineral rights under the town. The North Star includes the New York Hill, the Gold Hill, the Massachusetts Hill, the Irish American, and many individual claims.

The two principal mines are examples of persistent enterprise. This is matched by continuity of ownership. The Empire has been owned by W. B. Bourn since 1874, when he inherited the property from his father, who bought it in 1869. George W. Starr became superintendent in June 1887; he left for South Africa in August 1893, returning to Grass Valley in April 1898, since when he has been in charge of the Empire mine uninterruptedly. That is one reason for its prosperity. Incidentally, I may remark that not often an engineer leaves a mine to return to the management of it five years later. Moreover, great as has been the development of the Rand, it is doubtful if the mines (controlled by Barnato Bros.) to which Mr. Starr was attached during his stay at Johannesburg bear stronger marks of vitality than the old mine at Grass Valley. The North Star furnishes a similar story. Mr. Bourn re-opened this mine in 1885 and sold the control to James D. Hague in 1886. Arthur De W. Foote became superintendent in January 1895 and resigned in favor of his son, Arthur B. Foote in 1913. While James D. Hague has gone, alas! his son William is now the managing director, resident at the mine, so that each of these families has given two generations to its service. Moreover, James D. Hague was interested in both the Empire and the North Star properties, being president of both companies until 1896, when the two enterprises became separate. The names of James Douglas and George B. Agnew on the directorate suggest the fact that members of the firm of Phelps, Dodge & Co. have held an interest in the mine for many years, together with other men of prominence in New York. Mr. Bourn also has achieved distinction in other directions, for he is president of the Spring Valley Water Company, an enterprise of large importance to the people of San Francisco and one over which much controversy has raged in consequence of the effort made to acquire it for the municipality.

In the midst of the town a little mine called the Golden Center is doing well, supplying a 10-stamp mill on Wolf creek. It is controlled by Sacramento people and managed by Charles Brockington as superintendent. While as yet only 700 ft. deep, it is said to be opening up well. This is also an old mine rejuvenated, for it was originally known as the Dromedary. About 1½ miles east of the town is the Union Hill mine, with a 20-stamp mill. It is owned by San Francisco and Pasadena men who assumed control in September last. Since then the shaft has been sunk from 600 to 800 ft. Another notable old mine is the Brunswick Consolidated, which is on a vein parallel with the old Idaho-Maryland. A 20-stamp mill is supplied with ore of good grade, a new vertical shaft with a steel head-frame has been started, as well as grading for 20 more stamps, and a cyanide annex. Chris Mallon is the superintendent. The mention of the Idaho-Maryland recalls two famous mines, for both the Idaho and its extension on the ore-shoot, the Maryland, were great producers in their day. When reasonable terms are acceptable, it is likely that deeper exploratory work will be undertaken on this property.

The North Star Mines Company operates two mills: the North Star, built in 1886, and the Central, built in 1904. Both contain 40 stamps, of the same weight (1050 lb.), falling the same height (6½ to 7 inches) at the same rate (106 drops per minute). The crushing capacity is the same: 4500 tons per month, the duty being 3.8 tons per stamp. The wooden battery-frames in the older mill were replaced last June by cast-iron posts, on concrete foundations, while the younger mill was built with steel battery-frames on concrete foundations. As far as I could learn, these departures from conventional practice have proved neither a success nor a failure. In the Central mill the vibration seems excessive, for the noise is higher pitched. It sounds sizzling. This new mill has masonry bins with steel-plate fronts.

In the old mill, a good measure of the durability of seasoned wood is given. The battery-posts of sugar pine have been replaced from time to time. In 1906 seven old posts were replaced by new ones made of spruce. In 1911 another was replaced similarly. Two of the original posts were taken out in June 1914; at the same time the spruce posts were removed; they were rotten already.

In substituting cast-iron for the wooden battery-frames in this 40-stamp mill it was necessary to use 12 posts, each weighing 4000 lb., the cost at the Taylor foundry in Grass Valley being $250 apiece; also 16 H-beams weighing in all 5568 lb., the cost being $227.50. The total cost delivered was $3227, while the entire expense of preparing, dismantling the old, and erecting the new battery-frames was $557. The total cost per pound of material erected was 7.07 cents. The stamps were dismantled 20 at a time, so that only 3 days of crushing time was lost for each 20-stamp section.

The use of cast-iron in battery-frames is old, of course. It is customary at Bendigo, in Australia, where in 1890 I saw an iron-framed stamp-mill (the Garden Gully United) that had then been in use for fully 20 years. It is generally supposed that a wooden frame, being less rigid, takes the vibration better than iron, which, on the contrary, is supposed to become crystalline and then brittle, from 'fatigue.' A. B. Foote considers that the use of steel in the new mill has been justified, but he advocates a minimum of rivets and heavier shapes, say, a post of two H-beams.

Here I may mention the cam invented by Arthur B. Foote, the present superintendent. It is based on the idea of starting from rest with a uniformly accelerated velocity. While in use, it is impossible for the hand when placed on the tappet to feel the cam strike the tap-

pet. even when the stamp is dropping 107 times per minute. The adoption of this cam has lessened breakages and fatigue of the battery-frame. Thus in the old mill 11 cam-shafts were broken both in 1912 and in 1913, but only 2 were broken in the last 12 months. It is economical to run the stamp-mill fast even at the expense of breakages, if not excessive. In other words, there is an economic ratio. In one year the North Star mill has broken 24 cams, 10 tappets, and 11 cam-shafts.

Of the stamp-mill product, 60% is classified as sand, 40% as slime. The tube-mill formerly in the Central plant was 20 ft. long; it was cut in two, making two short mills, one for each plant. After three years, $22,000 in amalgam was taken out of the one tube-mill when it was bisected, after the treatment of 5400 tons of concentrate.

By way of comparison the following figures are interesting:

INTERIOR OF THE CENTRAL MILL OF THE NORTH STAR MINES.

In both mills 78% of the total extraction is effected by amalgamation. The apron-plates are 20 ft. long. Dodd buddles, 9 of them, are used to separate the concentrate. These machines are not commendable, for their maximum velocity is at the periphery, where the final separation is made. A tube-mill (4 by 10 ft.) is used to re-grind the sulphide concentrate, which then passes over small amalgamating tables, which extract 30% of the gold. The residue joins the other mill-tailing on its way to the cyanide annex, about 300 yards down the valley. Here the tailing passes through

4 Merrill classifiers,
6 thickeners,
Another Dorr thickener,
6 (100 tons each) sand-vats (6 by 25 ft.),
4 air-lift agitators** for slime agitation,
2 Oliver filters,
2 Merrill presses, one in use at a time.

**Built before the Pachuca was invented.

Year.	Weight of stamp.	Number of drops.	Duty, tons.	Screen, mesh.
1895	850	84	1.6	30
1915	1050	106	3.8	25

	Concentrate, %	Consumption of mercury per ton of ore, dwt.	Wear of screen, days.
1895	3	14½	24
1915	2	5	21

The screen of perforated tin-plate used 20 years ago has been replaced by punched steel with holes 0.04 in. diameter or 288 holes per square inch.

The Oliver filter is a Grass Valley product, for it was invented by E. L. Oliver while he was employed at the North Star. It is essentially a vacuum-filter on the outer surface of a drum. The drum is of 10-ft. diameter, with a face 7 ft. wide. This is covered first with 2-in. grooved staves or drainage strips, then a wire-screen, then burlap, finally canvas. The vacuum-pipes radiate

to the under side of this covering from a central nest of pipes. Of the total circumference, one part in 24 is blown, the rest is sucked, forming a cake of slime. This cake is removed automatically by a scraper and spray of water after it has been loosened or blistered by the air blown from the pipe under a strip across the face of the drum representing, as I have said, $^1/_{24}$ of its entire circumference. The filter is excellent for slime not requiring lengthy washing.

Two filters, with their line-shaft and vacuum-pump, use 8 hp. Air required for blowing is at the rate of 4 cu. ft. per minute, at a pressure of 18 lb. per square inch. The covers last for 8 months; the cost of re-covering is $25, including labor; each filter treating 800 tons of slime per month. The cost of re-piping is $30, but it is necessary only once in four years. The total cost of re-covering and re-piping is ½c. per ton only. The area of the filter is 220 square feet.

At the Empire mine, Mr. Starr showed me the new hoisting plant. It is a Wellman-Seaver-Morgan electrical single-reduction hoist, operated by a 500-hp. motor, which is worked 75% overload at starting, and can be worked at 100%. The drums have a capacity for 8000 ft. of rope, to raise 4 tons of ore at the rate of 1200 ft. per minute. Construction is of steel throughout. Wuest herring-bone gear is used. The brake is applied over a 12-in. drum-surface. Automatic arrangements to prevent over-winding are electrical. If the engineer fails to keep the lever under control, the power is cut-off automatically and the brakes applied. As the skip goes into tipplers, two electric devices give warning by a bell and lights; if over-wound two feet, another contrivance shuts off the power and applies the brakes.

The old mill of 40 stamps has been replaced successively by 60 new stamps, each of which weighs 1350 lb. and crushes 4.82 tons per day, as against the duty of 3.8 performed by the old 1040-lb. stamps. The timber foundations have been replaced by concrete. Some of the old timbers, which had served for 30 years, were solid throughout, but most of them had rotted at the edges. A separate motor drives each 10 stamps. A Tyler wire-screen of 27 mesh is used, giving 60% of a 200-mesh product. After the amalgamating tables, 53 in. wide and 13 ft. long, come twenty-four 6-ft. Frue vanners.

The tailing from the stamp-mill passes through a 12-in. terra-cotta pipe laid on a 2½% gradient to the cyanide annex. This terra-cotta pipe has been in use for 4½ years, but the glaze has not been worn off yet.

The concentrate, at the rate of 8 tons daily, assaying $140 to $160 per ton, is moved along a gravity tramway to the cyanide annex, where it is discharged into a bin, thence into a truck, weighed, and then discharged into a machine like a Blaisdell excavator, which feeds it into a tube-mill, 3½ by 12 ft., of Allis-Chalmers make. After being re-ground this sulphide product goes to three Devereux agitators, having a 4-blade propeller, 38 in. diameter, making 110 rev. per minute. Each agitator requires 3¼ hp. only. Before it is started the water in the vat (of 18 tons capacity, concentrate only) is drained off and the vat filled with a solution containing 0.10% cyanide. Then follows agitation and decantation: this process being repeated until the necessary treatment and wash is obtained. The residue contains only 5% of the assay-value. When the stamp-mill tailing reaches the cyanide annex it is doctored with lime (4 lb. per ton) in the form of a paste or emulsion as it passes to 2 Merrill classifiers or settling-cones. From there it goes to 4 clarifiers (24-ft. diam. and 22 ft. deep) or dewatering tanks. Thence to 4 Pachuca agitators, discharging to 3 Oliver filters. The sand is leached in 6 vats, each 24-ft. diam. and 10 ft. deep.

The concentrate represents 2% of the crude ore; the stamp-mill tailing contains $1.75 in gold; the final discard below the cyanide annex assays 21 cents. The total extraction is 97%. When as much as that is won, it is well not to make any change.

The cyanide treatment of the stamp-mill tailing was started only 4½ years ago; before that canvas tables were in use, the resulting concentrate being shipped to the Selby smelter.

Oil Exhibits at the Exposition

These are in the Palace of Mines and Metallurgy. That of the Union Oil Co. of California includes four huge dinosaurs, which are said to have existed during the period when oil was formed. These are shown crawling over the front of the booth. A cyclorama shows a scenic representation of a typical oilfield. The geological exhibit contains some rare and costly fossil specimens collected from various parts of California, Texas, Wyoming, Oklahoma, Arizona, Mexico, Panama, Utah, and Louisiana. There are also lubricating and refined oils and asphalts shown.

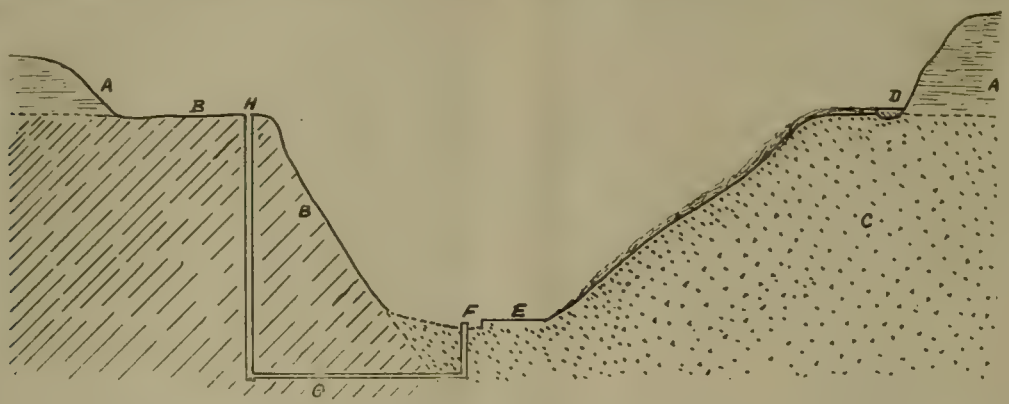
The Standard Oil Co. of California has a reproduction of the famous Section 36 in the Midway field, California, showing the strata to a depth of 3000 ft. On the surface are pumps, tanks, sumps, and employees' quarters. A panoramic reproduction of the field near Taft, California, is in operation. Various methods of transportation, a tank-steamer, tank-car, and motor and horse-drawn trucks, are shown in model. The displays include asphaltum products as applied to highway construction, illuminating and lubricating oils, candles and paraffine products, floor-polishes, and lamps and stoves. The exhibit space is surrounded by oil-derricks bearing placards of the production of various sections of the fields.

AN EXPOSED TRAIN OF GEARS, an unprotected revolving bolt head, set-screw, feather or spline, an open keyway on a shaft, and the like, are all well-recognized dangers. Yet few indeed are the machines where these are all absent. The means to be employed to prevent accidents from these causes are two in number: First, eliminate so far as possible angular projections on revolving or moving parts; for example replace ordinary square-head setscrews with those of the hollow variety which screw down flush. Second, guard or protect the moving parts of the machine.

Kaolin

By WILSON W. HUGHES

The term 'clay' covers a wide range of material. Clays differ in origin, mineral and chemical characteristics; they all exhibit plasticity when wet and become hard when dried naturally or artificially. They have been described as "Heterogeneous aggregates of hydrous or anhydrous aluminous silicates, free silicates, and ever-varying quantities of free iron oxides, calcium and magnesium carbonates, all in a finely comminuted condition." The ordinary clays used for brick, tiling, drain-pipes, terra-cotta, etc., are found in abundance in the United States, but high-grade white clays, known as kaolin or china-clay, have not as yet been developed in sufficient quantity to keep pace with their use in the manufacture of porcelain, china, and paper. The following figures, taken from the 'Mineral Resources of the United States' speak for themselves.



CHINA-CLAY PIT (section)

AA. Overburden.
BB. Undecomposed rock.
CC. Decomposed rock.
D. Washing water.
E. Sand-catch.
F. Shaft down which clay-bearing water drops to (G).
G. Level connected with (H).
H. Pump-shaft where clay-water is pumped to surface and sent to settling-pits.

KAOLIN MINED AND SOLD IN THE UNITED STATES

	Short tons.	Value.
1905-1913 (china-clay)	320,440	$2,427,023
1905-1913 (paper-clay)	795,997	3,607,408
Total	1,116,437	$6,034,431

KAOLIN IMPORTED INTO THE UNITED STATES

	Short tons.	Value.
1907-1913 (both kinds)	1,732,150	$10,526,157

Therefore the imports for 7 years exceeded the production of 9 years by 606,713 tons, valued at $4,491,726. The actual difference in favor of the imports for 1913, the last year on which figures are available, was 113,495 tons, valued at $818,559. That this country is now dependent on Europe for 60% of the kaolin used here is the more interesting because English potters imported it from North Carolina nearly 200 years ago for use in the manufacture of chinaware. Now the exports of kaolin from the west of England closely approach the million-ton mark, if not exceeding it, every year.

Barber* says, in regard to the export of kaolin from Carolina: "It was obtained in the Smoky mountains by the Cherokee Indians who called it *unakah* (meaning white) which was their name for the Smokies. It is still called 'unakah' in Mitchell county. English potters were using china-clay from this country previous to the middle of the last century (1700)."

In 1744 a patent was granted in Great Britain to Ed. Heylyn and Thos. Frye for the manufacture of chinaware. In their specification they state that the material used in their invention "is an earth the product of the Cherokee nation in America, called by the natives 'unakah,'" * * * In 1878-79 a Mr. Goss of Stoke-on-Trent in a series of notes states: "This unakah, the produce of the Cherokee nation, is decomposed granitic rock, the earth or clay resulting from the washing of the rock being the decomposed feldspar of that rock. It is curious that it should have been imported from among the Cherokees when we had mountains of it so near as Cornwall, unknown, however, until Cookworthy discovered them in 1768" * * * The Cookworthy referred to was familiar with American clays as early as 1745, for he is quoted as writing in that year: "I have lately with me the person that hath discovered the china-earth. He had samples of the chinaware of their making. T'was found in the back of Virginia where he was in quest of mines. Discovered both petunze and kaulin. 'Tis the latter earth he says is the essential thing. He has gone for a

*'Pottery and Porcelain of the United States.'

cargo of it, having bought the whole country from the Indians where it rises. * * *" Josiah Wedgewood also imported china-clays from both Carolina and Florida into England.

The origin of the word 'kaolin' as used to designate the high-grade white clays of commerce, was due to the mistaken idea that the clay used by the Chinese in the manufacture of porcelain was called *kao-ling* (meaning high ridge), from the district in which it was obtained. This however was not the case. T'ang Ying, director of the Imperial factory at Ching-te-chin in 1743 states: "Those of pure white color and fine texture are used in the manufacture of bowls and vases of egg-shell pure white, and white and blue porcelain. Besides, there are several other kinds of earth called *kao-ling*, *yu-hung*, and *chien-tan*, all produced within the limits of Jaochow. These are only used for mixing with the first named, or in the fabrication of coarser ware." The name now, however, is universally accepted as signifying the purest varieties of clay known. They consist almost exclusively of alumina silicate and water, and are an impure form of the mineral kaolinite, which is represented by the formula $H_4Al_2Si_2O_9$. They exhibit less plasticity than other clays, becoming pulverulent and of a white or creamy color when dry.

[Samples of the materials used by the Chinese were first sent to Europe by Pere d' Entrecolles, a missionary in that district. He may possibly have applied the name *kao-ling* to all the numerous varieties of material for which the Chinese had distinctive names.—EDITOR.]

Their chemical composition is shown in the following table.

Constituent.	Natural material from Ching-te-chin.	From Ching-te-chin used for blue ware.	English (Cornish) china-clay.	French clay, St. Yrieux.	Hockessin, Delaware.	Kaolinite.
Silica	73.55	73.55	73.57	46.68	48.73	43.10
Alumina	21.09	18.98	16.47	36.92	37.02	36.92
Ferric oxide	...	....	0.27	....	0.79	....
Lime	2.55	1.58	1.17	....	0.16	....
Magnesia	0.15	1.08	0.21	0.52	0.11	....
Potash	...	0.46	5.84	0.58	0.41	....
Soda	...	2.09		....	0.04	....
Water	2.62	1.96	2.45	13.13	12.83	20.07

All clays are of secondary origin. They are the result of the breaking up of rocks and minerals, with consequent aggregation and concentration of the less soluble residue. Silicate of alumina, being one of the most insoluble substances known, is the chief constituent of such residues. Such an aggregation, if remaining on the spot where the disintegration of the original rocks took place, is termed a 'residual deposit', but if it is transported by water or glacial action to another locality, it is called a 'transported clay.'

Kaolin deposits occur almost invariably as residual clays. They are the product of the disintegration of feldspathic rocks, in which the decomposition of the feldspar plays the most important part. The term used to describe the action is derived from the product, and the word kaolinization has become part of the English language. The cause of kaolinization has been ascribed to various agencies, atmospheric and hydro-thermal, but I hold no brief for either contention or their sub-divisions. Whatever the original cause, the fact remains that the action on the feldspar may be shown as follows:

	SiO_2	Al_2O_3	K_2O	H_2O	Total
	%	%	%	%	%
Orthoclase	64.56	18.29	16.85	...	100.00
Loses	43.24	....	16.85	...	60.09
					39.91
Takes up	...	....	....	6.45	6.45
Kaolinite	21.23	18.29	....	6.45	46.36

This alteration is naturally of varying degrees of intensity in any one place, the result is that any kaolin deposit is of irregular grade, and consists of an intimate mixture of quartz, undecomposed feldspar, mica, and other minerals in addition to the aluminum silicate contents. Partly-altered country-rock is also found. In the china-clay deposits of the west of England this is known as china-stone or petunze. Such deposits may be of any width and thickness and are usually covered by an overburden of subsoil, this also varies in thickness, and the cost of its removal has an important bearing on the economic value of the deposit.

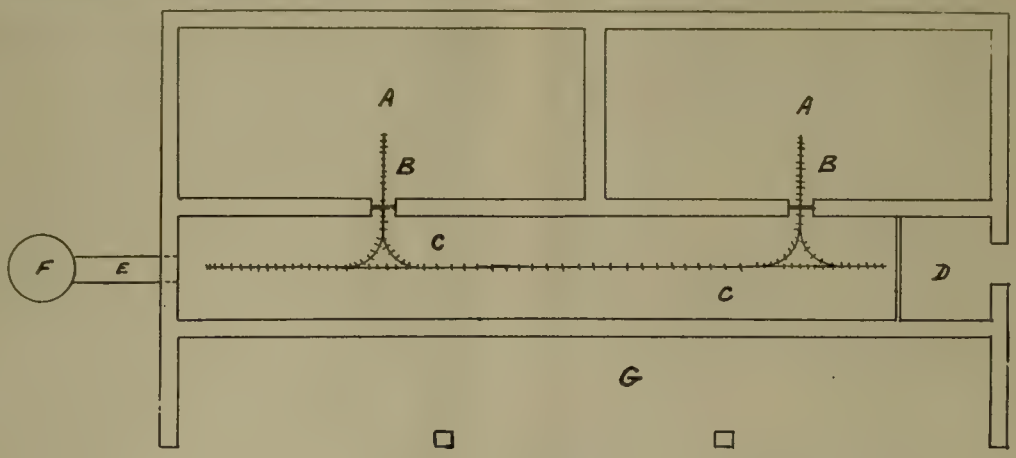
From the foregoing it can be seen that deposits of kaolin should be looked for in districts of highly feldspathic rocks, such as granite and gneiss. They may be expected to lie in depressions within such areas. Their presence is shown by the finding in marshy ground of a white clayey mud. Districts of low humidity are not so likely to contain them. When clay has been found, a weighed sample should be washed and the residue should not exceed 5.25 parts by weight to one of dried clay. The clay itself should not leave any residue on a 120-mesh screen, after brushing with a soft brush. The chemical analysis should approximate to one of the analyses given in the table above. As the refractory properties of clays seem to depend largely on the presence of alumina and silica, and freedom from constituents that are fusible or would combine with others to form a flux, it is necessary that a good commercial clay should be low in iron oxide and alkalies such as soda, potash, lime, and magnesia. Although iron is not possibly so detrimental as a flux, it is fatal to the ware, causing black spots on firing. Potash produces an incipient vitrification, which causes the ware to ring like a bell on striking. Therefore the presence of these minerals in large proportion unfits the clay for fine pottery work. At the same time it might be useful for other purposes. On firing a sample of the clay, it should be white, non-vitreous, free from specks, hard, and compact. Very often clay is colored by organic matter, but this color disappears on the application of heat.

After finding a deposit containing such a clay it is easily prospected by drilling or sinking pits to deter-

mine its area, average grade, and thickness. For the economic working of kaolin pits, and the production of a commercial clay, two things are essential: one is a good supply of water, and the other is ready transportation to commercial centres or the sea-coast. Assuming that the clay is found and that there is a plentiful supply of water, the working of the clay consists essentially in the washing of the decomposed rock by means of a stream of water. The water takes up in suspension the fine clay particles, leaving behind the associated quartz, unaltered feldspar, etc. The clay-bearing stream is then conducted over shallow troughs where the mica is deposited, and thence to settling-pits in which it drops its burden of clay, being returned to the deposit to be used over again.

In actual practice the water is conveyed to the side of the clay pit and allowed to run down the face. The clay start with, and as the clay settles on the bottom and accumulates in the pit the holes in the launder allow the stream always to deliver at the lowest point possible. The pits are usually circular and may be 20 ft. deep. In these the water drops its burden of clay, the clean effluent being returned to the deposit to be used again. The water-cycle is continuous.

When the clay rises in any pit to the point where settlement is slight, the stream is turned off and the clay allowed to subside. It is then run into other pits where further settlement ensues, until it becomes a fairly stiff clay. From these it is transferred by means of cars onto a drying-floor. The 'drys' or floors consist of fire-clay tiling, covering a number of parallel flues. The flues are connected at one end with the fire-grates and at the other to a brick stack. They are about 14 in. wide and the tiles are sufficiently wide to span them from



'DRY' FOR CHINA-CLAY (plan)

AA. Settling-tanks.
BB. Track to 'dry.' Elevated above floor.
CC. Drying-floor. Flues underneath.
D. Fire-grate end.
E. Flue to stack.
F. Stack.
G. Store for dried clay.

mixture is raked in the path of the stream, so as to obtain as thick a mud as is possible. The stream is passed into wooden bins with a perforated bottom in which the quartz and heavy residue is caught. The water, carrying the clay and mica in suspension, passes through the coarse sandy residue, and is then pumped into launders through which it passes to the mica-traps. These traps are shallow troughs in which the velocity of the clay liquid is reduced, and the depth of the stream diminished. The mica settles and is retained, the suspended clay passing forward to the settling-pits. These pits may be close to the works, but in many cases the clay in suspension is carried through pipes or launders for long distances. This procedure is adopted when the deposit is at a distance from the railroad, as it is then possible to settle and dry the clay at the point where fuel and transportation are readily obtained. The water with its clay burden passes into the settling-pits through vertical box-launders, perforated with holes. The delivery is therefore always at the bottom of the pit to centre to centre, having a thickness of 5 to 6 in. over the firing end and reducing to 2 or 3 in. at the other end. These 'drys' vary in length and width, but are usually 150 to 200 ft. long, and up to 15 ft. wide. The clay is run upon this to a depth of 9 to 12 inches at the fire end and about 6 in. at the stack end. The charge at the fire end will dry in about a day, but the other end may take three days. When the charge becomes plastic it is cut into rectangular blocks. This assists the drying process, and also is of help in shoveling the dried clay. When dry the clay is thrown off the side of the 'dry' into a paved space that runs the whole length of the floor. Here it is packed into barrels for export or lies in bulk awaiting shipment. Where possible, the railroad track adjoins the side of the 'dry' so that cars can be loaded direct. The fuel used for heating purposes is hard coal. A bituminous coal is detrimental, as the clay is likely to be smutted by it. The Cornish drying system as outlined above is, I believe, capable of much improvement. A large amount of the moisture in the clay percolates

through the porous tile flooring and is converted into steam in the flues, as is readily perceived from the white cloud of steam that escapes from the stack. This surely cannot be the most economical method of evaporation.

The limits of this article will not allow of entering into these points of detail. It is many years since I have visited a clay works; the data I have may be slightly out of date, but the system as outlined is, I am told, in use at the present time.

China-clay is used principally in the manufacture of porcelain or china, and paper. China, or porcelain, is a mixture of kaolin with various substances; the mixture must be plastic enough to be worked into forms for ware. When burned it fuses sufficiently to give it the proper strength. The subject of porcelain-making is a complex one, and the reader is referred to the treatises on the subject for further details. Paper-clay must usually be pure white, but that of poor color may be re-washed and used. Wall-paper manufacturers employ it to give a smooth satiny finish. It is applied in the form of a thin size, and then polished between brushes. As purity of color is essential for this purpose, only the finest clay can be used. In the manufacture of other papers it is used to give body and weight. Heavy wrapping papers contain about 5% china-clay.

The kaolin-producing states of this country are Delaware, Georgia, North and South Carolina, Missouri, and Pennsylvania. Discoveries have been noted in 17 counties of California, but, with the exception of the Carbondale deposits, in Amador county, they do not seem to have been developed seriously. Kaolin from these beds has the following composition:

	%			%	
Silica	48.9 to	60.00	Magnesia	trace to	0.09
Alumina	30.29	38.18	Alkalies	1.02	2.32
Ferric oxide	0.53	2.40	Water	8.05	8.95
Lime	trace	0.50			

The average composition therefore approximates that of the Delaware clays. The production from other western states is so small as to be negligible. I have not dealt with the cost of production in this country, as data on that point are difficult to obtain, and any figures would have a local value only. So much depends on situation, labor, transport, availability of fuel, etc., but it may be briefly estimated that the value of clay ranges from $3.66 to $7.50 per ton and that with favorable conditions it ought to be produced for $1.55 to $3.25. This article has been compiled from notes extending over a period of years, supplemented by personal observation. I have not always been able to find the authority for some of the statements made, and if I have plagiarized in any item it is unintentional on my part.

Solidification of various hot molten materials is most commonly carried out with water from any natural source of available temperature, but is better controlled by mechanically cooled water or brine, as, for example, in the manufacture of candles, wherever the speed of cooling and the constancy of the rate contributes to cost reduction or to improvement of quality of product.

Zinc Smelters in United States

In an address made by Paul E. Ewert before a meeting of zinc-ore producers recently held at Joplin, Missouri, the statement was made that of 120,000 zinc retorts in the United States, 87,000 are owned by five companies, which the attorney designated as the 'Big Five,' though on just what basis is not clear, as two companies not included are larger than one of those included in the nefarious group. Presumably the inference is that the five companies have combined to control the spelter market, but this overlooks the important fact that the keenest competition exists between these companies and the relations of some of them are far from cordial. As a matter of fact the smelting companies are said to be welcoming the Federal investigation of the zinc industry as affording an opportunity to demonstrate before an official body that there is not and never has been a combination of the smelters. As the list of smelters prepared by Mr. Ewert is of much interest, we give it below without alteration, except to correct some of the more obvious errors. It is impossible to check the number of retorts given, since the recent rise in the price of spelter has brought about rapid changes in the effort to increase smelting capacity as quickly as possible. Plants that had been closed down have been re-opened and new construction rushed to completion, so that complete accuracy is difficult to obtain.

The "Big Five" consists of the following: The New Jersey Zinc Co., the American Metal Co., Vogelstein & Co., Beer, Sondheimer & Co., and Granby Mining & Smelting Company.

Total retorts in the United States	120,000
Total retorts owned or controlled by the "Big Five"	87,000

The New Jersey Zinc Company

The New Jersey Zinc Co. owns a controlling interest in all of its smelters. It has an absolute monopoly of the zinc oxide output in the United States. It manufactures between 80 to 90% of the zinc oxide of the country. It also is a producer of high-grade spelter, making the highest-grade spelter produced in the United States. It alone produces 20% of the total spelter output of the United States. It owns and controls the following smelters:

	Retorts.
Mineral Point Zinc Co., Mineral Point, Wisconsin	3,920
Prime Western Smelting Co., Gas City, Kansas	4,768
New Jersey Zinc Co., Bethlehem and Palmerton, Pa	5,760
(Now building)	3,456
Mineral Point Zinc Co., Depue, Illinois	9,080
(Now building)	2,280
Tulsa Fuel & Manufacturing Co., Collinsville, Oklahoma	6,232
Bertha Mineral Co., Pulaski, Virginia	1,400
Total retorts owned or controlled by the New Jersey Zinc Co.	36,896

The American Metal Company

The American Metal Co. is commonly supposed to be a branch of the German Smelter Trust. Much of its stock is owned by the Metallurgical Company of America. Next to the New Jersey Zinc Company, it is the biggest

factor in the American smelting industry. It owns the stock or controls the output of the following smelters:

	Retorts.
Bartlesville Zinc Co., Bartlesville, Oklahoma	5,184
Bartlesville Zinc Co., Collinsville, Oklahoma	8,064
Lanyon Starr Co., Bartlesville, Oklahoma	3,456
American Zinc & Chemical Co., Langeloth, Pennsylvania (now building)	3,456
Total retorts owned or controlled by the American Metal Co.	20,160

VOGELSTEIN & COMPANY

Vogelstein & Co. owns or controls the output of the following smelters:

La Harpe Spelter Co., La Harpe, Kansas	1,856
American Zinc Lead & Smelting Co. (51% of this company is held in the vaults of Hayden-Stone & Co., bankers, Boston, for Vogelstein interests).	
Deering, Kansas	3,840
Caney, Kansas	3,648
American Zinc Co., Hillsboro, Illinois	3,200
(Now building)	800
Total retorts owned or controlled by Vogelstein & Co.	13,344

GRASSELLI CHEMICAL COMPANY

Clarksburg, West Virginia	5,760
Meadowbrook, West Virginia	6,912
Total	12,672

(Buyer of low-grade ore. Manufacturer of acid at Grasselli, Indiana, shipping residue to Virginia to make low-grade spelter.)

BEER, SONDHEIMER & COMPANY

Beer, Sondheimer & Co. is commonly believed to be one of the subsidiary companies of the European Smelter Trust. It owns only one smelter in its own name, but has a majority of the stock or controls the output of three smelters, as follows:

National Zinc Co., Bartlesville, Oklahoma	4,470
National Zinc Co., Springfield, Illinois	3,200
Altoona Zinc Smelting Co., Altoona, Kansas	3,960
Total retorts owned or controlled by Beer, Sondheimer & Co.	11,630

HEGELER ZINC COMPANY

Hegeler Zinc Co., Danville, Illinois	3,600
Matthiesson & Hegeler, La Salle, Illinois	6,168
Total	9,768

(Uses its own spelter for the manufacturing of sheet zinc.)

GRANBY MINING & SMELTING COMPANY

Granby Mining & Smelting Co. owns or controls the output of the following smelters:

Smelter, Neodesha, Kansas	3,840
Smelter, East St. Louis, Missouri (now building)	3,240
Total retorts owned or controlled by Granby Mining & Smelting Co.	7,080

EDGAR ZINC COMPANY

Edgar Zinc Co., St. Louis, Missouri	2,000
Cherryvale, Kansas	4,800
Total	6,800

(Eighty per cent of stock owned by American Steel & Wire Co. of the U. S. Steel Corporation. Buys only for spelter used by the Steel Corporation.)

ILLINOIS ZINC COMPANY

Peru, Illinois	4,640

(Purchaser of high grade blende only, which it manufactures into sheet zinc.)

TULSA SPELTER COMPANY

Sand Springs, Oklahoma	4,000

(Works supposed to be backed by United States Zinc Co.)

CLARKSBURG ZINC COMPANY

Clarksburg, West Virginia	2,736

UNITED STATES ZINC COMPANY

Pueblo, Colorado	1,920

(Not in Joplin market. Is part of lead monopoly, smelting zinc-lead ores only.)

ROBERT LANYON ZINC & ACID COMPANY

Hillsboro, Illinois	1,840

COLLINSVILLE ZINC SMELTING COMPANY

Collinsville, Illinois	1,536

(Now owned by certain stockholders of the Picher Lead Co. of Joplin, Missouri.)

CHANUTE ZINC COMPANY

Chanute, Kansas	1,280

SANDOVAL ZINC COMPANY

Sandoval, Illinois	996

(Purchaser of zinc dross only.)

MISSOURI ZINC COMPANY

Beckemeyer, Illinois	192

The Transvaal at the Exposition

Simple yet attractive is the display of the Transvaal Chamber of Mines in the Palace of Mines and Metallurgy at the Exposition at San Francisco. In the centre of the booth is a high obelisk, divided into sections showing the relation of the Rand to the rest of the world's gold output, as follows: Rand, 40%; United States, 19.4%; Australasia, 11.3%; Russia, 5.5%; Mexico, 4.5%; Rhodesia, 3.1%; Canada, 2.9%; India, 2.7%; West Africa, 1.8%; and all other countries 8.8%. On each side of the obelisk is a large golden sphere. One represents $180,812,720, the other $271,320,720, the respective gold yields of the Rand and the rest of the world in 1913. A case contains a model of the surface plant at the Modder B. mine. The 90 stamps on this mine in 1914 crushed 440,000 tons of ore. Other cases show the typical Rand rock and ore. Miners and others are able to better understand the small amount of gold in one ton of ore by the exhibit of a cube, 12 cu. ft., representing one short ton of Rand ore. On top of this is a small gold cube equal to 6.84 dwt., the average value in 1913. The yield was $6.54, and residue averaged 30c. per ton. Gold output of the Rand in April was 744,080 oz. valued at £3,160,651. For the first four months of 1915 the yield is 240,528 oz. more than in 1914.

FLUORSPAR PRODUCTION of the United States in 1914 amounted to 95,116 short tons, worth $570,041. In 1913 the total was 115,580 tons, valued at $736,286. The market for this mineral depends on the steel industry.

Cyanide Plant at Kushikino, Japan

The most up-to-date cyanide plant in Japan is that of the Kushikino gold mine, Kagoshima-Ken. It is not only new in its construction, but is the first mill to employ the all-sliming process. All the other gold mines in Japan use the percolation or semi-sliming process.

The Kushikino mine had been worked for a long time by crude methods when the Mitsui Mining Co., one of the most important corporations in Japan, acquired it in 1906, forming a concession by gathering together a number of small properties. For some years the company carried on only exploration and development work underground. When the existence of a sufficient amount of workable ore had been proved, it was decided that a mill of modern design should be built. Meantime the company had sent K. Hasegawa to America to study the best process of treating the ore. He found the methods prevailing at Goldfield, Nevada, best suited for the requirements. It was therefore decided to order all the machinery from the Allis-Chalmers company, Milwaukee, which designed and erected the plant of the Goldfield Consolidated. The Kushikino mill was completed in the fall of 1913, and the work has since proceeded smoothly and satisfactorily under the management of Mr. Hasegawa.

The mill is well placed on a hillside only half a mile distant from the railroad station, called Kushikino. It is 23 miles west from Kagoshima city, and only a mile from the sea-coast on the west. The mill, both inside and out, much resembles that of the Goldfield Consolidated, only on a diminutive scale. All the machinery is of nearly the same pattern and about the same arrangement. There are 40 stamps, each weighing 1250 lb., with a capacity of 6 tons per head. The power is obtained from a 318-hp. suction gas-engine, which drives four 50-kw. electric generators. The fuel used is lump coke made at the Miike coal mines, belonging to the same company. The cost of power is only 0.6 cents per kilowatt-hour. The pebbles used in the tube-mills come from Denmark, the consumption being 100 lb. per day. For the lining of No. 1 and No. 2 tube-mills, silex is used. This comes from France, and costs $200 for 25 cu. yd., the wear being 1 inch in six months. In No. 3 tube-mill cast-iron lining has been tried recently.

As the ore contains 10 to 16 times as much silver as gold, rather strong solution is used, the strength in the agitation-vats being 0.3% cyanide. The consumption of cyanide is said to be 3 lb. per ton of ore. The cyanide averages 98 to 100%, and comes from England.

The zinc-dust used is manufactured in Amuda, near the Miike coal mine, where the same company established a large zinc-smelting works in 1913. The consumption of dust is said to be 0.25 lb. per ton of ore. The ore is low-grade, the average content of gold being $6.25 per short ton and 3.45 oz. silver. The extraction made is 87% of the gold and 84% of the silver.

The production of gold and silver in this mill in the last four months was:

	Gold, Oz.	Silver, Oz.
November 1914	1,554	15,579
December "	1,301	16,993
January 1915	1,040	9,410
February "	1,443	12,442

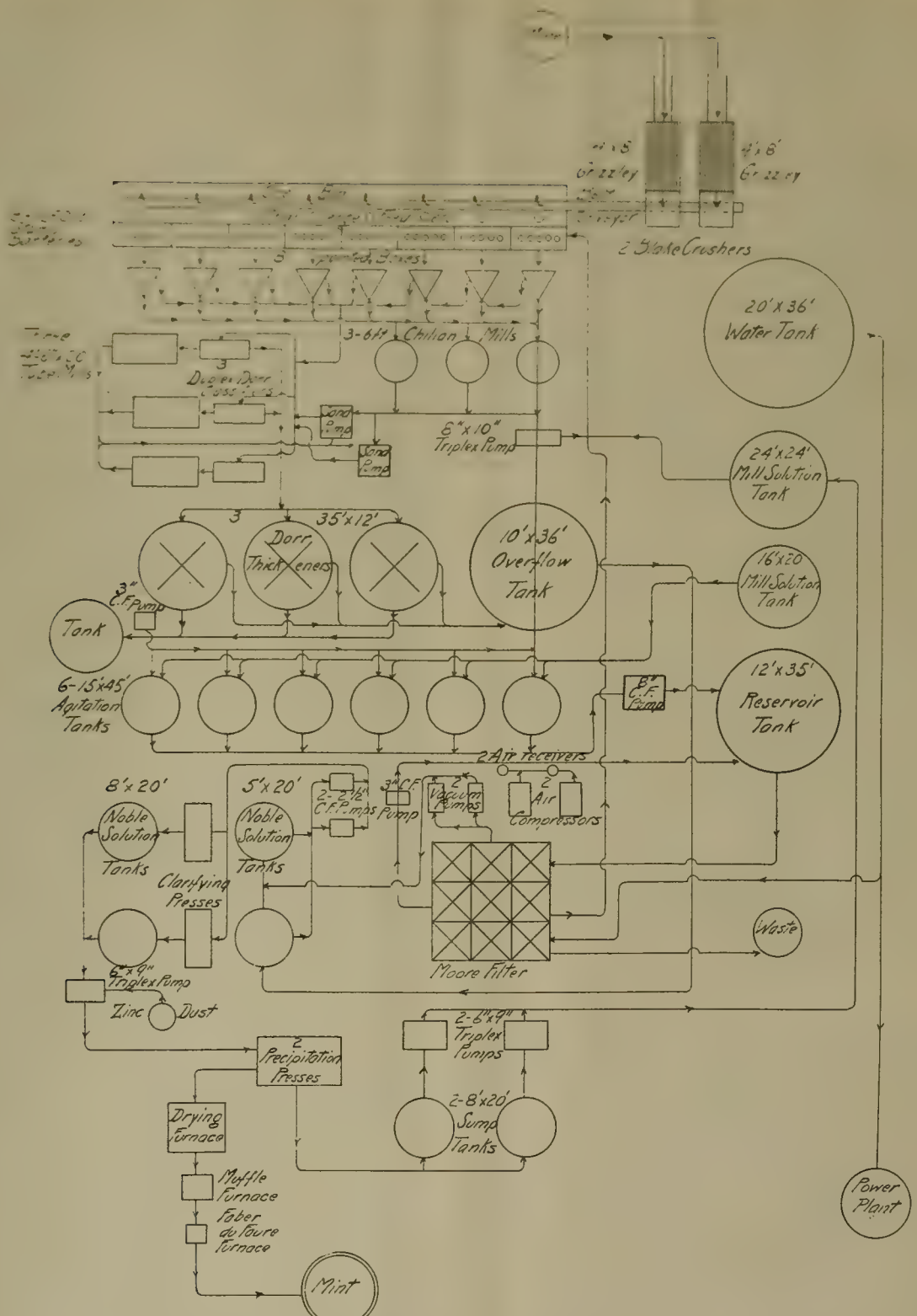
The production at Kushikino is nearly equal to that of the Sado mine, which stands second in gold production in Japan, Hidachi ranking first. The last is a custom smelter and smelts gold-bearing quartz from several mines all over the country. The Kushikino mill is only supplied with ore from the mines owned by the company in its vicinity.

The ore handled by the mill comes mainly from the Nishiyama mine. The company has another mine called Hajima, which is now mostly in the exploration and development stage. The Nishiyama mine is three miles from the mill, and the ore is brought down on a surface tramway in cars drawn by horses. In the mine there is only one large vein, striking nearly east to west with a dip of 50 to 70° south. The country-rock is andesite, which has intruded Tertiary sandstones and tuffs. The thickness of the vein varies from 3 to 50 ft., averaging 15 to 20 feet. It has already been followed for 7000 ft. along its strike by an adit-level. The vein was well explored above the adit, and three different shoots of good ore were found. Each of these extends for 1000 ft. in length, though it is not yet known to what depth the ore may persist. A shaft has been sunk on the vein 120 ft. below the adit. Sinking is now hindered by a flow of 300 cu. ft. of water per minute. With the present capacity of the mill, it is not necessary to push work below the adit, since there is enough ore in reserve ready for stoping. The ore reserve is calculated at more than 1,000,000 tons with an average gold content of $5.50 per ton.

Another mine belonging to this company, the Hajima mine, is situated on the opposite side, at the distance of two miles from the mill and nearer the coast. There are a number of veins, though none is large; and they have been well explored, showing ore of the same quality as at Nishiyama. After the completion of an aerial rope-way now planned, a considerable tonnage of ore from the Hajima will be brought to the mill for treatment. The Kushikino gold mine, with its new mill and two mines, is making good profits and has demonstrated that modern methods of mining and milling are the most advantageous for work in Japan. The future of Kushikino is promising.

MINERAL EXPORTS of Chile decreased from $126,988,673 in 1913 to $93,818,408 in 1914. This was due to the War, which upset the nitrate industry. On March 25 the price was $1.54 per 101.4 pounds.

BARYTE PRODUCTION of the United States in 1914 was 34,315 tons, valued at $447,358. Most of this is used in white paint.



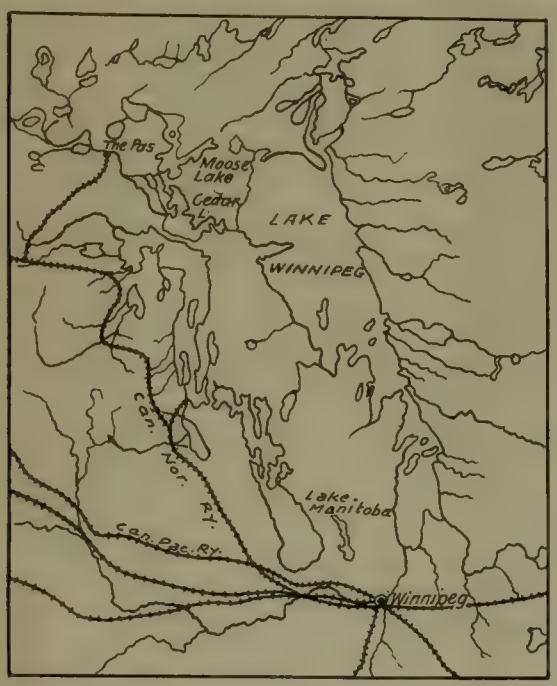
FLOW-SHEET OF THE KUSHIKINO MILL.

Beaver Lake District, Saskatchewan

By CHARLES A. BANKS

Beaver lake, around the north shore of which there has been considerable staking of claims, is about 20 miles long. It contains a number of small islands. It is situated in northern Saskatchewan; within about 12 miles of the western boundary of Manitoba. The nearest railway connection is the small town of Le Pas. This place is in northwest Manitoba, on the south bank of the Saskatchewan river, where the latter is crossed by the Canadian Northern railroad.

The population of Le Pas, including its large number of transient railway men, is about 2000. It is a typical



A PART OF SASKATCHEWAN.

Canadian frontier town, boasting of one well patronized hotel, and two moving-picture theatres. The recent real-estate boom is probably responsible for the scattered appearance of the town. Ill-fed 'huskies'—the dogs of the North—are to be seen prowling around most of the streets, which were, at the time of my visit, in a hopeless state of mud and disorder. Le Pas is reached by a tri-weekly service from Prince Albert or Winnipeg. Either route occupies about 24 hours. Beaver lake is about 65 miles, direct line, northwest of this town.

In the winter months the mining properties, which are scattered around the north shore of the lake, are reached by means of sleighs or dog-teams. These, starting from Le Pas, take you by way of the frozen Saskatchewan river, and over many frozen lakes and snow-covered portages, to the small town of Beaver City, situated on the south shore of Beaver lake. The distance is about 90 miles. It takes two days. As the first night out from Le Pas has to be spent in a tent with Indians, or in some other equally uncomfortable place, the rather crude boarding-house at Beaver City is in no way despised. An 18-mile run from the town takes you to the centre of mining activity on the north shore of the lake.

During the summer months a boat service is maintained between Le Pas and a point 20 miles south of Beaver City. The latter is then reached by dog-team across the 20-mile portage. A launch can be hired to carry people to any part of the Beaver lake. During the formation and break-up of the ice, the new field cannot as yet be reached.

The first claims to be staked were recorded in August 1913, in the name of the Prince Albert Exploration Company. Since this date ground has been staked for some distance back all along the north shore of the lake. In April 1914, the Beaver Lake Gold Mining Co., of Prince Albert, Saskatchewan, acquired most of the holdings of the Exploration company. Since then development has been done in a small way on several of its 32 claims. Work has been concentrated mostly on the Prince Albert claim, where, at the contact of the Huronian schist and fine-grained Laurentian diorite a 48-in. quartz outcrop can be traced for a considerable distance. This shows a good deal of coarse gold, and a little pyrite. An incline-shaft has been sunk 70 ft. on the vein. The ore thus exposed is from 4 to 5 ft. wide from top to bottom of the shaft. The average value, neglecting a few feet of enrichment on the surface, is, according to the prospectus of the Beaver Lake Gold Mining Co., $16 per ton in gold, and about 2 oz. silver. The quartz in the shaft is white, with thin seams of mineral running through it. Fine gold can be seen in most pieces with the aid of a glass. I understand that the company is arranging with Toronto people to assist in extensive development. The profitable opening of this mine may warrant the development of numerous other properties, the owners of which, in the meantime, will probably content themselves with assessment work only.

MECHANICAL REFRIGERATION, first used only for ice-making, and next applied to brewery cellars and beer wort, soon was extended to all kinds of cold-storage purposes and became the foundation of the modern fresh-food distribution system. These uses of mechanical refrigeration are today so common and well known as to obscure a more recent and valuable extension of mechanical cooling as a part of manufacturing processes. While these are constantly increasing in number and variety, there are even more instances where this type of machinery could be economically used and where, for some reason, its application has not been undertaken. Wherever the general process includes such steps as gas, liquid or solid cooling, condensation, crystallizing, fermentation, mechanical refrigeration must be carefully considered as a possible means of improving the product, increasing rate of production or permitting recovery of new products.—*C. E. Lucke.*

Eruptions of Mt. Lassen and Tertiary Eruptions of the Sierra Nevada

By H. W. TURNER

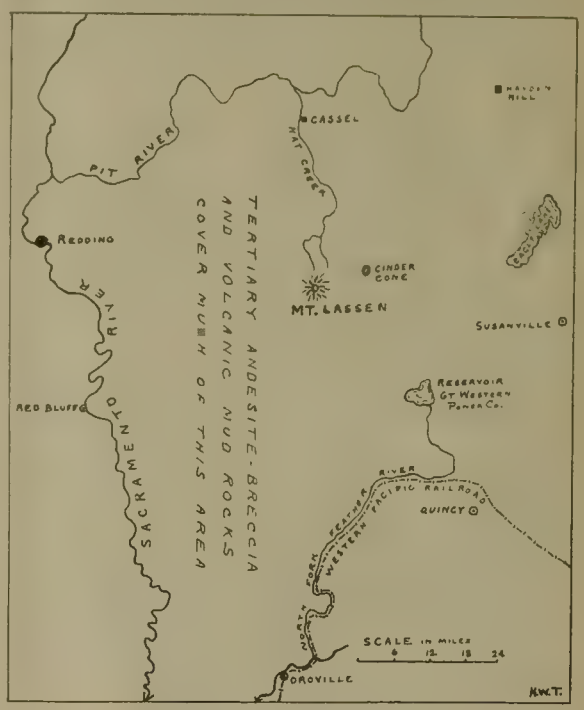
In late Tertiary time, there were many volcanoes in the Sierra Nevada, mostly in the central and northern portion. At that time, vast floods of volcanic material were emitted, covering the larger part of the area between the Yosemite Park and the Oregon border. These volcanic materials consisted both of molten and fragmental lava, the last the result of steam explosions. This fragmental material, angular pieces and fine volcanic dust, was deposited on all the slopes surrounding the volcanoes in layers more or less nearly horizontal as we find them today; but a large part of the ejectamenta, becoming mixed with water, formed enormous mud flows that filled the river-valleys and traveled westward to the present site of the Great Valley of California.

Similar mud-flows have taken place many times in Japan, even in historic time, covering farms and villages.

That broken material, if on a steep slope, can flow is well illustrated in a land-slide that took place at Frank in Alberta on April 29, 1903. A huge mass of rock, nearly half a mile square and about 400 ft. thick, suddenly broke loose from the east face of Turtle mountain and precipitated itself with terrific violence into the valley beneath, overwhelming everything in its course. The great mass, urged forward by the momentum acquired in its descent, and shattered into innumerable fragments, ploughed through the bed of the Old Man river, carrying both water and underlying sediments with it, and crossed the valley to hurl itself against, and up, the opposite terraced slopes to a height of 400 ft. Blocks of limestone and shale, mingled with mud, covered the valley to a depth of from 3 to probably 150 ft., over a square mile of area. The track of the Crow's Nest railway was hopelessly buried for nearly 7000 ft. and about 70 people were killed.

The mud-lava flows of the Sierra Nevada in their progress caught up boulders and fragments of the bedrock formation (slate, schist, and granite), and trunks of trees; the latter, becoming silicified or lignitized, have been preserved to this day. Generally these tree-trunks are found lying at all angles in the mud or 'cement' lava, but in some instances where the mud was fine-grained and the flow quiet, the trees were covered up in a standing position. Of this Ross E. Browne gives an interesting example.* The locality is the Weske channel of the Forest Hill divide in Placer county. Browne writes: "The cement filling the bed to the depth of 100 ft. is a more uniformly fine-grained material than is usually encountered. It encloses a number of trees standing on the banks of the channel, with roots intact in the gravelly soil and bedrock. One of these is nearly 100 ft. in height and 4 ft. in diameter at the base, and stands perfectly upright."

In surveying for a geological map in the Sierra Nevada, I came across two instances where the mud-lava had filled great fissures in the bedrock formations, these fissures presumably having been opened by earthquakes. One of these is at Poker Flat, in Sierra county, a place rendered famous by Bret Harte's famous story. Here



MT. LASSEN AND ITS VICINITY.

Canyon creek has cut to the depth of 1000 ft., exposing a vertical dike-like streak of volcanic ashes and fragments; and this streak continues as a narrow band up both the north and south slopes of the canyon with serpentine and slate as a wall-rock. The material near the hotel is nearly horizontally stratified, which is hard to explain on the theory of a filled fissure; in other places, it is made up of a rubble of andesite and serpentine fragments and boulders, and there are also inclusions of a white lava. In this instance no proof was obtained that this cement mixture could not have come up from below, but at a similar occurrence on Fall river, in Butte county, the fissure has granodiorite for walls and

*10th Annual Report, State Mineralogist, p. 441.

in the concrete or cement-like material of the 'dike' there are fragments of lignitized wood, as well as fragments and pebbles of pre-Cretaceous bedrock and of a basalt of a type older than the andesite eruptions. The inclusions of wood (a species of *sequoia*) and the pebbles and fragments of bedrock can only be explained by the hypothesis of an open fissure filled from above.

The larger part of the gold of California was originally deposited in veins or impregnations in the bedrock formations long before Tertiary time. The placer gold, as every miner knows, came from the vein or lode deposits by the gradual erosion of the bedrock series. Being very heavy, it was gradually concentrated in the river-gravels. Then when the river-beds and valleys were filled by the lavas and mud flows, the rivers, with a vigor renewed by an elevation of the range, cut new channels; the present river-canyons left the old channels and their rich gold gravels high and dry, though in most places they became capped by volcanic material, largely of the cement or mud-lava type. The ancient channels, known as 'deep leads,' have since produced some hundreds of millions of dollars in gold by drift and hydraulic mining.

In the Lassen Peak area there were in Tertiary time several volcanoes, which gave out both molten lava and showers of volcanic ejectamenta. The fragmental material at one time covered a large part of the area between the Pitt, Sacramento, and North Feather rivers, and the cement-lava that caps the gold-bearing gravels of the Magalia ridge north of Oroville came from the Lassen area.

Judging from all the printed descriptions, the recent eruptions of Mt. Lassen have all been of the nature of steam explosions. The hot lava fragments and dust or ashes have melted the snow and with the water from this source and from the streams they have formed mud-flows, which are reported to extend down into the Hat Creek drainage for a distance of 15 miles north of the sources of eruption near the summit of the peak.

G. M. Homans, State Forester, insists, however, that the material ejected from a new orifice on the northern slope of the peak, in May 1915, came out of the crater as a mud-flow and that the path of the flood is plainly marked down the north slope of the mountain.

According to the observations of W. H. Storms,† on June 20, 1914, the steam-explosion crater on Lassen peak was 650 ft. long, 100 or more feet in width and about 100 ft. deep. It resembled a big open-cut or 'glory-hole' and should not be confused with an ordinary crater, which is usually more or less nearly saucer-shaped and formed of rounded fragments of lava (lapilli) and volcanic ashes, which, being thrown into the air, fall down more or less symmetrically around the orifice, forming usually a conical hill with a basin in the centre. Later other cavities were formed and the larger crater altered. Prof. R. S. Holway, of the University of California, reports that: "The bowl of the old crater of 1914, formerly 300 or 400 ft. deep is now filled. The first glance, however, does not show the most interesting fact—the crater has not been filled by volcanic ash and rock fragments, but the bottom of the old crater has been literally shoved upward as a whole, undoubtedly by lava pressure from underneath." This observation by Prof. Holway seems not at all unlikely, as there must surely be a heated mass below to account for the steam explosions.

Lying about 10 miles northeasterly from Lassen peak is Cinder Cone, which has been described in detail by J. S. Diller of the U. S. Geological Survey in Bulletin No. 79. This cone of ash or volcanic sand is nearly perfect in its outlines and was undoubtedly formed in comparatively recent time, possibly less than 500 years ago. Since that eruption apparently the volcanic forces of the Lassen Peak area have been quiescent up to 1914.

The Lassen area, however, cannot claim all of the volcanic activity of California in recent time, speaking in a geological sense, for there are nearer-by, in Lake county in the Coast ranges, to the east of Clear lake, several craters from which basaltic lava issued and which are still in nearly perfect condition, indicating their comparatively recent origin. One of these, the McPike crater is symmetrical, with a saucer-shaped basin at the summit about 60 ft. deep. Lapilli cover the bottom and sides of this crater, which rises about 800 ft. above the flat land at its base. Then along the eastern slope of the southern Sierra, there are a number of craters and lava-fields showing the curious curling shapes of molten surface flows, indicating that not a great time has elapsed since the eruptions took place.

†Mining and Scientific Press, July 25, 1914.

Smelting at Greenwood, British Columbia

According to the report of the general manager of the Canadian Copper Corporation, Oscar Lachmund, the plant at Greenwood showed the following results in 1914:

The ore from the Mother Lode mine assayed from 0.396 to 0.868% copper, 0.0275 to 0.095 oz. gold, 0.149 to 0.178 oz. silver, 21.2 to 34.65% silica, 15.36 to 28.6% iron, 11.95 to 20.01% lime, and 2.37 to 13.2% sulphur.

The total amount of ore smelted from January 1 to August 23 was 299,928 tons. It consisted of B. C. Copper Co.'s ores, 193,512 tons, and custom ores, 106,416 tons. Converter slag made and smelted was 5129 tons. It contained 1627 tons of custom ore and 466 tons of clay. Coke used was 41,026 tons. It represented 13.52% of the entire charge fed to the furnaces. The time of actual operation was 450 furnace days. Charge smelted, excluding coke, was 303,430 tons. The amount of charge smelted per furnace day was 674 tons. The average grade of the matte was 39.7% copper. The blast-furnace slag contained 0.251% copper, 0.0039 oz. gold, and 0.07 oz. silver per ton. The average analysis was: silica, 41.9%; iron, 18%; and lime, 22%.

The recoveries, based on blister copper returns, slag losses, and metals tied up in process, were as follows: gold, 101.39%; silver, 75.48%; and copper, 77.27%. Production was: copper (fine), 4,116,190 lb.; gold, 14,442 oz.; and silver, 63,501 ounces.

CONCENTRATES

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Silver sulphate is an efficient solvent of pure arsenides preparatory to analysis.

Tube-mills were first used for the fine-grinding of ore in 1894 at the Moulton mill, at Butte.

Maucherite, Ni_4As_3, contains the largest proportion of nickel of all the nickel arsenides. It is widely distributed.

Tellurides at Kalgoorlie, Western Australia, are mainly confined to the richer ore-shoots, in veinlets crossing the lodes at right angles.

Fluorspar is used as a flux in basic open-hearth steel-making furnaces. It is also consumed in other metallurgic operations and in the manufacture of hydrofluoric acid.

Silver and gold recovered by concentration at the Montana-Tonopah mill in 1914 was 22.2%, out of a total extraction of 93.3%. The concentrate contained 362 oz. silver and 8 oz. gold per ton.

Filter-presses were borrowed from sugar-refining practice, and the tube-mill from the cement industry. In exchange, the vacuum-filter is now being used in sugar-mills for the treatment of crushed beets.

In regions abounding in deposits of native silver associated with arsenical minerals, the source of the silver should be attributed to the action of arsenides rather than to arseno-sulphides, such as arsenical pyrite and cobaltite.

Organic material may be removed from glass or porcelain by immersing the apparatus to be cleaned in hot sulphuric and a little nitric acid. The sulphuric-potassium bichromate cleaning mixture leaves by-products on the ware.

The capillary concentration of oil and gas in sands and fissures is an essential requirement of the organic theories, which postulate that oil was originally disseminated in shales and limestones, according to C. W. Washburne. It is not essential to the inorganic theories, under which the phenomena of concentration are capable of independent explanation, but the principles stated are thought to hold true for all oils in porous rock, regardless of their origin.

Mine mules were discussed in the Press of February 6 and 13. Recently in a coal mine at Wellsburgh, West Virginia, one mule hauled 152 two-ton cars distances of 1200 and 2500 ft. in 8 hours. In this district a day's work for one animal is from 40 to 50 cars.

Brass founder's ague, 'brass shakes,' and 'spelter chills' are names given to complaints arising from working in brass mills. There is a difference of opinion among doctors and chemists as to the cause. Zinc-oxide fume is considered by some to be part of the source of the trouble.

The change-house at the Raritan Copper Works, Perth Amboy, contains a main ventilating-pipe that is fixed along the centre of the building. Branches from it run to, and underneath, each lot of lockers. By this means it is expected that the lockers will be kept thoroughly ventilated, and in wet weather the damp clothing will be dried.

General constituents in white paints are white lead or basic carbonate of lead, zinc-white or zinc oxide, sublimed white lead, or basic-lead sulphate, and lithopone, which is a mixture of barium sulphate and zinc sulphide in molecular proportions. In addition to these major constituents there are also certain inert white pigments. These are barium sulphate, barium carbonate, calcium carbonate, calcium sulphate, china-clay, silica, and asbestine or magnesium silicate.

An instructive device at the U. S. Bureau of Mines booth at the Exposition shows, by means of flowing streams of crushed coal, the distribution of the losses that occur in burning coal in various types of boiler-furnaces. The small amount of coal that is finally made available for useful work is shown so as to impress the spectator with the need of fuel-efficiency investigations,

such as the Bureau is conducting in the attempt to find methods of minimizing the losses of fuel which now total many millions of dollars per year.

STAGE-CRUSHING at the Commonwealth mine, Arizona, using crushers, stamps, Hardinge, and tube-mills, resulted in a duty of 10.46 tons per stamp per 24 hours in 1914. The term 'stamp-duty' is hardly correct when a stamp is only part of the crushing system.

PORTLAND CEMENT CLINKER consists essentially of lime, alumina, and silica; from a mixture of these in the proper proportions a clinker possessing all the properties of a desirable portland cement can be made by proper burning. Such a clinker will consist of the three compounds, $3CaO.SiO_2$, $2CaO.SiO_2$, and $3CaO.Al_2O_3$; if, during the burning, complete equilibrium has not been reached—as happens in actual practice—there will be, in addition to the above three major constituents, two minor ones, namely, CaO and $5CaO.3Al_2O_3$.

COMMERCIAL GRAPHITE should consist chiefly of carbon in the graphitic condition, it should not melt or burn easily and should contain very little volatile or easily alterable substance. Possible adulterants of graphite which are of similar nature are gas carbon, coke, anthracite coal, lignite, bituminous coal, lampblack, and wood charcoal, all of which consist in large part of carbon. It is easy to determine qualitatively whether any of the above impurities are present although when mixed with considerable pure graphite it is difficult to distinguish between heated anthracite coal, strongly heated wood charcoal, and certain kinds of lampblack.

A PRACTICE that is fast gaining adoption in progressive power-plants is the use of paint for the inner surface of steam-boiler drums. The paint is said to afford protection against pitting. Silica-graphite paint is used for this purpose. For a number of years the manufacturers of this paint have coated the steam drums of five B. & W. boilers developing 1800 hp. As a result the drums are in almost perfect condition. In another instance—a plant equipped with similar boilers developing 8400 hp. —the interiors of the drums were scalded, painted both above and below the water-line, and allowed 48 hours to dry thoroughly. This treatment was repeated every 10 months. Not only did it stop pitting, but where it had previously occupied six men seven days to clean the drums of one boiler, two men now clean them in a day.

GASOLINE-VAPOR is not a gas, according to the suit of Locke v. Russell, decided in West Virginia on April 20, 1915. The lessees under an oil and gas lease perfected a method for condensing, saving, and marketing the gasoline that was wasting from the casing-head in the form of vapor, and tendered to the lessors the stipulated royalty based on oil extraction. The lessors claimed in addition thereto the minimum gas rentals, basing their contention on the theory that the gasoline-vapor was a gas product. The court held that gasoline-vapor was not gas within contemplation of the lease, and that the lessors were entitled to royalties based on its production as a part of the oil yield of the well.

THE ordinary forms of iron corrosion have been found to be due to auto-electrolysis, the presence of segregated impurities being responsible for differences in potential at certain areas, which set up galvanic action and cause solution and the formation of rust at the positive nodes. A similar but more rapid action takes place when an electric current is passed through an iron anode immersed in an electrolyte: salt water, for example. When damp cement contains an embedded iron anode, the cement acts as an electrolyte and the same rusting action takes place, regardless of the fact that concrete contains sufficient lime to inhibit corrosion when no electrical currents are present. With the electrolytic change of metal into oxide comes an increase in volume of the products of reaction, and there is developed an enormous expansive force or mechanical pressure, which is sufficient to crack the strongest forms of concrete.

THE CONDITION OF MATTER called temperature is a species of motion. This motion is not an organized motion of the mass as a whole, but a disorganized motion of the minute, invisible parts of the body. The temperature of a body is commonly estimated by touching it and finding if it feels hot, warm, or cold, according to E. F. Northrup in the Journal of the Franklin Institute. But if the body glows, its temperature is judged by the sense of sight, and the temperature is considered high in proportion to the brightness of the light which the body emits. Again, if a substance, ordinarily observed in its gaseous or liquid form, is seen in its solid form, and is recognized as the same substance, it is then called very cold and is said to be at a low temperature. All sense perceptions inform us that what we call temperature is a word which expresses our recognition of a 'condition' under which all matter exists, and common experience shows that this condition varies widely.

FIRE in bales of cotton at Calexico, California, was recently extinguished by kerosene. This may appear strange. The explanation is as follows: A cotton bale has been subjected to a heavy pressure. Water will penetrate it only an inch or so, whereas kerosene will go to the centre. A fire in a cotton bale does not blaze, simply smolders and eats its way into the bale. At the comparatively low temperature at which cotton burns, and where there is no flame, kerosene does not ignite. This is the explanation. After the fire is extinguished the bands are removed from the bale, and the burned portions of the cotton stripped off. It is said that the use of kerosene has practically no detrimental effect on the cotton, and after it has been spread out and aired for a few days all odor of the oil disappears. Those who experiment with kerosene as a fire-extinguisher should proceed with extreme care. Bales of cotton-waste or sacks at mines sometimes catch fire, and could be extinguished by the use of kerosene.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

LORDSBURG, NEW MEXICO

NEW MEXICAN CONDITIONS.—WALDO-BEAN LEAD MINE AND MILL.—85 MINE AND DISTRICT.—EMPIRE ZINC.—PINOS ALTOS DISTRICT.—BURRO MOUNTAIN.—CHINO.

Throughout New Mexico mining properties that have been dormant for many years are being opened; active mines are increasing their production; new mills are under construction; the outlook in general is bright. New companies to be incorporated in New Mexico are: the Pittsburg Placer Mining Co., of Shandon (post-office, Derry), New Mexico; capitalization, $250,000. W. R. Dorna is agent. Brooklyn Development & Mining Co., of Albuquerque, New Mexico, has been granted a charter. W. C. Heacock is agent. The company will operate in Cochiti district; capitalization, $200,000. Gold Crown Mining Co. has been incorporated by Valacott and Fowler of Silver City, New Mexico. The Santa Fe Dredging Co. has been incorporated in Santa Fe, New Mexico, by W. T. Middleton, president, and J. A. Wood, secretary. A. Renehan is agent. Eastern office is New York Life building, Kansas City, Missouri. Denver-New Mexico Oil Co., of Dayton, New Mexico, is a recent company to be incorporated in New Mexico. M. B. Culpepper is agent.

In the Lordsburg district the Waldo-Bean lead-carbonate property has been taken over by Anderson and Brown, of Los Angeles. A 50-ton dry-concentrating mill is being built. No mining will be done at present, there being several thousand tons of good-grade ore on the dumps. Mining will be resumed after thorough tests are made in the mill. The process will incorporate the Stebbins dry-concentrator for lead-carbonate ores. The flow-sheet is as follows: gyratory jaw-crusher (Samson type), pebble-mill, trommel, fine orebins, elevator, feed-bin, and Stebbins table. Tailing will be saved for future concentration. Laboratory experiments gave a 65% lead concentrate. The ore also contains silver and copper.

The Nellie Bly mine at Leidendorf is under lease from the Susquehanna Copper Co. to Col. Randall and associates. The dump is being sorted and shipped. Mining is on a small scale. Gwartney and Fairley are mining good-grade gold ore from a small vein in adjoining claims.

The Atwood mine is being operated by the Atwood Copper Co., with J. L. Wells in charge. Regular shipments are being made to the Copper Queen smelter at Douglas. Dumps are being shipped. The hoist is being repaired. This is one of the best mines in this district. It adjoins the 85 mine.——Andrew Bain, former superintendent for the U. S. S. R. & M. Co., at the Dundee mine, is operating the Battleship claims north of the 85 mine, under lease from W. T. Scarborough and others. The mine will soon be ready for shipping.——The 85 mine, under management of A. J. Inderrieden, is shipping 400 tons of ore daily to Douglas, El Paso, and Hayden. Another 'Caterpillar' tractor from the Holt company, Stockton, California, has been added to the ore-hauling plant by the contractors, Rowan and Downey. The two tractors are handling practically the whole output of the mine. An electric-truck has been received here, but has not yet been used. Surveyors are still running lines from A. & N. M. railroad to the 85 mine, but nothing definite has been decided on relative to the construction of the spur.

The Gold Crown Mining Co. has been incorporated by E. A. Wayne and associates for the operation of mines and two mills at Twin Peaks in the Steeplerock district. The mill at Clear Lake has been overhauled. Tests are being made. The company also has a lease on the property of the Twin Peaks Mining Co., including the mill. David Gough is metallurgist. Extensive operations are said to be contemplated by the operators. ——The Carlisle and other mines at Steeplerock, via Duncan, Arizona, owned by George H. Utter, were examined this week by John H. Sully and an engineer of the Chino Copper Company.

John M. Sully, manager of the Chino company, and others have been examining property at Kinston, Hillsboro, and in the Carpenter district of Sierra county.

At Hanover, the United States Copper Co. is unwatering its shaft, preparing for resumption of work.

The Empire Zinc Co. is making progress at its Thunderbolt shaft, and is shipping large quantities of zinc carbonate ore from the Nason adit. Thunderbolt shaft is now down about 80 feet.

MAP OF NEW MEXICO.

Several shipments of copper ore have been made from Fierro, although the larger operators (Colorado Fuel & Iron Co. and Phelps, Dodge & Co.) have entirely ceased operations.

The Humboldt mine of the General Electric Co., is again under lease. This time to Nelson, Page, and Smith, who are said to have opened a good orebody. Other shippers from the district are G. W. Hightower, Minters and Atteberry, Fletcher and Bell, and Sinks.

In the Pinos Altos district the Empire Zinc Co. is constructing the concrete foundation for its mill at the Utter-Cleveland mines. Large consignments of machinery are being received. Orebins are being built at the Silver City end of the new Empire Zinc Co.'s tramway.——The Golden Giant mine has been bonded and leased to W. Hill and associates, from Dr. Hayden. The Golden Giant mill is being overhauled.——The Manhattan mine is being operated by J. Doyle and associates. Irregular shipments are made.——Peterson and Esplane are making

small mill-runs of zinc-sulphide ore, with good recovery.——Stauber and Wright will have their new mill in operation within a short time.——The Balback mine is being operated by John and Walter Oglesby.——Barnum and Rosenfeld have opened high-grade ore, according to recent reports.——McKee and Hammond are preparing to make shipments from the Cornie mine.——The whole Pinos Altos district is very active; the place is crowded with mining men.

Good progress is being made at the mill-site of the Burro Mountain Copper Co at Tyrone. The foundation for the 1000-ton mill is nearly completed. The crushing-plant and auxiliary-buildings are finished. The new town-site is being laid out, residence construction is being managed by the Hallorans. ——Shipments are being made by lessees from the Copper Gulf mines of the Savannah Copper Co.——A deal is pending for the sale of the property of the Big Burros Copper Co., in charge of King Wade.

The Silver Glance Mining & Development Co., at Treasure mountain, Camp Fleming, is operating its mines extensively and soon will be shipping ore. It has developed good-grade orebodies containing silver and copper. Camp Fleming will no doubt soon become active once more.

The Chino Copper Co. is working full force at the present time. From 140 to 150 cars of ore are being moved to Hurley from the Santa Rita mines per day. From 12 to 15 carloads of concentrate is said to be shipped daily to the El Paso smelter. The assessed valuation of the Chino Copper Co., as given by the county assessor for 1915 is $4,343,307, against $3,907,506 for 1914.

The property of the Victorio Mining & Smelting Co., at Cutter, is to be sold at Las Cruces. W. F. Jacoby was appointed trustee May 27.

TORONTO, ONTARIO

Dome Mine, Mill, and Dividends.—Imperial.—Vipond.—McIntyre.—North Dome.—Beaver.—Temiskaming Proposals.—Coniagas.—Seneca.—Superior.—Foster.—Keeley.—Copper Refinery.—Oil.

The expectation that the Dome Mines Co. would shortly pay dividends has been confirmed by a letter from the president, J. R. DeLamar, read at the annual meeting on May 25, outlining the policy of the company under the new management. He stated that on the authority of the general manager, C. D. Kaeding, he was able to announce that by the middle of the year the mill would be treating between 28,000 and 30,000 tons of ore per month with a recovery of 94%. As it was possible to forecast this result, the payment of dividends had been decided on. It was further proposed to double the capacity of the mill within the present building without loss of time and to construct a mill of greater capacity, regulated by the tonnage of ore developed by the funds now being realized from the sale of new shares.——Some alterations have been made in the Dome mill which will aid in increasing its capacity. From the last 40 stamps installed, new launders having a greater fall were put in, enabling coarse screens to be used. Two large Robinson pumps have been installed to lift the pulp to the amalgamating floor.——An abstract of the report of this company for the past year will appear in the Press next week.

Underground development has been resumed at the Imperial with encouraging results, $9 to $10 ore being extracted from the vein on the 100-ft. level.

At the McIntyre a large tonnage of good ore is being developed at 400 ft. No. 4 vein at 600-ft. is widening, with increased richness.

Good ore is being taken from a winze on the 300-ft. level of the Vipond, which is now down about 20 ft. A 6-ft. ball-mill is being installed.

The North Dome mine is now wholly owned by the Temiskaming Mining Co., the assets of the former company having been bought at the liquidation sale for $10,000.

A merger of the Beaver and Temiskaming companies of Cobalt is regarded as probable. The two companies are under the same management and have to some extent co-operated and are understood to be jointly interested in the project of sinking a deep shaft to cut the diabase sill, 1100 ft. thick. The Temiskaming has ordered a Nordberg hoist. This will be able to haul ore from a depth of 2000 ft., indicating that the shaft will be put down on its property. While the Beaver is financially stronger than the Temiskaming, the latter, since recent discoveries, is richer in ore reserves and is treating a larger tonnage, but the latter disparity will be removed by the 50% increase in the capacity of the Beaver's mill when improvements now in progress are completed.

A recent discovery at the Coniagas is regarded as important. The vein of heavy niccolite and smaltite, found on the 300-ft. level from the new shaft, is from 3 to 4 in. wide, in some places containing 2000 oz. silver per ton, in addition to wall-rock which will give a good milling ore. The shoot is in the conglomerate in previously unexhausted territory.——In the winze now down 80 ft. from the 335-ft. level, the Seneca-Superior has proved high-grade ore on the main vein. It is as strong as on the upper levels.——The Glen Lake company is opening up the old Foster property and will cross-cut the territory lying under the lake.

The Adanac company, now being organized with a capital of $2,500,000, has taken over the Coleman Development claims in the southeastern part of Cobalt.

The Keeley mine at South Lorrain and the White Reserve in the Maple Mountain district, both of which have been closed for some time, are again being worked.

The project for establishing a copper refinery in Canada, with Government assistance, to supply the extraordinary demand for copper and brass occasioned by the manufacture of ammunition on a large scale, is well under way. W. D. Matthews, president of the Consolidated Mining & Smelting Co., and C. D. Warren, of Toronto, recently had a consultation with the Government and military officials at Ottawa. The refining plant may be at Trail, British Columbia, where the works of the Consolidated are situated. It is urged on behalf of the scheme that the saving in the price of copper, which at present is enhanced by heavy freight and duty in shipping the ore to the American refineries, and the metal back to Canada, will speedily counterbalance the outlay.

Production of oil on a commercial scale has been started at Calgary by the Alberta Consolidated Co. On May 24 it gave a public demonstration of oil producing and refining at its No. 2 well. Several hundred spectators were present. In an 8-hour pumping test 75 bbl. of oil was secured, with no perceptible diminution of the supply in the well. The refining demonstration showed that about 20% pure gasoline can be refined from the crude oil, in addition to valuable by-products.

DEADWOOD, SOUTH DAKOTA

Oro Hondo, Deadwood Homestake, Echo, Anaconda, Hidden Treasure, Homestake, Columbia, Holy Terror, Wasp No. 2, Wells Fargo, Rainbow, and Monarch.—Tin.

Sinking is again under way at the Oro Hondo. In the past few weeks the auxiliary-hoist has been moved from the 1000 to the 1500-ft. level. The latter is now the basis of operations. From that level to the surface the broken rock is handled by the large double-drum hoist installed on the surface. Lateral work is being done at 1500-ft. It is probable that diamond-drills will also be started on that level at an early date. Every effort is being made by Mr. Talbert, the manager, to hasten the work of prospecting the southernly extension of the Homestake orebodies. John T. Milliken, of St. Louis and Cripple Creek, is supplying the money.

Pittsburg people, said to include Senator Oliver and William Flynn, have secured options on the Deadwood Homestake, controlled by C. E. McHugh, and the Montezuma and Whizzers

group owned by J. T. Gillmore. It is proposed thoroughly to explore the property by shaft-sinking and drifting. The ground adjoins the Homestake on the east. From a geological standpoint it is worthy of development.

More water than could be handled by bailing was encountered in the shaft of the Echo company, at Maitland, and on May 1 sinking was suspended, at a depth of 135 ft. Since that time a 10 by 12-in. single-stage air-compressor, driven by 30-hp. motor, has been installed, air from which will be utilized to operate a No. 5 Cameron sinking-pump. An additional length of cable has been spliced onto the hoisting-rope and minor repairs made. When work is resumed every effort will be made quickly to put the shaft down to the 300-ft. level.

Since removing the boilers, hoisting-engine, compressor, and other equipment from the Elk Creek slope to the Bare Butte side of the Anaconda company's property, the new shaft has been completed to a depth of 100 ft. Only one shift of miners is employed in sinking, but it is expected the crew will be augumented.

Cross-cutting is being accelerated at the Hidden Treasure shaft, at a depth of 200 ft., in an endeavor to locate the vein which dipped out of the shaft. It is now thought that faulting has occurred, and more exploratory work will be necessary than was anticipated.

IN THE BLACK HILLS OF SOUTH DAKOTA.

E. H. Clark, president of the Homestake Mining Co., is at Lead from New York to inspect the progress of operations. New construction is proceeding as fast as thorough workmanship will permit. At the boiler-plant the work of erecting the two steel stacks has been commenced. These will be 210 ft. high and 13-ft. diameter, each to serve three of the six 650-hp. boilers the plant will contain. The large amount of structural-steel work in the head-frame, tipple, and shaft-house at the B. & M. shaft is rapidly nearing completion. The great Nordberg hoisting-engine is being assembled.

McNish & Mills, of Hill City, have resumed milling of tin ore at their leased plant near that place. They had been treating 10 to 15 tons daily when wet weather interfered with ore-hauling, forcing a suspension. A good recovery is said to have been made, pan tests on the tailing showing this. The tin concentrate is to be smelted on the ground in an oil-furnace being erected. So far as known this is the only tin mill in operation in the United States at the present time.

Richard Blackstone, superintendent, and other employees of the Homestake Company, are interested in the development of the Columbia mine, at Keystone. During the winter an option on the property was secured. Prospecting is now under way. ——It is stated that Charles R. Morgan, of New York, intends doing something at the Holy Terror mine, at Keystone, which he owns. The recent inspection of the property by Louis D. Huntoon, is believed to foreshadow activity underground.

Repairs have been made to the electric hoist at the Wasp No. 2, recently destroyed by fire; everything is again running smoothly.——Lessees of the Wells Fargo ground, Holstein, Norman, and associates, are having good results. They are regular shippers to the Golden Reward mill, at Deadwood, and every few weeks send a carload of $30 to $40 ore to the Denver smelter.——Burns, Sanford, & Von Woehrmann, leasing on the Rainbow, near Maitland, are extracting milling ore which they are piling on the dump, as the property is not yet equipped with a cyanide-plant.

California miners represented here by C. D. McQueen, have secured options on the property of Sam Sweet, Thomas Charlton and others, at the head of Two Bit gulch, adjoining the Monarch. Development has been commenced.—Owners of the Monarch property, on Two Bit gulch, contemplate installing machinery. The mine has produced some rich ore, and according to all reports is not yet worked out.

James Cochran is driving a long adit to reach the orebody in his property in the Rochford district, and hopes to complete it during the present summer. This adit is intended to cut the shoot at a lower depth than any previous development. Mr. Cochran, working in a small way, with never more than two or three men employed, and milling in a small plant only the richest of the ore, has realized a fortune from this property. He now makes his home in Oklahoma, spending his summers in the Black Hills. It is interesting to note that he has been highly successful in the oil business in his adopted state.

LONDON

CROWN MINES DIVIDENDS, RESERVES, GOLD CONTENT, PAST HISTORY.—J. J. BERINGER AND TIN.

The death of Sir George Farrar happens at a time when the financial house that put East Rand Proprietary right four years ago, during a bitter disillusionment, is suffering itself from a similar adverse incident at one of its own properties, the Crown Mines, Sir George was the victim of the optimism that does not recognize the almost universal law of impoverishment in depth, for the great East Rand consolidation was not able to maintain the average grade prognosticated. Since the re-organization of working methods, the company has done well enough on the basis of 25% dividends, instead of the 40% expected. The Rand Mines group, which arranged the technical management on the new basis, is now confronted with an equally anxious problem at the Crown Mines. Put briefly, the situation may be explained by the statement that the yield per ton is a pennyweight less than the average of the ore reserve calculated on December 31, 1913. The development during 1914 also provides unpleasant evidence of impoverishment, in that the amount required by the mills, 2,500,000 tons, was not disclosed during development, 1,742,700 tons only being added to the reserve. In connection with these results, it is additionally disconcerting to find that the directors do not give the assay-value of the ore recently developed. It has been necessary moreover to re-value the ore reserve. On December 31, 1914, the figure was estimated at 10,022,000 tons averaging 6 dwt. per ton, as compared with 10,449,000 tons averaging 6.82 dwt. the year before. How much of the fall in assay-value is due to the re-valuation of old reserves, and how much to the lower grade of the ore recently developed, we have no means of judging. With the fall in the yield, it is natural that the profit cannot be maintained, the dividend now being at the rate of only 60%, instead of the 130% prognosticated at the time of the consolidation in 1909. The board of directors is maintaining discreet silence, and contents itself by announcing that investigations are being made. R. C. Warriner, the manager and consulting engineer, states that the recent developments have been so bad as to induce the idea that the variation in grade can only be temporary. It is generally recognized that alternations of the quality of the ore in this part of the Rand follow lines pitching eastward, so, taking an optimistic view, it is possible that the developments at present may be in a zone of poor ground and that later the luck may turn. Some of your readers may remember the chart exhibited by H. F. Marriott at a meeting of the Institution of Mining and Metallurgy when the non-persistence of ore in depth was discussed. His contention at the time was that, on average, the ore in the central Rand did not show a general impoverishment with depth. We can only hope that Crown Mines will take a turn for the better, but most men wag their heads ominously.

In looking through the past history of Crown Mines, some assistance is obtained in diagnosing the present position. The company is really a continuation of Crown Deep, which, with

the Crown Reef above it on the outcrop, did remarkably well for shareholders. Those two mines were to the west of the Robinson, and contained much of the same high-grade ore. Below the Robinson was the Robinson Central Deep, which also did remarkably well. Farther to the west there were many other properties, most of them deep levels below the Langlaagte Estates. These, as far as tested, all contained ore of much lower grade, 6 dwt. or less. Some had been worked with disastrous results, and one had managed to pay small dividends. But it was obvious that this great area could not be worked as individual mines, and it was decided therefore to amalgamate them with the Crown Deep and Robinson Central Deep and work the consolidated property on a big scale. The reduction of working cost consequent on a re-organization of underground work was expected to yield the margin required to make the western ground profitable. It was calculated also that the rich ore in the deep levels in the eastern section would continue. Another favorable consideration in connection with the amalgamation was that the capital required for putting the western sections on a profitable basis would be obtained from the cash resources of the Crown Deep, and no less than £700,000 was obtained in this way from the accumulated profits of the latter company. It is an open secret that funds could not have been obtained in any other way. Now that the partial collapse has come to Crown Mines, there are not a few of the original shareholders who are indulging in "ungentlemanly emphatics" in connection with the scheme of 1909. As regards the cost of re-organization, the original estimate was far too low, and another £1,000,000 had to be raised by the issue of debentures, and the expected reduction in working cost was never realized. The original estimate was about 13 shillings per ton, and the actual figure for 1914 was 15s.7d. This higher cost, now followed by the drop in grade, has had a serious effect on profits. We may take it that the rich ore of the Crown Deep and Robinson Central Deep is exhausted. A year ago an attempt was made to absorb the remains of the Robinson, no doubt with the hope that the rich ore would help the Crown Mines for a short time at least, but on the first show of opposition the proposal was withdrawn. Unless the miracle expected by Mr. Warriner and Mr. Marriott should happen, Crown Mines will take its place as a huge low-grade property like Randfontein Central and East Rand Proprietary, with dividends on a modest scale.

The late J. J. Beringer, head of the Camborne Mining School, has left behind him a posthumous paper of great importance in the domain of ore-dressing literature. Some years ago he was engaged in the microscopic study of Cornish tin ores, with the object of ascertaining the physical nature and behavior of cassiterite particles. His results were embodied in a paper presented to the Institution of Mining and Metallurgy. Long ago he told us that the finest wire screen, 200-mesh, was no good in the study of tin ore, as the particles went through "three abreast." Separation by settlement in water was necessary for the sizing of these particles, and the measurement of their dimensions had to be done by the microscope. So fine are some of the particles that their presence is only indicated by crossed nicols. To give an abstract or even an outline of his paper would be impossible, and seeing that lode-tin is not an American product of wide distribution, it would be inadvisable to make the attempt. But some of his points are of general interest. In the first place, the particles are so fine that the most convenient unit of measurement is the micromillimetre, one-thousandth of a millimetre. Second, a more detailed classification of the sizes than 'sand' and 'slime' is required, and he introduces the word 'clay' for particles of 5 micromillimetres and under, particles that would go '10-abreast' through the 200-mesh holes. The characteristic of the clay size is that on settlement they look not so much like a growing sediment but a shrinking fluid increasing in density at the bottom. As regards the behavior of particles on tables or buddles, settlement rapidly becomes difficult when the size is less than 25 micromillimetres. If the water is given a vibration on a table or Frue vanner, the settlement is greatly hindered, so that more of the fine particles are lost on a vibrating concentrator than on a stationary buddle. Another interesting point made by Mr. Beringer was that fine particles that would not settle on a table or buddle by themselves could be caught if mixed with particles of larger size. This supports the experience of many practical tin-dressers who have objected to the modern theory of close sizing. Generally speaking, he found that particles above 25 micromillimetres in diameter did not present insuperable difficulties in water-concentration. With regard to the occurrence of these fine particles, he found that their existence is not by any means solely due to pulverization during crushing, but that they often exist in the form of microscopic grains disseminated as a cloud through quartz. Mr. Beringer, throughout the paper, did not use the word 'colloid,' no doubt considering that this word is overworked by the ore-dresser.

KALGOORLIE, WESTERN AUSTRALIA

Labor Union Suit.—Gold Returns.

In June 1914, the Yuanmi Union of Workers expelled from their association six miners, who were sinking the Yuanmi main shaft on contract. This resulted in the mine being closed for 68 days. The contractors sued the union, together with the Murchison Amalgamated Workers Association, the Sandstone Workers Union, and the Industrial Association of Workers, together with 21 residents, for boycotting them, and preventing their earning a living, or even securing food or drink at any stores, etc. If it had not been for H. G. Walton, manager of the mine, supplying them with food and shelter, and conveying them in the company's auto to the Sandstone railway station, 40 miles, the men might have starved. The judgment was in favor of the six plaintiffs. They were awarded $6990 and costs. These men are now working in the Kalgoorlie district, where contracting is still in force, although a majority of the local union has, on two occasions, voted against it. This decision should be a lesson to unions, which have on several occasions in this state made themselves obnoxious.

March gold returns for the state amounted to $1,991,400. The chief producers were as follows:

Name.	Tonnage.	Value.	Profit.	Dividend.
Great Boulder	18,687	$244,400	$132,500	$328,100
Ivanhoe	20,145	162,800	50,000	.....
Kalgurli	10,870	104,200	45,000	.....
Edna May	2,887	63,200	40,000	32,100
Golden Horse-Shoe	25,267	190,500	37,900	.....
Sons of Gwalia	13,800	107,000	29,800	40,600
Sand Queen	2,000	42,000	25,500	22,500
Fenian	2,878	48,000	25,400	.....
Lake View & Star	18,800	109,400	17,900	.....
South Kalgurli	9,879	62,300	11,400	.....
Bullfinch	6,542	41,700	11,100	.....
Mararoa	2,720	24,400	8,600	.....
Menzies Consols	2,367	28,200	7,900	.....
Ingliston Consols	2,100	18,500	5,500	.....
Black Range	2,759	27,300	5,300	.....
Yuanmi	3,900	38,200	4,500	.....
Queen of the Hills	3,220	25,800	4,400	.....
Oroya Links	12,800	70,200	4,100	.....
Perseverance	21,393	103,400	3,900	.....
Edna May Central	2,100	9,400	1,900	.....
Victorious	2,822	20,200	1,700	.....
Commodore	710	6,800	1,200	.....
Corinthia North	5,540	20,700	5,700	.....
Associated Northern	193	7,400	500	.....
Kyarra	1,096	10,200	50	10,000
Great Fingall	5,030	35,400	–7,300	.....
Associated	10,812	48,500	–12,800	.....
Ida H.	1,356	23,100	–2,000	.....

Total output, $606,892,800; total dividends, $126,284,500.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press

ALASKA

Cordova

Large transactions have been taking place at New York in bonds of the Kennecott Copper Corporation. Production has been as follows: 1911, 22,854,000 lb.; 1912, 23,319,000 lb.; 1913, 17,729,000 lb.; 1914, 17,200,000 lb.; and first three months of 1915, 7,836,359 lb. The outputs in 1913 and 1914 were affected by a tramway fire and the War respectively. Net earnings during this period total $8,123,267. Most of this came from the Bonanza mine, which has been developed to 600 ft. Cost of production has averaged 4.72c. per lb. The Jumbo mine has been opened, and its mill enlarged. Metal output of the company is about 5,000,000 lb. per month. The Beatson Copper Co. is now under control by the Kennecott. Its mine is low-grade. A concentrating plant to yield 10,000,000 lb. of copper per year has been constructed.

Juneau

The Alaska Exploration Co. is being organized by Juneau mining and business men to examine and develop the resources of southeastern Alaska.

ARIZONA

Cochise County

The Mascot and Western railway, 18 miles long between the Mascot Copper mine and Wilcox, was completed on June 15. Ore is now being sent over the line to smelters at Douglas.

Operations at the Copper Queen mines and smelter are at about 90% capacity, with an increase in the near future. Churn-drills on Sacramento hill have disclosed considerable information on the west orebody. Drills are now working on the east deposit, also at the Dallas.

Work is to be resumed at the Oliver shaft of the Calumet & Arizona. This is one of the mine's producing shafts.

Gila County

(Special Correspondence.)—L. D. McClure and J. E. Miner, well known in this district, have taken a bond and lease on 11 claims of D. Baatz, J. Klinfelder, and J. W. Bennett of Globe, situated in the Sleeping Beauty range, three miles north of the International smelter. The formation is a mineralized conglomerate of large extent. Within three weeks the lessees will commence shipping 4 to 6% copper conglomerate to the Old Dominion, International, or El Paso smelters. The ore is mined by quarrying.

In the Schultz Ranch district the Copper Springs Mining Co., composed of well known Miami people, will commence active development. Prospects are very good. A heavily mineralized quartz vein occurs at the contact of granite and diorite. It has produced a good deal of copper ore. A 250-ft. adit is being driven to cut the shoot. The ore averages 6.5% copper and about 20 oz. silver per ton. A 100-ton concentrating plant is contemplated.

Miami, June 11.

Concreting of both main shafts, 584 ft. deep, at the Inspiration is nearly finished. A two-decked concrete platform is to be constructed on sub-level No. 4 for handling men. High-pressure air-pipes are to be installed underground for supplying the compressed-air locomotives. The compressors have been tested. They will supply air at 1000-lb. pressure.

The Miami mine produced 3,819,339 lb. copper from 116,845 tons of ore in May. Development totaled 1920 ft. An 800-ton ore-pocket is being cut at 570 ft. Six 10 by 46 ft. Dorr thickeners are in operation at the mill.

Mohave County

The Oatman district produced gold worth $160,000 from 14,000 tons of ore in May. This was $5000 less than in April, due to a three days' shut-down at the Tom Reed mill.——At 20 ft. depth in the Mazona company's ground ore showing gold has been opened.——The Big Jim company has started sinking to 500 ft. near two shafts of the Tom Reed.

The report of the Tom Reed Gold Mines Co. for the year ended March 31, 1915, contains the following: A winze has been sunk to 1075 ft., showing ore all the way. The main shaft is to be sunk from 850 to 1225 ft. A 150-hp. electric hoist was installed. There are 30,000 tons of ore broken in stopes. The mill treated 46,995 tons, averaging $21.33, with 96.2% extraction. The total gold yield was $1,002,407. Costs amounted to $9.21 per ton.

Pima County

Bids for construction of the railway from Gila Bend on the Southern Pacific to the New Cornelia mine of the Calumet & Arizona company at Ajo, 130 miles, were opened at Warren on June 10. It is intended to have the line finished by the end of the year.

Yavapai County

The United Verde Extension company at Jerome has bought 25 adjoining claims for $100,000, of which $10,000 has been paid. Development at 1205 ft. continues excellent. Work is also being done at 1100 and 1400 ft.——The Walker district near Prescott is showing increased activity, due to lessees and the Pine Mountain mine. The latter's 10-stamp mill is being overhauled, as is also that at the Milliken.——The Ruth zinc mine is being re-opened by W. S. Wilhelm and others. A concentrating plant will be erected.

CALIFORNIA

Amador County

After being overhauled and enlarged, the Original Amador mill resumed work on May 1. The process is as follows, according to *The Amador Record*: The new plant consists of twenty 1000-lb. stamps, two 8-ft. by 36-in. Hardinge mills, and eleven Deister tables, ten of which are double-deck. This plant, after adjustment, will have a capacity of about 300 tons per day, against 90 tons in the old mill.

The design of this mill is quite a departure from regular Mother Lode practice. Ore from the bin is fed into revolving screens having ⅜-in. openings, the oversize only going to the stamps, while the undersize, amounting to about 25%, is passed around and joins the discharge from the stamps, going to the Dorr classifiers. The sand discharge from these is fed into Hardinge mills. Excess water and slime overflow goes to the slime-thickening tank. The battery-screens vary from ¼ to ¾-in. opening, depending on the character of the ore. The object sought is to regulate the quantity of feed, percentage of water, and pebble load in the Hardinge mills so that the discharge will show a maximum of sand minus 30-mesh with a minimum of slime. Results indicate that there will be less slime than with the stamps crushing to 20-mesh.

The discharge from the Hardinge mills passes into the Hardinge amalgamator, which is attached to and revolves with the mill. Mercury is fed into the amalgamator as required by the condition of the outside plates in the same manner as it is fed into the mortar-box. Also about a dozen copper balls made

from ⅜ or ½-in. diameter wire are amalgamated and put into the amalgamator. As these roll around they form good-sized amalgam balls, which are removed while the mill is running. After the amalgam is scraped off they are returned to the machine. The discharge from the amalgamator passes over copper plates, and goes to a hydraulic classifier having three spigots for coarse, medium, and fine sand. This is fed to corresponding sand-tables. The slime-overflow from this classifier joins the slime-overflow from the classifier to the thickening tank, from which the thickened slime is run to the slime-tables, and the clear overflow from the thickening-tank is piped back and again used in the mill.

Concentrate from both sand and slime is collected in one sump and elevated to pass the second set of amalgamating plates, where any gold escaping from the first set or carried over into the slime-overflow is recovered. The concentrate from the second set of plates goes to the settling-bins, from which it is trammed to the cyanide plant. This has a capacity of 300 tons per month. The concentrate is ground to slime, amalgamated, and cyanided. T. S. O'Brien is superintendent.

The following is the preliminary statement of production and costs of the Plymouth Consolidated in May:

Ore crushed, tons	11,600
Total value	$59,841
Working expenditure	28,402
Development charge	6,196
Surplus	25,243

The affairs of the Hardenburg Mining Co., which operated four miles from Jackson, are being straightened out. The company is heavily in debt. John Martin and Henry Malloch, who own the controlling number of shares in the South Eureka Mining Co., are the principal holders of the Hardenburg company. They have made a proposal to the creditors to give one-half of their shares to the Hardenburg treasury so that the same may be sold and sufficient funds raised to pay the debts and renew operations at the mine. Creditors will not interfere for six months. Mrs. Peter Wells, owner of the Hardenburg mine, will agree to the arrangement. The property is well equipped for mining and treatment. Deeper work is hoped to reveal better ore.

Butte County

Oakland people are re-opening the Morning Star mine, near Romsey Bar. It has not been worked for 10 years.——Good reports are coming to Oroville from the Berry Creek district.

Some rich ore has been discovered in the Butte Creek district by F. E. Whitlock, according to news from Chico. A number of prospectors have started for the area.

Calaveras County

On June 7 forty stamps started crushing at the Royal Gold Mines Co.'s property at Hodson. Twenty more will be added shortly. A large tonnage of ore has been proved. The property is in good shape. Frank W. Page is manager.

Eldorado County

The Frog Pond and Collins & Bacchi quartz mines have been acquired by T. J. Daly of New York. F. C. Levitt will superintend work.

Inyo County

The Carbonate Lead Mines Co., operating 42 miles west of Zabriskie on the Tonopah & Tidewater railroad, is shipping 200 tons of ore per month. This is to be increased. According to the manager, John Salsberry, the ore averages $30 per ton.

Nevada County

(Special Correspondence.)—Favorable developments in the deepest workings of the North Star and Empire mines seem fated to bring these two companies into conflict. The lowest level, at 6300 ft. on the dip, in the North Star disclosed good ore in a vein to a part of which the Empire claims apex rights, based mainly on the Pennsylvania-W.Y.O.D. case, which ended in one of these mines absorbing the other and both being absorbed later by the Empire. That was a costly litigation, disclosing a complex vein-structure, to which the law of the apex could be applied uncertainly. In a praiseworthy effort to prevent further litigation, to be based on uncertain factors, a serious attempt was made to compromise the claims of the Empire as against those of the North Star. A final conference at San Francisco this week proved abortive and a big law-suit seems now inevitable.

Grass Valley, June 16.

Old hydraulic mining tailing at Shady creek is to be worked by a small dredge.——The vein opened at 500 ft. in the Oustamah mine continues to yield good assays.——The Cassidy, adjoining the Empire, is nearly unwatered. Electric pumps have replaced the air pumps. Sinking will soon be started.——The mill at the Ancho mine at Graniteville is being moved to the lower adit.——At the Columbia Hill claim, four miles from Washington, J. H. Sieling, W. C. Hunter, and S. E. Guernsey were killed last week in an adit. The coroner's jury returned the following verdict: "That they came to their death through the accidental explosion of powder, caused by picking into a hole that had been cut off by an explosion in the same round."

Placer County

Part of the Banner Consolidated company's stock has been acquired by English people. A large tonnage of ore is said to exist in the Eureka, Lookout, Little Banner, Hathaway, and Kirkland claims controlled near Auburn. Extensive development and erection of machinery is to be started.——Additions to the Borealis mill will soon be complete. In May 350 ft. of development was done on the 280-ft. level.

Trinity County

A 2½-mile flume is to be constructed for the Corona de Ora mine near Hawkins Bar on Cedar creek. This will cost about $25,000. The past season was a good one, but water was short, so the new scheme will augment the supply.

Tuolumne County

A description of the mines of Tuolumne county by Robert Thom has been published in the last four issues of *The Union Democrat*, Sonora. It covers the quartz, gravel, marble, and limestone properties. The large producers include the following: Eagle-Shawmut, underground work to 2450 ft. below the surface, three veins being opened, an 1100-ft. adit serves for haulage of ore, 100 stamps and concentrators, chlorination plant for concentrate, power-plants, and complete equipment in charge of G. F. Williamson. Republican—adjoins Eagle-Shawmut on south—opened to 700 ft., considerable stoping has been done, 20 stamps and concentrators, etc., managed by C. M. Delameter. Crystalline, working four wide veins to 630 ft., 10-stamp mill, controlled by C. E. Shafer. Harvard, opened to

MAP OF TUOLUMNE COUNTY.

1750 ft., lode up to 30 ft. wide, complete mine plant, 60 stamps and concentrators, 1000 hp. electric plant, managed by H. W. Gould. Dutch Sweeney, developed to 1867 ft., ore-shoot between 600 and 800 ft. levels was 250 ft. long and 60 ft. wide, 40-stamp mill with vanners, crushing 200 tons per day, costs $2.25 per ton. Black Oak, near Soulsbyville, a well-known producer, vein in granite, ore somewhat complex, three incline shafts, 17 levels, considerable faulting, 20 stamps and all-slimming cyanide plant, complete surface equipment, all controlled by Rodger C. Knox. Draper, near the Black Oak, opened to 560 ft., 10 stamps, etc., in charge of C. Sullivan. Other mines, some producing, developing, and idle, some with large outputs in the past, are the Clio, Hart & Jacobs and Ham & Birney, Alabama, Manganite and Carlin, App, Santa Ysabel, Jumper, Mazeppa, Tarantula, Densmore, Horse Shoe Bend, Confidence, Lamphere, Excelsior, Dreisam, Soulsby, United, Providence, Spring Gulch, Buchanan, Longfellow, Sugarman, Hope, Bonanza, Sam Guiseppe, and Golden Gate. Gravel mining is confined almost to the deposits in the Table Mountain channel, and the deposits in the east belt area. The Springfield Tunnel & Development Co., A. L. Horner, manager, and J. Cademartori, superintendent, has six channels converging in its property west of Springfield. Past development proved valuable gravel, but water was too strong for the shaft pumps. Shafts were abandoned in December 1913, and an 8 by 8-ft. adit started below bedrock. Drainage would be accomplished by the adit. The total length is to be 12,000 ft. It is in 2500 ft. Gravel extraction will commence in July, from which rich returns are expected. A 240-ton Krogh gravel-mill is part of the equipment. The Saratoga claim adjoining the Springfield is still being worked.——A number of other gravel mines are in the vicinity, having a large aggregate past output.——The Rough & Ready and Stanislaus owners are busy.——Marble is being extensively quarried by the Columbia Marble Co., three miles northwest of Columbia.

COLORADO

Lake County (Leadville)

Underground work at the Big Four mine is to be resumed, the rebuilt surface plant being complete.——In the Ponsardin, on Yankee hill, the new orebody at 430 ft. depth is 70 ft. long and 15 ft. high. It assays 23 to 31% zinc, 19% lead, and 6 oz. silver per ton. The Penrose shaft pumps had lowered the water so that lessees were able to start in a level that had been flooded for years. Pumps have lowered the water in the Penrose shaft 140 ft. They are working at 350 ft.——The Twin Lakes and Lackawanna districts are busy.

Teller County (Cripple Creek)

Stratton's Independence, Ltd., advises that in April the mine output was 5489 tons of $6.50 ore. The mill treated 8387 tons of mine and dump ore. The net profit was $8000.

IDAHO

Shoshone County (Coeur d'Alene)

The water-flume to the Frisco mill at Gem is nearly finished. It is 6000 ft. long and 24 by 36-in. cross-section and will supply 600 hp. The mine will employ 200 men when water and power are available.——The vein in the Snowshoe at Mullan has widened to 12 ft. It is in 1600 ft. from the mouth of the adit and 1000 ft. vertical depth.——A deadlock still exists between the Hercules company and the A. S. & R. Co. over the smelting contract.——The Marsh mine and mill are in operation. They have been closed since May 31, 1914, being closed on account of the low price of lead.——Development at the Red Monarch is encouraging. This mine is in Missoula gulch near the Interstate-Callahan. An adit is being driven to cut two veins. A third orebody contains silver and zinc. A Fairbanks-Morse compressor is being installed.

During May the Stewart company sold about 3,000,000 lb. of lead. Profits were over $80,000.

MICHIGAN

Houghton County (The Copper Country)

Copper production of the mines of this district in May was as follows:

Mine.	Pounds.	Mine.	Pounds.
Tamarack	402,300	Hancock	90,000
Osceola	1,785,000	Isle Royale	755,700
Ahmeek	1,871,000	Arcadian	6,800
Wolverine	725,000	Winona	140,000
Mohawk	1,236,000	Victoria	225,000
Franklin	47,700	Calumet & Hecla	8,500,000
Centennial	235,000	Copper Range	5,100,000
Allouez	805,500	Quincy	2,100,000
Mass	568,000	White Pine	250,000
Superior	330,000		

This output was worth about $5,100,000.

The White Pine Copper Co. has issued a report for 1914. Development at three shafts amounted to 5617 ft. Openings on the 1st level west of No. 2 shaft have been rather poor. The 2nd level east of No. 4 shaft has been badly faulted, but shows good copper ore when in the lode. The 2nd and 3rd levels west of No. 3 shaft have opened fair ground. These two levels between No. 3 and 4 shafts are very good. The 4th level drifts, east of No. 3 and east of No. 4 shafts, are good as far as opened. There was hoisted 8000 tons of copper ore, making about 28,000 tons now in stock-piles, all from openings. Operation cost $122,395, and construction $195,929. Balance of liabilities at the end of 1914 was $134,559.

Part of the shaft-house at the C. & H. No. 4 shaft was burned last week. This is being re-built. The re-grinding plants are busy on mill and lake tailing.——The Ahmeek has five stamps dropping at Hubbell. Another will be ready in a few weeks.——At 900 ft. in the New Arcadian, 385 ft. east of the amygdaloid formation, mineralized conglomerate high in copper has been opened. This ore has never been found in this area before.——The Hancock company has raised wages 10%, starting May 29. This brings the rate equal to that in force before work was stopped in August 1914.

MISSOURI

Jasper County

Up till recently tailing plants in the Joplin district were idle, or working with small profit. The increased price of zinc has made all plants active and profitable.

A 300-ton mill is to be built by the G. & L. company in the Lawton district, costing about $20,000. Drilling showed a 40-ft. face of ore averaging about 6% zinc.

MONTANA

Broadwater County

Prospecting and development in the Radersburg-Hassel district is reported to be increasing. The Keating company has cut a station at 1200 ft. Bad roads have interfered with hauling ore.——The Black Friday company is working at 400 ft., and the Greenhorn at 260 ft. Copper-silver ore occurs in the latter.

Cascade County

The Great Falls concentrating plant is to resume work. From 1500 to 1800 tons of ore from Anaconda will be treated daily.

Granite County

The Brooklyn mine at Princeton has been acquired by Minneapolis and other people. G. G. Thomas and C. E. Jury, of Toronto, Ontario, are examining the property. A lower adit is to be driven. A concentrating plant for the zinc ore is to be erected at once. C. W. Beckley, of Butte, completed the deal.

Lewis and Clark County

(Special Correspondence.)—Over 100 men are employed in

the Marysvale district. Three Lane mills at the Gloster have been started. Marysvale and Bald Butte ores are free milling as a rule, although there are some complex ores near the latter place. These have not been thoroughly prospected. Likewise the Lost Horse area.

Marysvale, June 10.

The Shannon mine in the Marysvale district has been acquired under bond and lease by the Barnes-King Development Co. About 2000 ft. of work has been done in the property. A wide lode of $17 ore has been opened. It is intended to construct a tramway from the mine to the company's mill at the Piegan-Gloster, 2½ miles distant.

Missoula County

(Special Correspondence.)—The Curlew mill is being remodeled. It will treat a dump of old tailing at the rate of 200 tons per day. Water concentration and pneumatic flotation will be used to recover the gold, silver, and lead.

Victor, June 10.

Silverbow County

Nearly 100 men are working at the Butte-Alex Scott mine. The daily output is about 2½ carloads of ore from 2000 ft. In April the net return was $19,916. Sinking is under way to 2200 feet.

In Bulletin 102 of the A. I. M. E., C. L. Berrien, of Butte, discusses fire-fighting methods at the Mountain View mine. The paper is accompanied by 11 plans of the mine. He states that many fires have occurred in the mines of Butte in recent

500-FT. LEVEL OF MOUNTAIN VIEW MINE, BUTTE.

years. While all have been of a serious nature, simply because they were mine fires, six of them have been especially dangerous in respect to loss of life and property, and the expense of extinguishing or controlling them. It is needless to say that everything possible has been done to check all fires at the beginning, but without success in some cases; and it has then become necessary to bulkhead all connections to them, in which state several now exist. Mine fires occur in both accessible and inaccessible workings. That in the Mountain View was in the latter class of fires. It started in June 1913, between the 500 and 600-ft. levels, and at the end of that year was apparently extinguished. It was suspected that there was fire before that date. There is no space on this page for details of the work done to put out the fire. For five months 670 gal. of water per minute was poured onto the area. When the water reached the pumps it contained about 1% copper. No time was lost underground, the mine producing 1600 tons per day during the fire period.

NEVADA

Esmeralda County

(Special Correspondence.)—Five new working faces of the Jumbo Extension mine are in ore of high grade and a sixth, the raise from the south drift on the 107-ft. level, has penetrated the shale-latite contact area of silicified-latite and should reach the hanging wall, where the best ore is found, within a few days. If the ore proves to be present here, in quantity and grade approaching that on the upper levels, the development must be regarded as of great importance, owing to the distance, over 350 ft., on the dip of the contact below or beyond the rich 524 drift. It will further establish the trend of the orebody toward the adjoining St. Ives claim of the Merger Mines Co. The mine is now shipping 100 tons daily, the average value being approximately $50 per ton. Regular production will be 75 tons until the Velvet shaft is completed, when the output can readily be doubled. All litigation in any way involving the Jumbo Extension company has been settled satisfactorily.

Daily shipments are made from the Atlanta mine. Ore is broken for a width of 15 ft. in the main stope, opened from incline raise 1007-A, 115 ft. on the incline above the 1750-ft. level. In the 1010-A air-raise, 80 ft. below the 1400-ft. level, ore was exposed that assayed 3 oz. gold, in addition to copper and silver. Three other raises are being driven in ore.

Goldfield, June 14.

In the Jumbo Extension the ore-shoot has been proved to a depth of 910 ft. J. K. Turner states that they are now raising on four feet of $60 ore from the 957-ft. level and winzing from the 880-ft. level on three feet of $120 ore. These will connect and expose over 150 ft. on the dip. They raised to the ore from the 964-ft. level, and then began sinking a winze on the ore. At a depth of 910 ft. vertical from the surface, or six feet down in the winze, four feet of bornite has been exposed sampling $175. On June 8 three feet of the winze assayed $172.60, and on the day previous the first shot opened two feet assaying $125.34. Raise 524A is up 42 ft. in ore, from which a sample from 67 cars gave $60.64. A face sample from the same raise yielding $73.36. They are extracting a little sweetening from the old workings that give some better idea of the resources of the Jumbo Extension. Seventeen cars from the 511 stope sampled $151.12 and 52 cars from the same place sampled $178.42. A surface grab of 114 mine cars on the same day gave $90.88 per ton. Development at 500 ft. in the Booth is sometimes revealing shoots of $45 to $70 ore.

Humboldt County

The erection of a custom mill at Willard is contemplated. Sixty tons of over $60 ore has been sent to the mill at Rochester from the Cole-Huntington lease on the Weaver property. ——The Stowell Mining & Leasing Co.'s adit at the Limerick is in 457 ft.——The Buck & Charley Leasing Co. is shipping 100 tons per month.——Eighteen inches of $60 ore is being opened in the Colligan lease on the Weaver.——The Codd lease is shipping 50 tons daily to the mill.

Lincoln County

The Prince Consolidation company will distribute 2½c. per share, or $25,000, on July 1. The daily output is about 300 tons of lead-silver-iron-manganese ore from the 200, 300, 400 and 500-ft. levels. A winze has been sunk 100 ft. below the 600-ft. level.

Mineral County

It is reported that a wide body of $25 ore has been cut in the Aurora Consolidated.

J. H. Monjar will erect a 10-stamp mill on his Baron mine near Rawhide.

Nye County

Six mines and lessees (104 tons) at Tonopah last week produced 10,392 tons of ore valued at $213,016.

On June 9 directors and shareholders of the Tonopah Extension, Tonopah Merger, and Tonopah Victor Mining Companies agreed on a consolidation of the properties. The management will be under that of the Extension. The Extension mine has been developed to 1350-ft. depth, a large ore reserve exists, and a good mill is in operation. The output last week was 1790 tons. In the Golden Anchor claim of the Merger are two veins. The north vein is 250 ft. long at the 1170-ft. level. The south vein has been opened on three levels, that at the 1170 ft. being the full length of the claim. The output last week was 351 tons. No ore has been opened in the Victor, but the Merger veins will probably continue into the Victor. Recent

work at 1260 ft. in the Extension shows the shoot so far to be 225 ft. long, up to 20 ft. wide, of good value. Results at 1350 ft. are also excellent.

OREGON

Josephine County

(Special Correspondence.)—Development of the upper portion of the Granite Hill mine on Louse creek is being continued by the Oregon Gold Mines Co. The lower workings are flooded. The stamp-mill is being overhauled. A 12-ft. lode was recently opened, and it is hoped to keep 10 stamps at work. Melting of the snow in the upper Siskiyou has resulted in numbers of prospectors starting work. Some are in the remote areas along the Oregon-California line. Hydraulic mines have been cleaning up. Some closed earlier than usual, due to a light snowfall. More interest is being taken in copper deposits of the county than usual. Construction of the new line from Wilderville will make them more accessible.

Grants Pass, May 27.

UTAH

Beaver County

At 325 ft. in the Paloma mine, in the Star district, 18 in. of high-grade lead-silver ore has been cut in limestone. The new hoist is working well. A small compressor is to be bought.

Juab County

A recent report on the Tintic Standard states that the main 1000-ft. level has been extended 221 ft., 546 ft. beyond the main ore winze. Several short cross-cuts passed through ore. Prospects are encouraging. A good deal of work is under way at 1200 ft. The Tintic district mines shipped 124 cars of ore last week.

To enable an increased output of lead-silver ore, the Eagle & Blue Bell company has ordered an electric hoist capable of hauling from a depth of 2500 ft. The whole surface plant is to be motor driven. Development at and below 1700 ft. is highly satisfactory.

More men are to be employed at the Chief Consolidated. The present force is over 100.——The Gemini company and lessees are benefiting considerably from the increased price of lead.——Several dumps in the district are being actively worked.

Salt Lake County

After being closed for several months, the result of its financial condition, the Ohio Copper Co.'s property at Bingham has been leased to the General Exploration Co. Work is to be resumed at the mine and mill at once. A large tonnage is to be treated.

In the Big Cottonwood district, the winze in the Cardiff is down 60 ft. in lead ore. The orebody is of considerable size. Some copper ore is also showing in the bottom. The new road is almost complete. Shipments are then to be increased to 100 tons per day.——The Price Mining Co. is to install an electrically-driven compressor, and machine-drills. Most of the property is on Montreal hill.——The interest of John F. Cowan in the Columbus Extension has been sold to Salt Lake City people. The total deal involved about 123,000 shares.——Tests have been made at the Wasatch Utah mine with the Koehring cyanide process. Results are reported to be good.

Zinc carbonate ore, assaying 39.6% zinc, has been opened near the surface 100 ft. above the main adit of the Relief claim of the Wasatch company. It promises to be an extensive lode. Shipments are soon to be made.——At the Emma copper mine the shale-limestone contact has been reached. Driving southeast is under way to reach the intersection of the contact with the Brain fissure.

Summit County

The Snake Creek tunnel was in 11,192 ft. last week. In May the advance was 330 ft. The formation is diorite, hard to drill, but breaks well. The flow of water is over 8000 gal. per minute.

PERSONAL

Howland Bancroft is at the Palace Hotel.

E. Gordon-Davidson is here from Lima, Peru.

George H. Garbey was at Pittsburg this week.

J. H. Mackenzie is on his way to Juneau, Alaska.

William Hague has been in San Francisco this week.

A. G. M. Bevan has returned to London from Siberia.

H. G. Cannon, of Los Angeles, was recently at Prescott, Arizona.

F. E. Browne has taken an office in the Hellman Bdg., Los Angeles.

H. W. Dubois, of Philadelphia, has gone to the Copper River district, Alaska.

J. B. Tyrrell has gone to the Michipicoten district in Northern Ontario.

Michael Th. Ortin is visiting the mines of California on his way home to Russia.

H. E. West, of Chas. Butters & Co., sailed on June 16 by the *Kroonland* for Peru.

I. D. D. Daimpré is now with the Canadian Copper Co. at Copper Cliff, Ontario.

C. J. Klinker is superintendent of the Eaglebird mine, at Washington, Nevada county.

F. W. Bradley sailed by the *Mongolia* on June 12 for a holiday in the Hawaiian islands.

A. M. Yonge has returned to Costa Rica, to resume the superintendency of the Mina La Union.

George Watkin Evans, of Seattle, has recently returned from a professional visit to New York.

W. E. Hopper, professor of mining geology in the Michigan College of Mines, is expected here shortly.

A. MacDonald has been engaged as mill superintendent by the Hammond Mining Co., at Glacier, Washington.

G. B. Massey recently resigned from the Bucyrus Co. He has opened a consulting engineer's office in Chicago.

Frederick G. Clapp has recently returned from a year and a half spent in geological explorations in China. His address is, as before, 331 Fourth Ave., Pittsburg.

Robert M. Keeney has resigned as mill superintendent of the Baker Mines Co., Cornucopia, Oregon, to become manager for the Magnesium Manufacturing Corporation, at Rumford, Maine.

Obituary

J. J. Beringer died at Camborne on March 29. He was known all over the world for his text-book on assaying; he was recognized by Cornishmen as an authority on all that concerned the technology of tin; he will be remembered by his students as an original, witty, kindly, and most helpful teacher; he will be mourned by his friends as a courageous soul and a loveable character.

Schools and Societies

The Utah branch of the A. I. M. E. will hold a meeting at Eureka on July 15. A large attendance is expected.

The International Engineering Congress, which meets in San Francisco on September 20 to 25 has issued a booklet describing the general program, including accommodation and excursions.

The Massachusetts Institute of Technology *Bulletin* 3, Vol. 50, covers the summer courses of 1915. These will be held from June to September, inclusive, supplementing the work of the regular school year. They are open to persons who are not students of the school.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, June 17.

Antimony	35 —35¾
Electrolytic copper	20½—20¾
Pig lead	6.50— 7.45
Quicksilver (flask)	$90.00
Spelter	25 —25¼
Tin	39½—41
Zinc-dust, 100-kg. zinc-lined cases	No quotation

The zinc-dust market is uncertain. The Australian embargo has complicated the situation.

EASTERN METAL MARKET
(By wire from New York.)

NEW YORK, June 17.—Copper is quiet; lead is very uncertain, there are plenty of sellers, and there is every prospect of a decline; zinc is dull, the decline being on account of re-sale offering.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending	
June 10	49.25	May 5	50.33
" 11	49.37	" 12	50.06
" 12	49.37	" 19	49.93
" 13 Sunday		" 26	49.77
" 14	49.50	June 2	49.40
" 15	49.25	" 9	49.35
" 16	49.12	" 16	49.31

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	....
Feb.	57.53	48.45	Aug.	54.35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	50.25	Oct.	51.12	....
May	58.21	49.87	Nov.	49.12	....
June	56.43	....	Dec.	49.27	....

The silver market is weak. London advice describes it as quiet and dull. Buyers have not shown much inclination to come forward. Enquiry from the Indian Bazaars has been small. It would appear as if 'bull' operators had laid up as much as they are disposed to hold at present. Their holdings have not been built up from purchases in the London market alone; fairly substantial supplies have been drawn from China and elsewhere. America has placed a fair amount on the market daily at current rates, but there is no pressure to sell from that quarter. Exports of silver from London to the East for the first five months of 1915 are about 12,000,000 oz. less than in 1914. Cobalt shipments last week were 382,464 oz. On June 12 410,000 oz. left San Francisco for the Orient.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
June 10	19.87	May 5	18.63
" 11	19.87	" 12	18.75
" 12	20.12	" 19	18.68
" 13 Sunday		" 26	18.50
" 14	20.37	June 2	18.67
" 15	20.37	" 9	19.39
" 16	20.12	" 16	20.12

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13 60	July	13.26	....
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13.60	....	Dec.	12.75	....

Exports from the United States during the week ended May 29 totaled 6,181,791 lb., valued at $1,128,474. Of this, 2,766,766 lb. went to England, 2,241,133 lb. to Russia, 897,109 lb. to Italy, and 150,365 lb. to Spain.

The Old Dominion output in May was 2,868,000 pounds.

Dividends declared are as follows: Granby Consolidated, $1.50 per share; Phelps, Dodge & Co., 2½% and an extra of 3%; and Utah Consolidated, 50c. per share.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date		Average week ending	
June 10	6.25	May 5	4.20
" 11	6.50	" 12	4.20
" 12	7.00	" 19	4.20
" 13 Sunday		" 26	4.20
" 14	7.00	June 2	4.69
" 15	7.00	" 9	5.44
" 16	6.25	" 16	6.66

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	....
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	....	Dec.	3.80	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
May 20	75.00	June 2	80.00
" 27	75.00	" 9	90.00
		" 16	90.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60.00	Aug.	80.00	....
Mch.	39 00	78.00	Sept.	76.25	....
Apr	38.90	77.50	Oct.	53.00	....
May	39 00	75.00	Nov.	55.00	....
June	38.60	....	Dec.	53.10	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date		Average week ending	
June 10	25.00	May 5	12.21
" 11	23.50	" 12	14.33
" 12	23 00	" 19	15.08
" 13 Sunday		" 26	17 79
" 14	22.50	June 2	22.10
" 15	22.00	" 9	26.17
" 16	21.00	" 16	22.83

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	5.22	9.05	Aug.	4.45	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9 78	Oct.	4.75	....
May	4.91	17.03	Nov.	5.01	....
June	4.84	....	Dec.	5.40	....

Zinc ore at Joplin has sold as high as $125 per ton, 60% basis.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	....
Feb.	39.76	37.23	Aug.	50.20	....
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	39.28	Nov.	33.51	....
June	30.72	....	Dec.	33.60	....

On June 16 tin was 41 to 42c. per pound.

ANTIMONY

Aside from a good business on one or two days in which a few hundred tons of Chinese and Japanese changed hands, there is nothing to report. The quotations range from 36.50 to 38c. The consumption of antimony in the making of shrapnel bullets will increase. The buying of the past week has been on the part of shrapnel makers.

ALUMINUM

The market for metal, 98 to 99% pure, is now quoted at 28 to 30c. While the demand has been slowly increasing, the advances in price are based largely in sympathy with the other metals.

Eastern Metal Market

New York, June 11.

Nearly all of the metals have gained in strength and quotations have gone higher. A cessation of the rush to buy spelter brought about an easier market in that commodity. Electrolytic copper has exceeded 20c. The indications are that it will go higher. Only a slight renewed demand for zinc would serve to send its price upward again. In lead there has been great pressure to buy. The American Smelting & Refining Co., has continued to advance its quotations from day to day. On June 11 its quotation was 6.50c. Independent sellers have been forced to decline attractive business because they did not have lead to sell. Tin has been active; aluminum has advanced, and in antimony a good business has been done at the high prices quoted.

The manufacture of munitions of war is assuming larger proportions every day. More and more of the larger industrial concerns are engaging in the work, and still others would take it up if the necessary machinery could be obtained in reasonable time. Some of the machine-tool manufacturers have sold all of their product to next January, and practically all are sold up to October or November. Many companies having war contracts have not yet organized the work, or have not completed plants for the new line of business, and a good part of their demand for the metals lies in the future. General business in the metal trades continues to improve, as evidenced by the call for equipment. The production of pig iron in May was 2,263,470 tons, against 2,116,494 tons in April, an increase of about 3000 tons per day. About two-thirds of the increase was contributed by steel-works furnaces.

Estimates put the aggregate of war orders placed in this country at about $500,000,000. The Bethlehem Steel Co. is credited with having over $100,000,000 worth. These figures are not excessive in the judgment of those in touch with the situation, and resultant business is spreading in new directions.

COPPER

Renewed demand from the manufacturers of munitions of war was particularly active in the first half of the current week. There are still good inquiries pending from the same sources, and from export buyers as well. Under this stimulus prices have advanced. The buying did not last long in full force, but the market was left firm at higher levels. At the close of June 9 producing interests were asking 20c. for electrolytic and the following day they asked 20.12½ to 20.25c., full terms, for July, August, and September shipments, but copper can be had today at 20c. Higher prices are predicted when the enormous war orders get in full swing. Lake is higher at 20 to 24c., choice brands commanding the higher figure, if it is found. The foreign market is firm. It is interesting to note that manufacturers of copper products are building up a good trade with countries supplied by Germany prior to the War. Chile, for instance, is taking rolled products, and some have been shipped to Scandinavian countries as well. The trade believes that a good part of this business will prove permanent, especially that with South America. Since the withdrawal of price lists on brass and copper products, only the outside market can be quoted and prices are almost entirely a matter of private negotiation. The base price of sheet copper today is about 25c. The International Nickel Co. has advanced its prices of monel metal, a natural nickel and copper alloy. It now quotes round rods at 28c., and flats at 29c. per lb. Exports of copper are proceeding at a fair rate, and up to June 12 totaled 8392 tons. The imports at New York, Baltimore and Philadelphia in April totaled 8700 tons, against 12,000 tons in the same month last year. In the first four months of this year the total of imports at those ports was 33,700 tons.

SPELTER

The scramble to get zinc at almost any price has subsided. Business is lacking and quotations have eased off. On June 10 offers were made around 25c., compared with 26.50c. for prompt deliveries in the preceeding two or three days, and June 11, there were offers at 24c. for June and July. Choice brands of brass-mill spelter are nominally quoted at 30 to 35c. Jobbers in galvanized sheets are offering to their customers sheets coated with lead and a small proportion of tin, since the price of galvanized sheets went up. Some of the mills making that product are now quoting No. 28 gauge at 5c., Pittsburg base, and others have ceased galvanizing altogether. Painted black sheets are freely substituted, and this is most natural in view of the fact that some engineers always have advocated the use of painted sheets. Many stories are going the rounds about spelter. One which does not deserve credence is that pro-German interests have control of its sale and are determined to make the Allies pay dearly for it; and it is also asserted that the supply is not so meagre as the selling interests assert. It is predicted that a large offering would bring prices down with a rush. Old and experienced students of the market assert their conviction that manipulation has little to do with the situation, and point to the fact that America is supplying almost the entire world. A lessened demand is about all that can bring prices down. Influences in this direction are the present substitutions for galvanized sheets, and the use of sheet copper in place of sheet zinc. The exports up to June 12 amounted to 8723 tons. In England much the same situation exists as prevails here, some of the consumers having shut down their works and disposed of their stocks and purchases of the metal.

LEAD

There has been a wild rush to buy and quotations have advanced in a most sensational manner. The buying of course, was responsible for the sky-rocket trend of prices. The largest interest quoted as follows: June 3, 5c.; 4th, 5.20; 5th, 5.20; 7th, 5.50; 8th, 5.75; 9th, 6; 10th, 6.25; and 11th, 6.50c. For a time after the metal reached 5c., the quotations of independents at St. Louis ranged higher than those at New York. At all times the outside quotations were higher than those of the largest interest. On June 10, for instance, the outside quotations for prompt delivery were 6.50 to 6.75c. and June 11, 7 to 7.25c. The general explanation is that the independents loaded up for contracts at low prices, leaving the so-called Trust practically in possession of the field. The exports up to June 12 amounted to 3273 tons in the month.

TIN

In the week June 3 to 9 a heavy business was done. The largest day was June 3, when probably 750 tons changed hands. Most of the buying was on the part of consumers who took all positions, but favored futures. Even September deliveries from the Far East found a ready market. Guaranteed deliveries brought premiums. At the close June 7, after a day of activity, June deliveries commanded 39c., and July 38.25c. The following day spot brought 40c., and today the quotation is 40.75c. Small stocks and very little to arrive in the next two weeks point to a tighter market for spot metal. The arrivals up to today, June 12, total 1225 tons. There is afloat 5685 tons. It is stated on good authority, that by the end of this year the A. S. & R. Co., will have a plant in operation at Perth Amboy, New Jersey, for the smelting of Bolivian tin ores.

In April, 1,387,636 lb. of tin was imported at San Francisco and 1,522,185 lb. at Washington ports, according to a report of the Department of Commerce.

COMPANY REPORTS

CALUMET & HECLA MINING COMPANY.

The report of this company, which has paid $124,250,000 in dividends to the end of 1914, has just been issued for last year. Like all other copper mines, operations were curtailed for some time late in the year. There was $1,000,000 distributed in two dividends of $5 each per share. Results are best shown in tabulated form:

	1914.	1913.	1912.
Development, feet	11,468	13,534	29,689
Mining cost per ton	$1.85	$2.38	$1.91
Ore treated, tons	2,592,462	2,035,625	2,806,610
Tailing treated, tons	351,929	388,164	481,320
Total copper yield, pounds	53,691,562	45,016,890	67,856,429
All costs per pound, cents	11.35	14.25	9.86
Dividends from subsidiaries	$915,439	.....	.....
Surplus	$6,902,866	$6,553,964	$10,716,414

The company holds large interests in 13 important companies in the copper country.

ROUND MOUNTAIN MINING COMPANY

This company operates a lode mine and placer deposit at Round Mountain, Nye county, Nevada. The illustrated report for the two years, April 1, 1913, to March 31, 1915, covers 34 pages. The general superintendent, R. H. Ernest, reported as follows:

The property now has an area of about 800 acres.

	1913-1914.	1914-1915.
Development, feet	4,211	4,707
Cost per foot	$7.27	$8.40
Material hoisted, tons	133,570	.....
Waste sorted out, tons	76,383	.....
Ore treated, tons	57,187	48,230
Average value per ton	$5.28	$6.57
Extraction, per cent	86.1	86.8
Total cost per ton	$4.59	$5.06
Litigation per ton	0.04	0.06
Revenue	$278,584	$292,295
Net operating profit	13,358	44,931
Cash	52,702	47,950
Surplus over liabilities	265,854	296,646

The output to date is 331,445 tons worth $2,594,819. Of this there was a profit of $730,900. Dividends paid, none last year, total $363,965.

No estimate has been made of the ore reserves, but the property is in better condition than at the end of the previous year. A large tonnage of ore has been developed between 800 and 900 ft. Cross-cuts 461, 501, and 702 have blocked out a good deal of low-grade ore. These results show that operation may be conducted on a larger scale.

Reference has been made in the PRESS several times to the 8-mile pipe-line being constructed for this company. It will bring water to the gravel deposit, which is of considerable interest. The Mountain Power & Water Co. worked this under lease until March 31, 1915. Their work, sampling and surveying indicated a large area of profitable ground. From 1906 to 1915 lessees handled 218,818 cu. yd., yielding $1.55 per yard. Their profit was about 50% of the gold recovered. Reserves of gravel are 1,508,445 cu. yd., averaging $1 per yard. Other areas will add to this. Water-rights were secured on Jett creek. A contract for pipe was awarded the Western Pipe & Steel Co. of San Francisco. This firm made riveted pipe, and the Youngstown Sheet & Tube Co., Ohio, made lap-welded pipe. Sluicing should start on June 15. The whole scheme cost $145,000.

MINING DECISIONS

MINING CONTRACT—DEFECTIVE TITLE

Purchasers of mining property, the title to a part of which failed or proved defective, who took possession of the property, could not, while retaining possession, resist payment of the purchase price.

Carter *v.* Butler (Missouri), 174 Southwestern, 399. February 9, 1915.

MINER'S LIEN STATUTE NOT RETROACTIVE

The new Arizona law (Laws 1912, c. 66) giving the employees of a purchaser of mining property under option contract, a lien for labor on such property, is not retroactive, and cannot apply to an owner who gave an option prior to the amendment. The optionee under such a contract is not the 'agent' of the owner, and cannot authorize a lien for his employees where the law did not so provide at the time he made the contract.

Oceanic Gold Mining Co. *v.* Steinfeld (Arizona), 147 Pacific, 717. April 17, 1915.

RIGHT TO DEPOSIT WASTE IMPLIED FROM EASEMENT GRANT

A deed granting the right to drive a tunnel through the grantor's property, and to use said tunnel for the operation of the grantee's mines, was held to convey by implication, the right also to dump on the grantor's property the débris and waste from such mines. The extent to which such surface can be used for these purposes was held to be a question of fact for the jury.

Himrod *v.* Ft. Pitt Mining & Milling Co. (Colorado), 220 Federal, 80. January 6, 1915.

SALE OF MINING LEASE—FORFEITURE OF CONTRACT

Claimant, a lessee of iron-ore lands which it was mining under a 30-year lease, transferred all of its property, including its plant, machinery, ore on hand, and leasehold interest to another who subsequently became bankrupt, in consideration of a cash payment, and a further payment of large royalty for fifteen years, with a specified minimum payment each year, payable quarterly. After about seven years there was a default in a quarterly payment, and the claimant at once gave notice of forfeiture and took possession of the property. It was held that the contract in question was an executory contract of sale of a leasehold interest, and that claimant having terminated the contract for default in payment of an installment of the purchase price, it could not also recover such.

G. W. Youngs Machinery Co. *v.* Courtney (Michigan), 219 Federal, 868. January 5, 1915.

CONVERSION OF ORE—PRIORITY OF LIENS

On September 14, 1911, the Clinton Mining & Mineral Co. recovered a judgment against the Imperial Mining & Milling Co. for $14,105.20 for unlawful conversion of ore belonging to the plaintiff. On April 26, 1911, the Imperial company executed a mortgage deed of trust on all of its properties to the Trust Company of North America. The judgment creditor brought suit to have the judgment declared a prior lien to the mortgage, on the theory that the proceeds from the sale of the unlawfully converted ores had been invested in the properties in such a manner as to augment their value. But on showing that the proceeds of the ores had all been spent in operation, and that the fund could not be traced to any permanent investment, there was held to be no need for intervention of equity.

Clinton Mining & Mineral Co. *v.* Trust Co. of North America (South Dakota), 151 Northwestern, 998. April 6, 1915.

BOOK REVIEWS

VALVES AND VALVE-GEARS. By Franklin DeRonde Furman. Vol. I, Steam Engines and Steam Turbines. P. 246. Ill., index. John Wiley & Sons, Inc., New York. For sale by *Mining and Scientific Press*, San Francisco. Price, $2.50.

The present volume is to be followed by another on valve-gears for gasoline, gas, and oil-engines. Together, they will form a complete text-book on the subject. Starting with the fundamental principles governing the admission of steam to the cylinder, the use of both the Zeuner and Bilgram diagrams is explained. Practical problems are given in the design of the various principal types of valve-gears. Eccentrics and shaft governors are also considered. The design of link-valves is discussed. The last chapter of the book is devoted to valves for steam turbines.

GOOD ROADS YEAR-BOOK FOR 1915. American Highway Association, Washington, D. C. P. 498. Price, $1.

A large amount of valuable information is contained in this book. The laws and systems of administration relating to highways in the various states of the Union are summarized, and considerable data on practice in foreign countries are also given. General specifications for the construction of the principal kinds of highways are given. There is a summary of road conditions in the United States and Canada. A bibliography is given, including the principal books on road-building as well as the various Government publications on the subject. Other parts of the book tell of college courses in road-building, a list of road associations, information regarding manufacturers of road material, and the constitution of the American Highway Association. One serious defect is the lack of a table of contents, the list which is called by that name being really an index.

ECONOMICS OF CONTRACTING. By Daniel J. Hauer. Vol. II. P. 334. Illustrated. E. H. Baumgartner, Rand-McNally Bdg., Chicago, Ill. For sale by *Mining and Scientific Press*, San Francisco. Price, $2.50.

The first volume of this useful work appeared two years ago. Volume II contains a large amount of new matter. It is probable that a larger proportion of contractors come to grief at one time or another of their business careers than of any other class of business men. A study of the present volume, written by a successful contractor, might prevent some of these failures. While the author lays considerable stress on the importance of cost records and estimating by analysis, other parts of the book are really more important, particularly because much has been written on cost-keeping during the past few years, while other equally important aspects of contracting have been almost neglected heretofore. One especially valuable chapter describes various methods for husbanding the contractor's funds until he can obtain payment for his work. Another chapter takes up the different classes of construction in turn and outlines a general plan for doing each job. Other parts of the book discuss handling men of all kinds from employees to public officials. Considerable space is also given to different phases of the law with respect to contracting. The book is badly in need of editing and condensation, two widely separated sub-heads in Chapter VI being 'The Liquor Evil' and 'The Drinking Evil,' but in general it will be found of great value.

PETROLEUM AND NATURAL GAS RESOURCES OF CANADA. By Frederick G. Clapp. P. 378. Ill., maps, plans, index. Department of Mines, Ottawa, 1914. Abstracts will be made in future issues of the PRESS.

RECENT PUBLICATIONS

PERMISSIBLE EXPLOSION-PROOF ELECTRIC MOTORS FOR MINES: CONDITIONS AND REQUIREMENTS FOR TEST AND APPROVAL. By H. H. Clark. Technical Paper 101. P. 17. Illustrated. U. S. Bureau of Mines, Washington, D. C.

MINES AND MINERAL RESOURCES OF IMPERIAL AND SAN DIEGO COUNTIES, CALIFORNIA. By Frederick J. H. Merrill. Chapters of State Mineralogist's report, 1913-1914. P. 113. Illustrated. Sacramento, 1914. A résumé of this work appeared in the PRESS of June 12.

A STUDY OF METHODS OF MINE VALUATION AND ASSESSMENT. With special reference to the zinc mines of southwestern Wisconsin. By W. L. Uglow. Bulletin XLI, Economic Series 18. P. 73. Charts. Wisconsin Geological and Natural History Survey. Madison, 1914. A résumé of this work appeared in the PRESS of June 12, while an abstract appeared in that of June 5.

A PRIMER ON EXPLOSIVES FOR METAL MINERS AND QUARRYMEN. By Charles E. Munroe and Clarence Hall. Bulletin 80. P. 180. Ill., index. U. S. Bureau of Mines, Washington, D. C., 1915. This bulletin contains chapters on combustion and explosion; blasting and mine explosives; fuse, detonators, and electric detonators; firing blasts by electricity; the use of explosives in excavation work; the use of explosives in quarrying; the use of explosives in metal mining and tunneling; drilling and blasting methods on New York rapid-transit tunnel; magazines and thaw-houses; permissible explosives, etc. Abstracts from this work will be made in the PRESS.

U. S. Geological Survey, Washington, D. C., 1915. Water-Supply Papers:

WESTERN GULF OF MEXICO DRAINAGE BASINS. Compiled by B. D. Wood. No. 340-H. P. 21. Index.

COLORADO RIVER BASIN. Compiled by B. D. Wood. No. 340-I. P. 23. Index.

THE GREAT BASIN. Compiled by B. D. Wood. No. 340-J. P. 21. Index.

GROUND-WATER RESOURCES OF THE NILES CONE AND ADJACENT AREAS, CALIFORNIA. By W. O. Clark. No. 345-H. P. 42. Ill., maps.

GAZETTEER OF SURFACE WATERS OF IOWA. By W. G. Hoyt and H. J. Ryan. No. 345-I. P. 57. Index.

GROUND-WATER FOR IRRIGATION IN THE SACRAMENTO VALLEY, CALIFORNIA. By Kirk Bryan. Prepared in co-operation with the Department of Engineering of the State of California. No. 375-A. P. 49. Illustrated.

UNDERGROUND WATERS OF THE COASTAL PLAIN OF GEORGIA. By L. W. Stephenson and J. O. Veatch. Also a discussion on 'The Quality of the Waters,' by R. B. Dole. No. 341. P. 539. Ill., maps, index.

GEOLOGY AND WATER RESOURCES OF TULAROSA BASIN, NEW MEXICO. By O. E. Meinzer and R. F. Hare. No. 343. P. 317. Ill., maps, index.

OHIO RIVER BASIN. By A. H. Horton, W. E. Hall, and H. J. Jackson. No. 353. P. 263. Ill., index.

ST. LAWRENCE RIVER BASIN. By N. C. Grover, W. G. Hoyt, A. H. Horton, and C. C. Covert. No. 354. P. 136. Ill., index.

GROUND-WATER IN SOUTHEASTERN NEVADA. By Everett Carpenter. No. 365. P. 86. Ill., maps, index. A résumé of this paper appeared in the PRESS of June 5.

RECONNAISSANCE OF THE GEOLOGY AND OIL PROSPECTS OF NORTHWESTERN OREGON. By Chester W. Washburne. Bulletin 590. P. 111. Map.

New Machines and Devices

Information based on letters and catalogues from manufacturers.

A New Stopinig-Drill

In placing the 'New Cleveland' 2S stoper on the market, the Cleveland Rock Drill Co., Cleveland, Ohio, claims to be offering a stoping-machine which is a marked improvement over old and present types. The new machine embodies a number of changes in construction which, it is claimed, make for higher efficiency and greater footage.

The piston of this machine is only 2 in. diameter, which is a decrease in size over the standard machines. This results in a material reduction of air consumption. A marked increase in power is also claimed for this machine. This is accomplished by means of a valve which is faster than usual, together with an air-storage pocket in the hammer-head, which insures line pressure of the air when it gets to the piston, instead of a great reduction in pressure due to wire drawing and surface friction of air caused by taking the air through long ports with sharp turns. This reservoir is immediately behind the valve, and the air, when the valve shifts, not only reaches the piston instantly, but it maintains its pressure on the piston, until just before the piston hits the tappet. In older type machines, the air being choked, cannot fill the piston chamber fast enough to start it immediately, and does not maintain line pressure on the piston.

A shell-valve is used in this new device which is different in construction from the ordinary shell-valve, in that the piston goes completely through the valve and not into it. This makes the valve larger in diameter than the ordinary valve of this type and gives it a greater wearing surface, which, it is claimed, adds to the life of the valve and gives it a long continuance of its initial efficiency.

In the new stoper is used a tappet-seat. That is, instead of the tappet being seated in the hammer-cylinder, it is in a small forged part placed between the cylinder and the chuck. Ordinarily, the constant pounding slowly wears back the face in the cylinder, resulting in a constantly decreasing length of stroke, and a retarded reversal of the valve. The tappet seat is designed to reduce this to a minimum, the seat being made of forging which is hardened properly and uniformly.

The company has issued Bulletin 35 describing the new machine.

Valves at the Exposition

One of the largest and most artistically arranged exhibits in the Palace of Machinery at the Panama-Pacific Exposition is that of the Crane Co., of Chicago. The booth is 63 by 63 ft. The principal entrances are marked by arches, the legs of the arches being joined into railings comprising various sized valves, fittings, and specialties made by the company. The main entrance is 19 ft. high, made of an 18-in. cast-steel header, a 20-in. welded-steel header, and a proportionate 'U' bend below. Inside the railings are the following: a 72-in. cylinder-operated gate-valve weighing 57,000 lb.; an ⅛-in. brass valve weighing two ounces (between these two extremes the firm makes all sizes of valves for every purpose), a 48-in. back-pressure and exhaust relief valve, weighing 14,000 lb., a motor-operated 24-in. gate valve, pipe bends, drainage fittings, flanges, blow-off cocks, check-valves, whistles, tees, elbows, malleable-iron fittings, brass globe valves, steam traps, expansion bends, fusible plugs, safety-valves, and a host of other fittings used in mining.

Commercial Paragraphs

The Burd High Compression Ring Co., Rockford, Illinois, has increased its capital from $50,000 to $200,000. Increased business is said to be the reason.

A 5 by 10-ft. adjustable quick-discharge tube-mill of Chalmers & Williams, Chicago Heights, Illinois, make has been purchased by the California Slime Extraction Co. of Sutter Creek.

Mine hoists is the subject of Leaflet No. 13 of the Lidgerwood Manufacturing Co., New York. The particular hoist described stands 2 ft. 3 in. high. The drum holds 1000 ft. of ⅜-in. rope and 800 ft. of ½-in. rope, and is equipped with either a 5-hp. alternating or direct-current motor.

The Sullivan Machineey Co., of Chicago, has sent us Blue Booklet No. 115 on Sullivan air-compressors; Bulletin No. 34-U, giving instructions for installing and operating 'Chicago pneumatic' class N-SO fuel-oil driven compressors; and Bulletin No. 66-G, second edition, describing Sullivan air-feed stoping-drills, 'DF-21,' 'DA-21,' and 'DG-21.'

Bulletin No. 42,552, entitled 'Motor-Generator Sets,' has just been issued by the General Electric Co., Schenectady, New York. It is an attractive publication of 28 pages, inclosed in a designed cover and containing numerous illustrations of various types of motor-generator sets designed and manufactured by that company. There is included a general description of this type of apparatus.

The Round Mountain Mining Co., Nye county, Nevada, has just completed a pipe-line 45,336 ft. long to its gravel areas. The first section consisted of 14,000 ft. of 30 to 15-in. riveted steel pipe; second, 28,000 ft. of 15-in. lap-welded steel pipe; and third, 3336 ft. of 15-in. riveted steel pipe. Plain-end pipe, with bolted forged-steel joints, was specified for most of the line. Only 7550 ft. was of slip-joint design. The maximum head is 495 lb. per square inch. The installation cost about $125,000. The Western Pipe & Steel Co., of San Francisco, and Youngstown Sheet & Tube Co., Youngstown, Ohio, manufactured the pipe.

The Ingersoll-Rand Co., 11 Broadway, New York, has recently issued two new catalogues, Forms 3031 and 4034. The former is descriptive of the new Ingersoll-Rogler class 'FR-1' steam-driven, single-stage, straight-line air-compressors. The catalogue is profusely illustrated, showing the details of the machine in section. Among the principal features of construction may be mentioned the Ingersoll-Rogler air-valves in the air cylinder, and the balanced piston steam-valve, with automatic cut-off control, in the steam cylinder. The air-valves are silent in operation and long lived, operate entirely independent of any driving mechanism, and require practically no attention. The steam-valve represents the most approved design, permitting the use of the highest steam pressures and superheated steam. Form 4034 covers the type Bo. 36 Leyner-Ingersoll water-drill. This machine resembles the larger successful Leyner-Ingersoll drill, No. 18, but, it is, however, considerably lighter in weight, and intended for smaller diameter and shorter depth holes.

Mining and Scientific Press

Edited by T. A. RICKARD

Volume 110 SAN FRANCISCO, JUNE 26, 1915 Number 26

In the Altai

AMERICAN and English capital is going into the Altai mountains of Siberia. After the war there will be many opportunities in that part of the world for engineers and manufacturers. See article by H. W. Turner in this issue.

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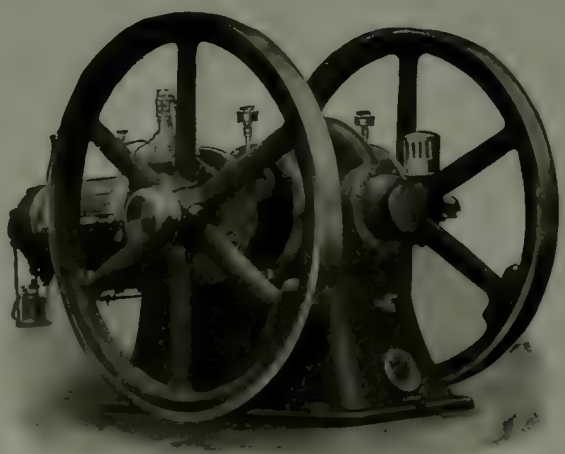

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Advertisers Index—Last Page
Buyers Directory—Page 28

TABLE OF CONTENTS

EDITORIAL Page.

NOTES 973

PREFERENTIAL FLOTATION 974
More research is needed.

THE RAND AND THE WAR 974
Effect of the War on the development of a great gold-field.

METAL-SELLING METHODS 975
The selling of metals is largely in the hands of a few closely-allied firms.

MEXICO 976
Compromise and conciliation offer hope of a restoration of peace.

DISCUSSION

BOLTS AND NUTS.
By Millman 977
A practical detail.

ALASKA MINING LAWS.
By Maurice D. Leehey 977
Recording of power-of-attorney prior to making locations is not required.

PROFESSORS OF MINING.
By Thomas T. Read 977
Practical experience is of value in so far as it enhances teaching ability.

CONSTRUCTION OF UNDERCURRENTS.
By Calvin W. Haffey 979
How to decrease wear due to abrasion.

MIDAS MILL.
By B. P. Howell 979
Treatment rates are actually reasonable.

ARTICLES

PREFERENTIAL FLOTATION.
By O. C. Ralston 980
Separation of minerals that float can be done by special methods, varying according to the minerals to be separated. The various patents are reviewed and commented upon.

THE ALTAI REGION, SIBERIA.
By H. W. Turner 985
To the south and east of the Great Siberian steppe are the Altai mountains; in their foothills, at elevations from 1200 to 3000 ft., are rich mines of zinc and copper ore, containing gold in notable amount. Mining has been done for many years, but only recently have large companies begun to develop the deposits by modern methods on a large scale.

THE RAILWAY DOLLAR 993
From what it is derived and for what it is spent.

DEGREE OF CRUSHING TO FREE THE ECONOMIC MINERALS.
By D. P. Hynes 994
To separate mineral from gangue they must be in separate grains. Crushing is expensive, and the necessary limits may be determined by microscopic study of the crushed product.

MINING IN THE SHALE AT GOLDFIELD.
By J. K. Turner 995
The discovery of good ore in the contact zone between the shale and the latite has opened a new field for exploration at Goldfield. The ore channel is most likely to be found in depressions in the shale surface. As the contour is irregular, a complex system of development is necessary.

APEX LITIGATION AT GOLDFIELD 996
The main vein has a shape like a saucer. Locations on the outcrop possess extra-lateral rights that converge, like the sticks of a fan. The oldest location, the Booth, has the right-of-way over all subsequent claims.

DEPARTMENTS

CONCENTRATES 998

REVIEW OF MINING 999
Special correspondence from Weaverville, California; Cripple Creek, Colorado; Leadville, Colorado; Austin, Texas; Miami, Arizona; Toronto, Ontario.

THE MINING SUMMARY 1002

PERSONAL 1007

SCHOOLS AND SOCIETIES 1007

THE MARKET PLACE:
Metal Prices 1008
Eastern Metal Market 1009

MINING DECISIONS 1010

COMPANY REPORTS 1010
Domes Mines Co., Ltd.; Seoul Mining Company.

NEW MACHINES AND DEVICES:
Mining in the City of New York 1011
An Improved Balanced Safety Valve 1011
Mining Machinery at the Exposition 1012
Boilers at the Exposition 1012
Commercial Paragraphs 1012

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DREDGES

EDITORIAL

T. A. RICKARD - - - - Editor THOMAS T. READ - Associate Editor

AGRICULTURE and mining are not only the two basic industries, but they are intimately connected. When the farmer is prosperous there is money for mining. Crops this year are extraordinarily good. The rise in the price of wheat, due to the War, caused the farmers to increase their tillage by 6,000,000 acres. The wheat crop is estimated at the vast total of 950,000,000 bushels. While the price has dropped from $1.70, the price quoted before the expedition went to the Dardanelles and threatened to unlock the Russian store of grain, to $1.04 at this time of writing, yet 'dollar' wheat represents enormous wealth when applied to such a continental harvest. Something like $1,000,000,000 is involved. When this is garnered it should prove stimulating to the railroads, mines, and other industries of the country.

ZINC AND LEAD have fallen in price considerably since we wrote last. It is well that the unhealthy inflation should have been checked. From 26 cents zinc has dropped to 18 cents: concurrently lead has declined from 7¼ to 5½ cents per pound. Even these prices are, from the miner's point of view, magnificent. The recent sudden rise has disorganized many manufactures requiring these metals, and compelled a search for substitutes. For instance, the making of galvanized iron is almost prohibitive with zinc at 26 cents and copper at much over 20 cents brings aluminum into the field as a successful competitor. One man's food is another man's poison. Undoubtedly the rise in the price of the base metals that has already begun, and is likely to be maintained, despite necessary recessions, will upset many minor industries and cause readjustments of a disagreeable character. The cure will be a bigger production of the metals, in this country at least. To that we look forward confidently.

ALTAI is a name unfamiliar to many of our readers, yet it is a historic mining region that has come into considerable prominence in London financial circles during the last two years, on account of the operations of a group of American, English, and Russian capitalists, with whom several Californian engineers are professionally associated. We publish a general article on the Altai region by Mr. H. W. Turner, a mining engineer and geologist requiring no introduction to the readers of this paper. Lead, zinc, gold, and silver are the metals sought and found in the Altai mountains. The conditions for work are highly favorable. Transport by water is available, and if railway communication is as yet incomplete, that is a defect now in course of being remedied. The Altai reminds the traveler of the Rocky Mountains, more particularly the park areas of Colorado. Life is rendered wholesome by productive agriculture and varied farming, it being a fact that eggs and butter from this remote part of Siberia find their way to the markets of Petrograd and London. After the War, this region is likely to attract considerable attention, for the enterprises already started, notably the Irtysh and the Russian Mining corporations, promise to be highly successful. Further expansion of Anglo-American enterprise in this part of the world should afford an opportunity and a market for mining engineers and mining machinery emanating from San Francisco.

SMELTER CONTRACTS are attracting attention in the Coeur d'Alene. The contract between the Hercules Mining Company and the American Smelting & Refining Company expired on May 30. The mining company asked for a rate of $14 per ton for freight and treatment, full New York price for 90% of the lead and 95% of the silver, but as the smelting company proved unwilling to cede these terms, the mine was closed down, pending further negotiations. The Hercules, controlled largely by Mr. Harry L. Day, is one of the sweetest things in mining, for it is able to yield a large tonnage of 60% lead ore containing an ounce of silver for every unit of lead. In many respects it is the handsomest lead mine ever uncovered by the miner's pick. Exactly a month after the Hercules contract expired, that of the Sierra Nevada Consolidated, in the same district, also came to an end, and it likewise was not renewed because less favorable terms were offered by the smelting company. The chief mine in that part of Idaho, the Bunker Hill & Sullivan, is interested in the contracts of its neighbors, for if a concession is made to them, it also is entitled to better terms. The Bunker Hill contract was made for a period of 25 years, subject to modification every five years, and one of these intervals has just closed. The contract was acquired by the American Smelting company when it purchased the Tacoma plant, to which the Bunker Hill ore used to go before that smelter was changed from a lead to a copper basis, 10 years ago, soon after it was transferred to its present owners, who then diverted the Bunker Hill ore to the Selby and East Helena smelters. The local papers in Idaho talk about a tacit agreement between the various ore-purchasing companies whereby the American Smelting company obtains a clear field in the Coeur d'Alene, but it is a fact that the International Smelting company, with its plant at Tooele, in Utah, has cut into that preserve, or tried to do so, hence it conveys a wrong

impression to state that the American Smelting company has had, or has now, no real competition. We understand that Mr. Edgar Newhouse, representing this company, is now in Idaho with a view to arranging a new schedule with the mining companies mentioned, and others.

Preferential Flotation

No process is of greater present interest or more in need of further research than flotation. We are glad therefore to be able to present to our readers the results of investigations conducted at the University of Utah by Messrs. O. C. Ralston and D. A. Lyon. The special phase of the subject to which Mr. Ralston has devoted his attention is of much importance, for while flotation may be used to recover sulphides from the enclosing gangue, it is equally essential to be able to separate the different sulphides so that they may be treated separately. Encouraging progress has been made, and it is essential that the numerous investigators should be familiar with what has been accomplished, so that they may devote their energies toward making fresh discoveries rather than to the re-discovering of things already known or discarded. An example of this is seen in the patents by Ramage, cited by Mr. Ralston, in which a process is described that involves the roasting of an ore containing pyrite, chalcopyrite, and sphalerite at a temperature below 600°C. to cause alteration of the pyrite, then floated, roasted again at 700° C. to alter the sphalerite, with subsequent flotation of the unchanged chalcopyrite. The first impression is that this involves an impossibility. Chalcopyrite is generally assumed to behave much like pyrrhotite, which begins to roast at a temperature of 325°C., if finely divided; therefore its persistence unchanged at a temperature of 700°C. is incredible. The first essential is, of course, to check the investigation to see if the action described really takes place and, if found to be authentic, the causes of such a remarkable action should be investigated, as they may have an important bearing on possible modifications of the process. One difficulty likely to beset the critical study of flotation is that so far the engineering schools of this country have made little effort to train men for investigation and research, the emphasis having been placed almost wholly on routine work. Thus not a little work has been done by men who had no adequate preliminary training for the task. In the works laboratory, it is commonly impracticable to separate a process into its elements and study the effect of varying conditions on that one element; where a number of factors have to be simultaneously considered, research is difficult, for the effect of a variation on one factor may be in one direction, and in the opposite direction on another, or an accidental effect may be produced that obscures the real effect. Thus an experienced investigator may draw entirely different inferences from the results of an experiment than would be deduced by one who considered only the single factor under investigation. There must be a large number of engineers who have great natural aptitude for carrying out the commercial research that is so marked a characteristic of today. Unfortunately no method is available for determining this aptitude beforehand. In this, as in other lines of industry, it is desirable to select the right man for the work.

The Rand and the War

The Central Mining & Investment Corporation is known to most of our readers as the London agency for transacting promoting business on a large scale and a big financial organization controlling a group of the most important mines on the Rand. In effect, it has inherited the mining business of Wernher, Beit & Co. In 1914 the mines controlled by this corporation in the Transvaal yielded 60% of the total dividends and 37% of the total gold output, which was $177,940,000. Thus this organization was responsible for 14% of the world's total gold output, and this does not include its operations in other regions, notably West Africa. The total reserves of ore in the corporation's South African mines is estimated at 35,000,000 tons, averaging $6 per ton. At the recent annual meeting, the chairman, Sir Lionel Phillips, mentioned the fact that $2,700,000 of the corporation's investments are in the form of German and Austrian government stocks, while a cash item of $885,000 more is tied up in Germany, whither it was sent in anticipation of dividends payable to German shareholders. Moreover the corporation owns $6,250,000 of British Treasury bills. The total cash available represents $10,000,000. On the investments in "enemy countries" the chairman allowed a depreciation of 30%. A large holding in De Beers diamond shares has suffered, as has other property, yet Sir Lionel was able to summarize the position by saying that the assets were worth $86 per share, with liabilities of $36, so that the present value is $50 per share, of 425,000 shares. In his frank and comprehensive survey of the corporation's affairs, more particularly in relation to South Africa, he referred to the fact that the public debt of the Union of South Africa would be increased by $75,000,000 to $100,000,000 by the War, more particularly the campaign in German South-West Africa. The Government of the Union has made a special levy of $2,500,000 on the mining industry, besides a sum of $1,715,000 that falls to it by way of mining revenue, from *bewaartsplaatsen*, or dump-sites. However it is not the gold-mining industry but the diamond mining that has suffered most. The diamond mines are closed down, and another industry in which many of the mining engineers and operators had participated largely, namely, ostrich farming, has been hard hit. The result may not be all bad, for much good agricultural land has been diverted to the production of ostrich feathers, a product not nearly so useful to the community as crops of grain. In South Africa, as in Europe, the War has developed organized paternalism, the exigencies of an abnormal period causing the Government to undertake responsibilities usually left to individual or to corporate effort. It is interesting to note that the Union of South Africa is one of the few governments that owns large

areas of gold mining ground. Most of this is in the eastern end of the Rand and covers about 80,000 claims, equal to about 117,500 acres. Already it has a big interest in the Premier diamond mine and in the Government Gold Mining Areas, the latter being in that eastern part of the Rand to which we have just made reference. In that locality is the Brakpan mine, and near-by is the Modderfontein, probably the greatest gold mine in the world today. Concerning the unworked area, still owned by the Government, it cannot be said how good it is or what portion of it is workable. In this Far East Rand, as it is called, the gold-bearing formation, known as the Main Reef Series, is at a vertical depth exceeding 3500 feet, and to test the ground it becomes necessary to sink shafts at an expense, say, of $750,000 to $1,000,000 per shaft. For safety, they must be sunk in pairs. Diamond-drilling in the ordinary way is unsatisfactory, the evidence of bore-holes having proved illusive. The distribution of the gold is too irregular and the proof of quantity, that is, tonnage of ore above the economic limit as to grade, is too essential to justify the launching of any scheme involving millions of pounds, not dollars, without the assurance obtainable by the actual reaching of the lode by means of shafts. Therefore, it is incumbent upon the Government, especially at this time, when gold is so pre-eminent an asset, to welcome large-scale exploitation by offering terms on which sagacious men will be justified in finding capital for the necessarily expensive and elaborate exploratory work, without which this large tract of gold-bearing ground must remain unproductive.

Metal-Selling Methods

An interesting case involving trading in metals has been concluded at Adelaide, South Australia. On December 12 proceedings were commenced by the Federal Government against Francis H. Snow, a well-known metal-buyer, on the charge of endeavoring to trade in copper with his principals, Aron Hirsch & Sohn, in Germany, after war had been declared. On May 14 the Judge directed the jury to return a verdict of 'not guilty,' because his attempts to trade had taken place before the passage of the Trading With The Enemy Act. Here we have a disproof of the adage that *inter arma silent leges*. It is well sometimes that justice should be blindfolded. War is abnormal; it is desirable to limit its power to disrupt the contracts and conventions of individuals as made in time of peace. This case, however, has proved important in that it disclosed the extraordinary interlocking of interests between the metal-brokerage houses. Whether doing business at Frankfort, Halberstadt, Rotterdam, London, New York, Melbourne, or Adelaide the ramifications of a complicated trade were shown to be controlled by a relatively small group of non-national metal-merchants. If the members of this group are mostly German, as they are, it is yet a fact that some of them are English and some American, so that the question of nationality does not arise in the present discussion. We are looking at the subject as it affects the metal-producing mining companies and operators facing a clique of metal buyers and speculators, who have an excessive and dangerous control of the approaches to the European market. In the course of the Snow trial a number of letters were read before the Court, disclosing the defendant's correspondence with sundry well known metal-brokers. We need not give their names, because it is not our purpose to attack any individual or firm but to warn the controllers of mines against the unhealthy condition of their selling arrangements. Some of these metal-dealers trade under two or three names, as subsidiary companies. Others, by participating in the business of firms distributed at various centres, are enabled to create a false impression of competition.

One specific case we can quote, namely, the European zinc cartel, or syndicate, which, before the War, had absolute control of the market and used that control outrageously. This cartel consisted of four ore-purchasing firms, three of which were German and one Belgian. They combined to regulate the market for Broken Hill zinc concentrate. Keeping on hand a large stock of zinc, they were able to hold the price down, by the mere threat of dumping ten or twenty thousand tons of spelter on this market whenever required to check American production. Their London representative regulated the price. If a manufacturer in the Midlands wanted spelter, he came to London to buy. When he placed his order with a broker, he was told there was no metal to be bought. Ultimately he came in contact with the agent of the cartel, who would impose a long-time contract. The manufacturer would express willingness to pay the market price. To this the cartel's agent would demur, insisting on the quotation at Berlin, not in London. Thus the miner sold on London and the consumer bought on Berlin, the latter being absolutely in the hat of the cartel. Consequently the consumer in England paid from 10 to 40 shillings more per ton for zinc than the quotation in London on a given day. He could not kick, because he found himself unable to get metal elsewhere. Obviously, the contracts of the Australian mining companies in final settlement should have been at the price on which the metal *is sold,* not the average price on any metal exchange. Many of the Broken Hill companies were victimized. These facts were disclosed in connection with plans to erect a zinc smelter, when the former agreements with the Belgian smelters came to light. Sub-contracts between the metal-brokers and the smelters in Belgium showed a difference averaging fully 20 shillings per ton in favor of the agencies. The fact became clear that the members of the cartel made their money not by brokerage but by these differences in price.

It may be asked, how is this sort of thing to be stopped? Is it not a feature in kindred industries? So long as men can put their heads together and get control of the marketing of any product, they will do so. Laws may be enacted, but their scope is limited by national boundaries. Nor do we wish international trade to be checked; on the contrary we want to see it expedited, but not at the expense of fair dealing. Obviously, the only remedy is for the producers of the

metals to do their selling through the medium of brokers that do not deal on their own account. It is the old story of the broker that speculates, until he finds it profitable to play both ends against the middle. Another remedy is for metallurgists or engineers to study the business and place themselves in a position to act as specialists in the matter of ore and metal contracts. Some have the knowledge and experience necessary. Their services should command a big retainer. It is an urgent matter, for it involves the marketing of an enormously rich produce, in the winning of which great skill is spent only to have the fruition of the effort spoiled by sheer ignorance at the conclusion. The metal industry needs brokers that do not speculate and engineers that understand the business of marketing. Mining companies must place the selling of their metallic products in the hands of competent persons in their own employ.

Mexico

We presume that no apology need be made for our frequent comment upon the trend of affairs in Mexico. The subject is one of deep concern to most of our readers, for the lack of orderly government in that distressful country has driven many members of our profession from their posts; it has caused loss of production and property to mine-owners and companies; it has closed one of the best markets for American machinery and the various supplies required by a highly complex industry. Indeed, while the colossal tragedy in Europe overshadows the Mexican quarrel, as the revolutionary conflict in Mexico eclipses the recurrent Yaqui uprising, yet the effect of the events following the enforced resignation of Porfirio Diaz has been of more immediate injury to most of our readers than the Armageddon across the Atlantic. To those living on the Pacific coast, with wide and varied interests in the mineral development south of the Rio Grande, it is a matter of acute moment whether order can be restored there or misrule rendered chronic.

President Wilson's declaration of June 2 has elicited a response from the leaders of the two principal factions. Both talk about their dignity: a sign that they expect to be compelled to make concessions. Francisco Villa appears the more amenable, expressing willingness "to invite a new union of all Mexicans to work together to insure the triumph of the revolutionary principles." He declared his respect for President Wilson and acknowledged "the moral aid given by the people of the United States" in the overthrow of Huerta. This was on June 12, just after his defeat by Alvaro Obregon at Leon. A week later, on June 19, his military prospects looked more cheerful, whereupon he became less docile. He sent a note to Washington asserting that "the only hope for Mexico is that your government recognize the faction which I represent. We alone can bring peace and prosperity to Mexico." Meanwhile Venustiano Carranza replied to President Wilson's *pronunciamento* by "a proclamation to the people" in the course of which he asserted the right of his party to recognition by the United States and other foreign governments. Lack of such recognition, he insisted, was the one difficulty preventing a restoration of constitutional government in Mexico. Since then he is reported to have quarreled with his principal commander, Obregon, and with four members of his cabinet. Indeed the quarrel has gone so far as to menace his life and cause his retirement to the fortress of San Juan de Ulloa, the famous island off Vera Cruz. This has caused a halt in the march of Pablo Gonzales, who is leading a body of Carranza's troops toward Mexico City. At the same time the Yaquis are on the war-path in Sonora and an American warship is on the way to Guaymas with a view to landing a force of marines for the protection of American settlers in that region. Against such interference General José Maytorena, who is Villa's representative in Sonora, protests, despite the fact that a force sent by him against these Indians has been defeated. The whole position, obviously, is highly complicated, but it is one that may be simplified shortly by the logic of events.

Already suggestions for a compromise candidate to the presidency have been made. The Villa-Zapata combination was reported, on June 15, to favor Manuel Vasquez Tagle, the one member of Madero's cabinet that neither resigned nor took part in the subsequent strife. He is now in this country. Another name mentioned is that of Felipe Angeles, Villa's chief of artillery; but he is, in many ways unsuitable. Indeed no strong partisan of either Villa or Carranza is likely to be able to win the general support of all warring factions. Representatives of the Villa-Zapata party are reported to be on their way to Washington, to confer with the President. This is a manifest acknowledgment of his moral influence.

It is clear, moreover, that the President's policy has passed from non-recognition, in itself effective as against Huerta, to peaceful intervention, now under trial. The third alternative is military intervention. This last, it is hoped, will not be necessary, but the course of events may easily bring it within the range of practical politics. The Mexican tangle must be unraveled before the European war ends. As we see the position, it is imperative that both Villa and Carranza be eliminated; both are impossible, because neither is able to rally the general support of the people. Some Mexican of good character, not too closely identified with either faction, must be supported in an effort to unite the discordant elements that have brought the country to ruin. Signs multiply that the Mexicans, outside the small bodies of marauding soldiery, are sick of the pillage and devastation. Famine stares them in the face. The purpose of the fighting has ceased to be clear. The two parties now in conflict profess equally liberal principles and exhibit equally sanguinary motives. Both claim to be the political heirs of Madero and his reform movement. Given a third party, able to absorb both the Constitutionalists and the Conventionalists under a respectable chief, it ought to be possible to end this protracted period of misrule. Recognition from Washington, together with financial support and an embargo on arms, should serve to consolidate a compromise government and enable it to restore peace over the major portion of Mexico.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment

Bolts and Nuts

The Editor:

Sir—Having received benefit from your paper, I would reciprocate, if possible, and therefore suggest that others might profit by a suggestion made to me by a mechanical friend many years ago, as follows:

In putting machinery and fittings together nearly everyone screws the nut on the bolt with the flat side bearing against the surface upon which it is being screwed down. Except in the case of machined nuts, you can readily perceive that more tension can be put on the bolt with less muscle, if you reverse the usual practice and place the rounded side down. Punched nuts are always rough on the under side, and when it commences to get tight, the irregularities dig into the surface on which they are being turned and the frictional resistance is increased so much that I have frequently seen threads stripped off when a bolt is only moderately tight. Moreover, it holds better, as the vibration gradually pounds down the projecting parts and the bolt gets loose and then you have a two-man job either tightening it or replacing it. One man and a wrench to hold the head of the bolt and another man and wrench on the nut, and both swearing.

I have just been over some 240 bolts on a machine that has been working some 30 days; several had threads stripped, and about 10 had threads worn off from playing in the holes; and the nuts had not turned on the bolts either.

MILLMAN.

Knob, June 7.

[Practical hints such as these are always welcome.—EDITOR.]

Alaska Mining Laws

The Editor:

Sir—In the Alaska news of your last issue, referring to the new mining law passed by the Legislature, you say that

"Claims may not be staked by power of attorney in future, unless that power has been recorded in the recording office of the district where the claim is staked, and before the staking of the claim."

The new law does not require record of the power of attorney "before the staking of the claim," as you say. Section 6 of the new act, approved April 20, 1915, provides that

"Such power of attorney be duly executed and acknowledged before an officer authorized to administer oaths and recorded in the office of the Recorder of the district in which such claim is located, prior to the date of the filing for record of any location thereunder."

You are correct in stating that this is the outcome of the Chisana litigation. It was there contended by the 'jumpers' that the Congressional Act of August 1, 1912, required the record of a power of attorney before the staking of the claim. My contention on behalf of the original locators was that the locations were good because of the record of the power of attorney at the same time with the location notices and before intervening rights. This position was sustained by Judge Brown in his decision, and evidently by public sentiment in Alaska, as you will note the new Mining Act clearly expresses this and makes it the law of the territory. The new law also adopts a suggestion of Judge Brown that such record be required in the recording district where the location is made instead of in any recording district in the Judicial Division, as the Congressional Act required.

MAURICE D. LEEHEY.

Seattle, June 12.

[We referred to the new enactment in our editorial columns last week.—EDITOR.]

Professors of Mining

The Editor:

Sir—The letter of Ross E. Browne, published in your issue of June 12, on this subject is exceedingly interesting. The views of an engineer of such distinction who has himself had experience as a professor deserve the most careful attention. There is, nevertheless, advantage to be gained from a multiplicity of opinions, and I should like to trespass on your space in order to express my own views, also derived from teaching experience, on some of the points involved.

As a major premise it may be assumed that the first essential for a teacher is to be able to teach. Teaching is an art, and, like music, is one that can be successfully cultivated, but only on the basis of a natural aptitude. Curiously enough, this essential feature is commonly overlooked: in several years of teaching experience I only once heard of a candidate being examined as to whether he could teach. The usual method is much the same as if a candidate for *prima donna* of an opera company were questioned as to what she knew of the theory of music, with what teachers she had studied, and how many concerts she had attended, but without trying her voice to see whether she could sing. Possibly it is as-

sumed that teaching is such a simple matter than anyone can do it with a little practice, but this is not at all true, and a critical study of the teaching methods pursued in the representative engineering schools will quickly disclose the fact that they are a very long way indeed from perfect.

The common mistake made by teachers of engineering is in assuming that the purpose of education is to convey information, whereas it should be the development of power. A student who desires information and can read the English language, can, for less than the cost of one year in college, buy a hundred of the latest books on mining and metallurgy, and find in them more information than he can absorb and learn how to utilize during the rest of his life. What his college training should, but too often fails to, give him is the power to apply the information which is everywhere available in abundance. Mr. Browne says that when he graduated from Freiberg he "found himself ignorant of all useful work around the mines." Judging from the use he has made of it, the presumption is that his Freiberg training was excellent, though perhaps, through natural ability he would have been a successful engineer even if he had had no training at all. At any rate, I submit that a well-trained graduate must necessarily be ignorant of the details of useful work around mines and smelters, except such relatively simple and universally applicable matters as surveying and chemical analysis. The variety of work involved is so great that it is absolutely impossible to teach it to the students, and it is equally impossible to determine what the student may be called upon to do. A metallurgical engineer retained by the largest financial interests in this country not long ago told me that his most recent tasks had been to pass upon the advisability of developing a hydro-electric enterprise and the mechanical feasibility of a wave-motor. If this man had been merely a trained metallurgist, he would have failed utterly, but he was a man of mental power and successfully performed the task. This is an extreme case, but the principle is generally true. There has been too much emphasis placed on practical training in engineering schools, and too little emphasis on the development of power, and this, in my opinion, is sometimes due to the employment as teachers of men of practical knowledge who are not skillful teachers. The leading educators are well aware of this, and Nicholas Murray Butler not long ago said, "It is to be regretted that neither within nor without the universities is there any public sentiment that justifies the dismissing of a professor on the mere ground that he cannot teach."

While generally agreeing to these considerations, Mr. Browne concludes, like Galileo, by asserting that a teacher must have had practical experience. It is desirable, therefore, to inquire as to what constitutes practical experience, and in what way it conduces to efficiency in teaching. Practical experience, I suppose, is the actual doing of work. On this basis a man who had worked ten years in one mine would have good practical experience; a teacher who had spent ten summers visiting the principal mines of the country and attentively studying their methods would be devoid of practical experience. But I do not think anyone will seriously disagree with me that, quite aside from relative ability, the teacher would be in a much better position to instruct young men in the principles of mining, because he is familiar with a great variety of methods and has been at pains to learn the reasons therefor, while the man of practical experience knows one method in detail and too often has given little thought to the fundamental considerations governing its adoption. I have often been struck with the fact that comparatively few men gain from their practical work a thorough understanding of the principles involved. Often in visiting mines and smelters I have been told by the manager, "I am too busy to go with you just now, but I will send Mr. X, who has a good knowledge of the details." Passing out into the plant, I frequently found that Mr. X was unable to answer my questions; he could tell me what they did, but not why they did this or that rather than something else, which I had seen practised elsewhere. Many companies, indeed, seem to prefer that subordinates shall not obtain too much understanding of the general principles of the business, possibly in the fear that they may later take it with them to competitors. Practical experience, to my mind, is the knowledge of actual operating conditions gained in the field, as contrasted with knowledge gained from books and technical journals. It is much easier to gain this practical knowledge by visiting and carefully studying the operations at a greater number of plants than it is by working in one or two. In addition, at the end of two or three years of teaching, the man who derived his practical experience from work would be in just the same position as the teacher, for practice at the places where he worked would have changed, and he would have to visit the plants to familiarize himself with the changes that had taken place meanwhile.

Another disadvantage of working experience is that it fills a man too full of details and when he tries to teach he is apt to be in the sad case of the centipede that fell into the ditch through trying to count his feet. A glance back through the files of the Mining and Scientific Press will serve to illustrate this. It will be seen that the most lucid and comprehensive articles describing the work at a mine or smelter have been written by visiting engineers and not by the superintendent or one of the engineers. To the latter the fundamental aspects of their work are as obvious as the climate or the weather, and it does not occur to them that one who knows nothing about the place must have them explained to him. In other words, they make the same mistake so commonly made by teachers of supposing their audience able to perceive the fundamental relations once the details have been stated. As a matter of fact, the reader, and to a much greater extent the student, is quite unable to perceive these general relations for himself; they are the things that above all need to be explained. This brings me back to my original statement, that the first essential for a teacher is to be able to teach, and teaching is an art in which few excel.

One other point is of vital importance in selecting a

teacher, but I have used up so much space that I cannot do more than introduce it with a quotation from Emerson: "In selecting human assistants, such superficialities as education, as physical strength, even antecedent morality, are not as important as the inner attitudes, proclivities, character, which after all determine the man or woman."

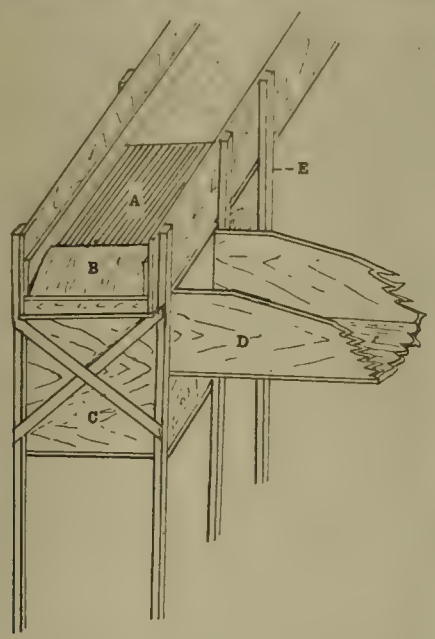
THOMAS T. READ.

San Francisco, June 15.

Construction of Undercurrents

The Editor:

Sir—Having read the article 'Construction of Undercurrents,' by Chas. S. Haley, in your issue of May 1, 1915, I am enclosing a sketch that I believe will be of interest both to your readers and to Mr. Haley. One of the objectionable features of undercurrents, the renewal of the throat-lining, is overcome by making the con-



ANOTHER FORM OF UNDERCURRENT.

struction as follows: Build the grizzlies far enough back from the end of the flume or sluice so that the water flowing through them will not strike the end of box *C* above water-level. At the end of the grizzlies *A*, board *B* with a steep pitch will provide for the disposal of the coarse material, which passes over the grizzlies. Box *C* should extend back as far as post *E*, which is placed at the beginning of the grizzlies. The principle involved is this: box *C* forms a reservoir below the level of the discharge into *D* and abrasive material will not come into contact with the wood, but will strike the water in *C*, thus preventing the wear on lumber. The necessity of lining *D* with sheet-steel, which is expensive when used to withstand the abrasive action of a heavy stream of water containing sand and fine gravel, is thereby obviated. The agitation due to the flow of water will be sufficient to keep the solid particles in suspension and they will be carried out of *D* by the water.

CALVIN W. HALLEY

Colfax, California, May 15.

Midas Mill

The Editor:

Sir—Supplementary to your notes on Elko county, Nevada, printed in the issue of May 29, quoting a correspondent in the *Tonopah Miner* concerning charges for ore treatment at the Midas custom mill, I should like to say that Rochester, having electric power, doesn't like Midas freight fuel-oil and all supplies over 30 miles of practically impassable Humboldt-Elko county roads.

The recovery obtainable on any particular ore is paid for, usually 90% of the assay value, in some instances as high as 95%. Treatment rates quoted apply to desultory and negligible quantities. Rates as low as in any camp of like conditions are given on lots of appreciable and regular or dependable amounts. I suspect that some time the *Tonopah Miner's* correspondent had a ton or so for which the Rex Reduction Co. cleaned the sampler equipment before and after handling, made a control-assay on the sample, and realized possibly sufficient to pay for the zinc necessary to precipitate the metal content.

Midas, Nevada, June 3. B. P. HOWELL.

BEEHIVE COKE-OVENS waste most of the valuable gases in coal. The Semet-Solvay by-product oven is a Belgian invention. From it are recovered many products, including coke, ammonia, sulphate of ammonia, tar, benzol, cyanides, gas for light and power, and several others. The process of making coke in a by-product oven differs in one essential respect from the beehive operation. In the latter the coal is charged into the oven and the coking takes place by means of air introduced directly into the oven chamber, so that all the by-products are destroyed. In the by-product oven the process is a true dry distillation. The oven chamber is filled almost full of coal and is sealed as tightly as possible to prevent the admission of air. The heat for coking is introduced by burning a portion of the gas produced in the distillation of the coal in a series of heating flues in the sides of the oven, the heat passing through the walls to the coal. Beehive ovens were formerly preferred here, on the ground that the coke is of better quality, but the use of by-product ovens is increasing.

THE LAW of Indiana requires oil and gas produced from wells to be safely and securely confined in pipes or other safe receptacles. Where persons have negligently allowed oil to escape from tanks insecurely hooped, and the oil flowed down a drainage ditch, took fire from live coals dumped from a steam-dredge, and burned the dredge, the former were held liable for the resulting damage. In such a case it has been held that the escape of the oil was the proximate cause of the injury, and that the accidental dumping of live coals from the dredge onto the oil was not an intervening cause.

Preferential Flotation

By O. C. RALSTON

*Introductory. 'Preferential' flotation is a specialized application of the flotative principle in the separation of minerals from their ores. It gained its first wide use as a name for certain methods of floating minerals in connection with the Horwood process mentioned below. 'Selective' flotation has come to mean (by common consent) the flotation of valuable minerals (generally the metal sulphides) in the presence of undesirable gangue-minerals. 'Preferential' flotation is the flotation of one of the ordinary selectively flotative minerals in the presence of another similar mineral. Thus, a mixture of galena and sphalerite can be floated 'selectively' from a gangue of granite, limestone, or other common gangue-material, while galena may be floated 'preferentially' from a mixture of galena and sphalerite.

On account of the great interest manifested in this subject of late, I have thought that the following review of proposed or operating processes might be of interest. This review is largely a compilation of patent literature, but it might be well to call attention to the fact that, at present, the patent literature is one of the best sources of information on the subject of flotation for one who does not have the opportunity to visit at first-hand the localities where the practice of flotation is being used or tested.

Cattermole. In 1904 Cattermole (U. S. Patent 763,259) made one of the earliest proposals for the preferential flotation of minerals. The method, as he described it, was not exactly a flotation method, but it involved most of the underlying principles of flotation, and hence is of interest in this connection. As stated by Cattermole: "The invention relates to the classification of the metalliferous constituents of ores which have been separated from gangue by oil or similar matter," and "consists in fractionally removing the different constituents from the agglomerated masses by freeing the constituents in turn from oil, and thus obtaining them in a separable condition by the use of emulsifying agents of varying strength and activity, preferably in conjunction with an alkali." "In carrying out the process, the metalliferous matter agglomerated by oil is mixed and agitated with a solution of an emulsifying agent, such as a soluble soap-alkaline oleate, for example, to which a certain proportion of soluble alkali, preferably caustic potash or soda has been added." "It is found that the minerals vary in their affinity for oil employed in the above manner, and thus by treating the oily masses or granules in the first place with an alkaline emulsifying solution of a certain strength, the mineral of least affinity can be separated therefrom, and by increasing the strength or modifying the proportions of the breaking down solution step by step, the various constituents can be thrown out in the order of their increasing affinities."

Cattermole's patent came at a time when the process was truly "oil flotation," as the use of small amounts of oil had not been made successful, and the particular method of flotation which he had in mind in this patent was probably that described in one of his other patents, in which the minerals desired were flocculated or granulated by the use of oil in larger amounts than the present methods of flotation, that is, in amounts up to 5% by weight of the ore, and these granules would sink of their own weight in an upward moving current of water, such as that of a classifier, while the unflocculated gangue would rise. He made the wording of his patent, however, broad enough to cover the treatment of products as obtained by true flotation.

As an example of the working of his process he uses an ore consisting of a silicious gangue, zinc-blende, copper pyrite, and galena, which has been treated with an oil for the granulation of the mineral sulphide particles, and the latter separated. The oil is preferably one that is not readily emulsified, such as a hydro-carbon oil, which will give a wide range of strength in the solutions used later in the breaking down of the granules. The compound granules are run into the first agitation apparatus where they are agitated with a solution containing, say, 0.75% soap and 0.75% alkali, by which the zinc-blende is "dropped out." The remaining granules are passed into the next similar apparatus, in which a solution containing 1.5% soap and 1.5% alkali is used. Here the copper pyrite is freed and only the granules of galena remain. As Cattermole proposed the use of so much oil, it had to be recovered by the use of strong alkali solutions.

The rules for proportioning the solutions took into account the fineness of the ore, the relative proportions of the minerals, their physical condition and chemical composition, also the kind of oil and emulsifying agents used, and the alkali selected. The finer the ore the more compact and cohesive the granules formed, and hence the stronger the solution required to break them down. With granules largely of galena which break down with difficulty, stronger solutions are necessary than for those consisting mainly of sphalerite. With animal or vegetal oils that emulsify easily the breaking down of the granules will be too rapid for convenience. The heavy residuum oils and the heavy hydro-carbon oils are the best. Oils may be blended advantageously for this purpose. An alkaline solution of the oil used in granulating is best for emulsifying.

Whether Cattermole's process was ever applied or not is not known to me, but it is not impossible that its principles may be applied to modern flotation froths.

Wentworth. Following the U. S. patents in their

*Contributed by the Department of Metallurgical Research, University of Utah. D. A. Lyon, metallurgist in charge; O. C. Ralston, assistant metallurgist. Published by permission of the Director of the U. S. Bureau of Mines.

chronological order, the next is No. 948,732, of 1909, taken out by H. A. Wentworth and assigned to the Huff Electrostatic Separator Co. It "relates to the separation of the ingredients which constitute ore mixtures, and particularly to the separation of sulphide ores from each other." "The process consists in the preliminary treatment of ore mixtures containing several sulphides, which converts some of the sulphides, superficially at least, into metallic compounds which are differentiated in their behavior" with respect to flotation processes as commonly practised. To use the words of a later patentee, the surfaces of such minerals as galena, pyrite, and chalcopyrite are "deadened" by a very short and slight roast in a roasting-furnace, while the sphalerite is unaffected. Thus the sphalerite can be removed by flotation from such an ore, leaving the other sulphide minerals to be removed by other means. A few minutes heating at a dull red heat has been found to be sufficient.

This is a type of process that has been tried in Australia under the name of the Horwood process. It is further described under that heading in this paper.

RAMAGE. The same idea underlies the next patent, which is No. 949,002, of 1910, taken out by A. S. Ramage and assigned to the Chemical Development Co., a Colorado corporation. "This process has for its object the separation of the valuable minerals from such ores as chalcopyrite, bornite, or erubescite, and mixtures of the same with pyrite, in which ores the copper is in chemical combination with the iron; and also from such ores containing zinc-blende. The method is also applicable to compound ores, such as those of the Cobalt district and other sulph-arsenides." "The principle of the process is founded on the combination of fractional roasting with chemical floating." Ramage's introduction of the term "fractional roasting" is particularly felicitous, as it more accurately describes the method than does the term "preferential flotation," used by Horwood.

Ramage described the process by the use of three examples, which are decidedly interesting. The first example is of an ore containing iron pyrite and chalcopyrite, with a content of about 5% copper and 30 to 40% sulphur. The ore is roasted at about a red heat long enough to decompose the pyrite slightly and not affect the chalcopyrite. "The burnt ore is then crushed to at least 15 mesh and passed through a solution of acid sulphate of soda and nitric acid (the solution being formed by adding nitric acid to sulphate of soda), which solution is kept near the boiling point. The copper sulphide immediately rises to the top of the bath and can be skimmed off." The copper dissolved in the bath can be recovered in known ways. This method of flotation (hot acid bath) is not new, having been patented by De Bavay, Potter, Delprat, and others. The fractional roasting had been previously patented by Wentworth and so the only thing that seems new is the combination of methods.

A second example is that of an ore containing pyrite, chalcopyrite, and zinc-blende in quantity. The ore is roasted at a temperature of not over 600°C., so that only the iron pyrite is deadened. The roasted ore is then subjected to the acid sulphate of soda solution for flotation of the unchanged sulphides of zinc and of copper. This product is then roasted at about 700° C. until all of the zinc sulphide is decomposed and the copper sulphide unchanged. This mixture is treated with a solution of dilute sulphuric acid for the dissolution of the zinc to be recovered from solution by any familiar process, such as electrolysis, and the copper sulphides sent to the copper smelter. There are certainly most interesting facts disclosed in this patent. The great resistance of copper sulphides to the roasting process, as compared to the sulphides of zinc is something new and will be a most valuable characteristic, if true.

The third example is that of the ores of the Cobalt district, Canada, where cobaltite, niccolite, chalcopyrite, pyrite, and native silver occur. All the sulphide and sulph-arsenide minerals are floated, leaving the silver in the gangue. The sulphides are roasted at about 800°C. and everything is decomposed except the copper sulphide, which can be floated from the calcine. Again we have mention of the almost incredible property of copper sulphides to resist roasting.

The next patent was that of H. A. Wentworth, amplyfying on his former patent in claiming the superficial chemical change of minerals as a method of separating them preferentially by flotation. He had in mind particularly the treatment of the ore with chlorine, which would act superficially on some of the minerals so that they would sink when subjected to a film-flotation process, while others would have their flotative properties enhanced. As an example, a mixture of zinc and iron sulphides when treated with chlorine gas in a slightly damp state, is so altered that the zinc sulphide will float on a film-flotation machine much better than before treatment, while the pyrite has a coating formed over its surface, which is much more easily wetted, so that it will sink. Still a further example is the application to the separation of pyrite and chalcopyrite. Chalcopyrite is attacked much slower than pyrite; hence it can be floated in its presence. A similar behavior of the minerals is observed when they are suspended in water containing dissolved chlorine in the proper concentration, but the best work seems to be done with minerals fed onto one of the film-flotation machines, such as that of H. E. Wood of Denver, although Wentworth gives the design of one of his own in the specification. It is easy to see that with chlorine-water and one of the mechanical frothing methods of flotation the soluble coatings that are formed on the surfaces of the minerals would be simply washed off and the preferential part of the flotation lost. Tests in our laboratory seem to show this. So far as is known to me, this process is not being used.

HORWOOD. This process of preferential flotation is practically the same as that described under Wentworth and Ramage. It has been worked for some years in Australia and received careful testing by the Zinc Corporation. It depends upon the 'deadening' of galena and pyrite in a short roast at 300 to 500°C., whereby the galena is coated with lead sulphate and the pyrite with iron oxide, while the sphalerite is unaltered. This allows a separation of the undesirable zinc from the lead-iron-

silver product and allows their separate marketing. This process has received more careful attention than any other process and reference to original articles is best.† According to the data given in some of this literature, it appears that it is possible to take a flotation concentrate containing 36% Zn, 15% Pb, and 22 oz. Ag per ton, and divide it into a zinc product running as high as 50% Zn, 7% Pb, and 15 oz. Ag, and a lead product containing 38% Pb, 8% Zn, and 42 oz. Ag per ton. This is of great interest to all producers of 'complex sulphide' ores, as the milling of coarsely crystalline material has presented much difficulty in the past for the reason that some finely divided material (slime) is bound to form in crushing, and while the combined lead and zinc sulphides can be floated nowadays without much difficulty, the mixture is of far less value than the two minerals separated. This is important enough, not to speak of the possibility of treating the microcrystalline sulphide ores and those containing gangue of high specific gravity, such as barite. While flotation has been a boon to the concentration of all sulphide slimes, preferential flotation is much more important for the ores containing undesirable combinations of sulphides. Hence Horwood's work should receive the highest praise.

Another detail, as regards this process, is that 35 lb. of sulphuric acid per ton of ore is necessary and 2 to 3 lb. of oleic acid for the flotation of the unaltered zinc. All of this appeared in Horwood's first patent, No. 1,020,353, of 1912, and he later came out with improvements on the process in Patent No. 1,108,440, of 1914. In this later patent he stated that he had found there was a tendency for the silver to follow the zinc, which is undesirable, but that this could be prevented by simply washing away all soluble salts on the concentrate before it was subjected to the deadening roast. This reduces the amount of oxidized zinc formed, and lost by solution in the dilute acid in the mill-water, as well as allowing the silver to become deadened to a greater extent. He also found that the most successful flotation took place with the pulp at a temperature of about 120°F.

It will be seen that the Horwood process has been applied only to concentrates from previous flotation or from other concentration processes. This is the logical place to apply it, as there is no object in leaving a non-flotative galena or other sulphide mixed with gangue, by using the process on crude ore. The same remark applies to many of the other processes. To be sure, there has been some success in the Australian mills as well as in the United States in the treatment of mixed galena-sphalerite concentrates from flotation machines on concentrating tables. As an example, the Timber Butte mill is treating the flotation concentrate of a zinc ore containing some lead on James tables, removing the lead, and obtaining a zinc concentrate carrying 53% Zn, 1.5% Pb, and 4% insoluble. However, this method has not always met with the best results, and where the proportions of lead and zinc in ordinary complex sulphide concentrates are about equal it is quite hard to get two products that are sufficiently pure. Where it can be done, it is certainly more desirable than the more complex fractional roasting and preferential flotation processes of Horwood, Wentworth, and Ramage.

LYSTER. This is another process that has received consideration by the Zinc Corporation for the year or two preceding the European war. Lyster's process is carried on in neutral or alkaline solutions (never acid) of the sulphates, chlorides, or nitrates of calcium, magnesium, sodium, potassium, or of their mixtures, or solutions of manganese, zinc, iron, acid sodium, or sodium-potassium sulphates. Using eucalyptus oil or a similar frothing agent, the agitation of the pulp takes place in centrifugal pumps, throttled to give further agitation, and discharging into spitzkasten with constricted tops. It is said that a galena froth can be collected carrying 55 to 60% lead and that by sending the tailing to a second machine with further addition of oil, the sphalerite can be floated.

It will be noticed that this, with the possible exception of Wentworth's second patent, is one of the first proposals to give a true 'preferential' flotation to a mixture of sulphides, as the roasting methods above mentioned involve an actual conversion of some of the minerals, so that sulphide surfaces are no longer presented to the oils and air bubbles in the flotation operation. Lyster's process, however, involves the actual flotation of one mineral in preference to another, unless the chemicals used are chemically altering certain of the sulphides so that they cannot float. Anyone who has worked with mixtures of sulphides has doubtless noticed that greater care is necessary in the flotation of zinc sulphide than in floating galena; in fact, galena is one of the most easily floated minerals outside of molybdenite, and zinc sulphide is considerably more difficult to float. The fact that a froth running so high in lead as the Lyster process is reported to give would also tend to make one suspicious that rather poor flotation conditions are maintained, so that only the most easily floated material (galena), and only the purest of that, is coming up in the first product. This takes place even in the presence of considerable oil, whenever flotation conditions are poor on almost any type of machine, and while the grade of froth that is obtained is high, the extraction is poor on account of the fact that only the best mineral is floating. It is possible that some such combination of results as this has caused the process not to be considered unfavorably.

NUTTER AND LAVERS. Perhaps the most important disclosure of a process for preferential flotation of minerals is contained in the patent specifications taken out by E. H. Nutter and H. Lavers, U. S. Patent No. 1,067,485 of 1913. This patent was assigned to the Minerals Separation Co., as the patentees are engineers in the employ of that company. The wording of the patent shows more actual contact with flotation work on the part of the patentees than perhaps any other single patent that has been granted. They have observed that while controlling conditions in a flotation plant, the vary-

†T. J. Hoover, 'Concentrating Ores by Flotation,' *Eng. & Min. World*, July 18, 1914, p. 96; *Eng. & Min. Jour.* (1914) 97, p. 1208; *Mining & Scientific Press*, April 18, 1914, p. 657; *Metal. & Chem. Eng.* (1914), No. 12, p. 350 and 592.

ing of certain of these conditions has been accompanied by changes in the character of the froth coming off their machines, the metals coming off in various ratios to each other at different times, and for definite causes. Thus there is considerable difference in the sizes of the different minerals separated under various conditions. It is no uncommon experience while developing the machinery of a flotation mill to float all of the fine part of the gangue as well as the sulphide minerals. In like manner, the more easily flotative minerals are liable to come off in the first froth that issues from a machine accompanied by the more finely divided portions of the less easily flotative minerals. "This tendency is dependent upon several factors, such as the amount and character of the agitation and aeration, or of each singly, the chemical constitution of the solution employed as mill-water, the degree of dilution, the temperature and the amount and nature of the different frothing agents." "The word aeration is used in this specification to mean the supplying of air or other gas or gases." By sufficiently controlling all of these factors it is possible to obtain effective separation of galena and sphalerite as well as other sulphides and metals. By taking the various froths obtained by subjecting the pulp to varying conditions, and classifying on apparatus such as concentrating tables it is often possible to get good separation of the minerals contained.

One example cited is that of an ore containing sulphides of lead, copper, and zinc. From this can be obtained a froth containing most of the chalcopyrite, and not much of the galena or the sphalerite, by the use of cresylic acid (cresol) without the addition of mineral acid to the pulp. This froth can be re-treated under varying conditions to purify it. To the mill-pulp that has been depleted of its copper can be added sulphuric acid as well as the frothing agent, to obtain the major portion of the lead, and, finally, by the addition of such an oil as oleic acid, it is possible to float all of the zinc mineral, as well as any coarse particles of chalcopyrite and galena. The re-treatment of these froths by further flotation, or on tables, makes it possible to get good products of the grade demanded by smelters.

When using an ore containing only copper and zinc sulphides they state that with the use of cresylic acid or eucalyptus oil, without the addition of any mineral acid, it is possible to get a froth containing a proportion of the copper minerals, some fine zinc, and some still finer gangue. They also state that if the remaining pulp is heated and treated with a small amount of sulphuric acid, the froth obtained will contain an additional amount of more coarse zinc and copper minerals and that the zinc minerals are finer than the copper minerals. If oleic acid is added to clean the tailing, the froth obtained will carry much gangue, but most of the sphalerite and chalcopyrite are very coarse-grained. The treatment of these froths on vanning machines or tables gives the desired products.

Consciously or unconsciously, a number of operators have applied methods more or less like those claimed in this patent. By restricting the amount of oil used, it seems to be possible to float galena in the presence of sphalerite, though the lead product obtained always carries a good deal of zinc, and it is impossible to get all of the lead out before the sphalerite is floated by the addition of further oil. This is practically an application of Lyster's process, except that pure water is used instead of the solutions recommended by him. However, there can be no doubt that the addition of certain substances to the mill water does help in this type of flotation. In another plant where an ore containing pyrite and chalcopyrite is being treated, the first froth contains most of the chalcopyrite in a finely divided form, while only a small amount of the pyrite, in large pieces, comes to the surface. The property of chalcopyrite to disintegrate into very fine flakes on crushing has bothered mill-men in the old days when the production of slime was kept down to a minimum. Now it seems to be an advantage. These two instances of "controlling flotation" conditions are somewhat different from the ones implied in the Nutter and Lavers patent, and it is doubtful if it could be held to cover these cases, at least more than in part. However, too much attention cannot be given to their patent, as it discloses the methods by which preferential flotation will be first developed successfully, as far as I am able to see.

Greenway and Lowry. A further development of the idea of using a solution of some chemical that will permit true preferential flotation of one mineral in the presence of another flotative mineral is contained in the patent of H. H. Greenway and A. H. P. Lowry, No. 1,102,738 of 1914. They discovered that "if a salt of chromium (such as sodium bichromate or potassium bichromate) is introduced in solution into the circuit liquors, or if the material to be treated is subjected to the action of such chromium salt solution by digestion or otherwise, that the sulphides are affected in such a way as to leave certain of them amenable to flotation, whereby products are obtained relatively high in certain sulphides on the one hand, and relatively high in the other sulphides on the other."

Three examples are cited: (1) A molybdenum ore containing 15% molybdenite and 25% iron pyrite was crushed to pass 100-mesh screen and treated in a froth-flotation apparatus with four times its weight of water containing 0.25% sodium bichromate, and heated to 120° F. One pound of eucalyptus oil per ton of slime was used and the flotation product consisted of 93% MoS_2 and 4.9% iron pyrite. Attention should be called to the fact that this example does not tell as much as it would seem to say, for the reason that molybdenite is one of the most easily floated minerals. I believe that work of a character more nearly comparable with this result could be obtained without the use of chromates.

The second example cited is of a copper ore containing 6.5% copper and 35% iron. This, likewise, was crushed to pass a 100-mesh screen and digested in a hot solution of 1% sodium chromate for about 30 minutes, the liquor decanted and the mineral treated in a flotation machine with one pound of eucalyptus oil per ton of dry slime. The flotation product contained 19% copper and 30.2%

iron, while the residue contained 0.7% copper and 36.2% iron. When we remember the case cited above of separating the chalcopyrite from the pyrite by virtue of the fact that fine grinding takes the copper down to a much finer product than it does the iron, we are led to wonder if this process is really necessary for this kind of ore. It may be that a better grade of product and a higher extraction can be obtained by this method than without the addition of bichromate, but otherwise it is doubtless possible in most cases to do the same work with proper control of ordinary conditions.

Their third example is of a lead-zinc slime containing 18.6% lead and 32.3% zinc, which was digested for 30 minutes in warm solution of 1% sodium bichromate. The solution was decanted and the material subjected to froth-flotation with one pound of eucalyptus oil per ton of slime. The flotation product contained 47.2% zinc and 6% lead, while the residue contained 31.6% lead and 16.3% zinc. The solution was heated to 120°C. These are interesting figures, but there is too much zinc in the lead concentrate. Here again I feel that the work is not much better than it would be without the aid of bichromates. By taking advantage of the fact that galena floats more easily than blende, it is possible to get a galena froth from an ore that will contain 54% lead and 15% zinc, while the blende-froth that follows will contain 37% zinc and 20% lead. This type of work errs in the other direction, that is, in having too much lead in the zinc product, but the point is that the addition of bichromates does not make a separation which is any more advantageous than does preferential flotation by other methods. However, the fact that the galena can be deadened by treatment with a weak solution of sodium bichromate is most interesting in that it shows that a true preferential flotation is possible. It is assumed that the action of the bichromate solution must be that of oxidation of the surfaces of the galena to insoluble sulphate while such an action on the sphalerite could not be possible, as the zinc sulphate would dissolve. The treatment of the high lead-zinc product of this last mentioned preferential flotation product by the bichromate process might be a useful method of cleaning this kind of concentrate. It is probable that successful preferential flotation will develop along such lines, though bichromates are not the only chemical that will be used. While the results obtained by this process have been shown to be capable of duplication otherwise than by the use of bichromates, this fact of the peculiar action of weak bichromate solutions is thankfully accepted and further work is urged to discover if it can have a field of application peculiarly its own.

Bradford. Another process along these lines is that revealed in British Patent No. 21,104 of 1913, by L. Bradford of Broken Hill. He claims the use of a solution that will wet one of the sulphides which it is desired to separate from the other preferentially without chemically altering the same. A medium which will wet galena particles and allow sphalerite and pyrite to float unaffected is a solution of one or more of the alkaline chlorides, slightly acidulated and heated to about 120 to 160°F. On account of its low cost a solution of sodium chloride is used, and Bradford states that there are no definite requirements as to how concentrated the solution shall be, but suggests a 10% NaCl solution as about the right strength to use.

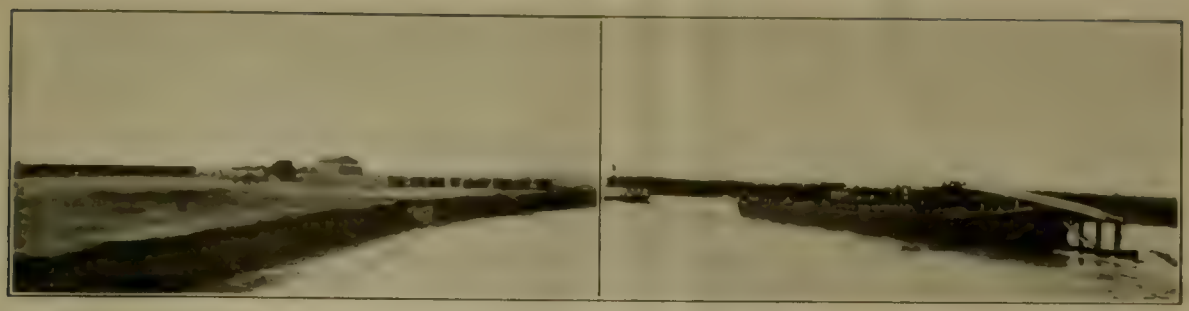
The acidity should be about 0.1 to 0.2%, for a higher amount than 1% will cause the flotation of galena on account of the formation of hydrogen sulphide bubbles on its surface. He states that if the process is applied directly to crude ores the use of a frothing agent is not necessary, although it will cause no harm if added. Any well-known apparatus can be used for the flotation.

The invention may be applied either to the crude ore or to the mixed flotation concentrate from the ordinary method of flotation. Where the plant is used on crude ore the tailings from the flotation of the sphalerite and the pyrite are agitated again in pure water with a frothing agent in order to float the galena. On account of this requirement it is thought better to make a mixed concentrate first by ordinary flotation and then separate preferentially as above described. This latter method, however, makes a higher-grade zinc concentrate.

When treating ordinary mixed flotation concentrate, it is best to remove the oil on the surfaces by the use of an alkaline or other alkaline carbonate solution, or by either. Further, finely ground material is liable to agglomerate too quickly, so that some of the galena will be entrained mechanically with the agglomerated sphalerite and decrease its value. In these cases it is desirable to add an agent that will retard flotation. Substances suitable for this purpose are sulphites or thiosulphites of alkalies or sulphur dioxide, but they must be used sparingly and with care or they will entirely spoil all flotation. He thought so much of this latter step that he later incorporated it in a separate patent (Brit. Pat. No. 19,844 of 1914). No further description of this patent is necessary.

There are many other proposed methods in the patent literature of England, Germany, France, and the United States, concerning which I am not fully informed, but it is believed that most of the important ones have been reviewed. Many interesting facts are disclosed, such as the fact that galena and sphalerite will not float in a solution containing zinc chloride of the right concentration and acidified by hydrochloric acid (German patent, No. 282,234). Aniline compounds are said to allow flotation of galena in preference to sphalerite, etc.

It will doubtless be noticed that little mention is made of the kinds of machinery used in the above methods of preferential flotation and there will doubtless be some question as to whether or not these principles can be applied equally well in the mechanically-agitated and in the pneumatic-agitation machines. Most of the above processes, where not specifically stated, have been worked out with the aid of mechanically-agitated machines, but it is possible to apply most of them to the pneumatically-agitated machines, such as the Callow or the Towne. Such machines, due to the economy of power in making froth, and the ease of control of flotation conditions, will doubtless materially assist in the development of preferential flotation.



EBMAK, THE RAILWAY TERMINAL. BARGE ON THE IRTYSH.

The Altai Region, Siberia

By H. W. TURNER

INTRODUCTORY. The following description of the Altai is based on observations made and data obtained in 1914 for the Russian Mining Corporation of London, to whose courtesy I am indebted for permission to publish them. The writings of Bernhard von Cotta, J. Hergenreder, and others have been freely utilized. The statistics of past production are mostly taken from the official records at Barnaul by courtesy of E. D. McDermott.

Southwestern Siberia, where traversed by the Trans-Siberian railway between Cheliabinsk in the Urals and Krasnoyarsk on the Yenesei river, is a vast plain, or steppe, and nearly level. This area as a whole is devoid of metalliferous deposits. It may at one time have been covered by a sheet of water, as will be noted later in this description. At many places the steppe is dotted with lakes, both salt and fresh; it extends far north of the railway; it is bordered on the west by the Ural mountains, while on the southwest it merges into the Kirghese steppe and south is limited by the Altai and other ranges.

The Russian side of the Altai mountains comprises that portion of the Siberian-Mongolian frontier ranges that are drained by the Ob river and its branches, the Irtysh and Tom. In the southern part of the Russian Altai, there are high peaks covered with snow even in the summer, one of which, Mt. Beluka, is credited with an elevation of 12,790 ft. above sea-level. While in general the region shows no evidence of glaciation, it is quite probable that local glaciers at one time existed in the highest part of the Altai, as suggested not only by the existence of summer snow at the present time, but also by the topography as seen in photographs. The known mining district of the Altai lies entirely in the foot-hill region and chiefly on the western side of the Russian Altai to the east of the Irtysh river.

THE GREAT STEPPE. Extending west and north of the Altai is the great Siberian steppe, already mentioned, a portion of which, bordering on the mining region, is shown on the accompanying geological map (Fig. 1). This map shows the limit of the metalliferous formations to the northwest of Zmeinogorsk and a steppe topography characterized by streams and strings of lakes lying in NW-SE troughs. At first glance it might seem that these troughs were due to NW-SE flexures of the flat-lying sediments or to faults. Von Cotta considers these troughs due to rows of sand dunes formed on the shore of a former shallow sea, the dunes lying parallel with the ancient shore-lines. This, in a measure, is confirmed by the geological map of von Petz (Fig. 1), which indicates that sand dunes border the troughs. Most of the lakes are salt or bitter, and there exists in this district extensive deposits of salt, which supply the inhabitants of the Irtysh basin. This saline portion of the plain is said to be called the "hungry" steppe. Some of the streams flow north-east into the Ob and others south-west into the Irtysh. The peculiar topography just described extends at least 130 miles north-west of the Alei river.

The Great Steppe, according to von Cotta and others, was a land surface from after the Carboniferous until Post-Pliocene time. During this dry period, the older rocks were much decomposed and disintegrated by the sun, wind, rain, and frost, forming a great mantle of loose material —the dust from which was no doubt shifted about by the wind, causing loess deposits. In Post-Pliocene time the region was submerged and these loose materials were spread over the basin by water action, forming the horizontally bedded deposits as seen today and loess (fine dust-like material showing little evidence of bedding), which may have been laid down in periods of low water by wind action. Von Cotta thought that the basin was covered by an arm of the sea but Adiassewich† notes that Dr. Martens of Berlin determined six kinds of fresh-water shells of species still living in Siberia from a collection contributed by the Post-Pliocene beds of the Irtysh basin.

Thomas Belt regarded the sediments of the Great Steppe as being formed in an enormous lake, which was caused by an ice-sheet damming back the north-flowing

†Trans. Inst. Min. and Met., London, Vol. XVII, p. 516.

rivers. However, neither von Cotta nor more recently C. W. Purington and G. Frederick Wright, have seen any evidence of glacial action in this central and southern Siberian region. Glaciers, if they existed, were probably local and grouped about high peaks like those of the Altai near the Mongolian border.

Finally De Launay describes horizontally bedded deposits of Tertiary age underlying the Great Steppe, so that the details of its origin must still be considered an open question, and for the purposes of this paper, it is only necessary to look upon it as a vast plain barren of valuable deposits, unless there be lignite beds in the Tertiary strata. On the other hand, its value from an agricultural point of view is enormous, as outside limited areas the soil is very fertile and affords pasturage to many hundreds of thousands of cattle, horses, and sheep. Settlement is being rapidly effected by Russian immigrants, who are given every aid to establish themselves by the Imperial government. Already it is a great butter-producing region, supplying Russia, England, and Denmark.

The Kirghese Steppe. Far to the south of the Trans-Siberian railway and to the west of the Irtysh river chiefly in the Akmolinsk and Semipalatinsk provinces, is the Kirghese steppe, in which are numerous groups of hills composed of rocks older than the Tertiary. These older rocks, following the Russian geologists, are of Carboniferous, Devonian, and Silurian sediments with intrusions of granite, diabase, porphyry, etc. The Carboniferous beds contain valuable coal seams and in the series generally are numerous deposits of gold, copper, lead, and zinc ores. Two of the copper deposits, the Spassky and the Atbasar, have been opened up by English companies. The Spassky, which also controls the Atbasar, is an example of the successful operation of a base-metal deposit far removed from the railway (500 miles from Petropavlovsk) with only horse and camel transport for the movement of supplies and the copper product. Such an operation would hardly be possible were it not for the existence of coal beds in the vicinity to supply the smelter with fuel. In the Semipalatinsk province, the Ekibastus coal beds are being developed by the Irtysh Corporation of London.

The Altai Mountains comprise that portion of the Siberian-Mongolian frontier ranges that is drained by the Ob river and its branches the Irtysh and Tom. These mountains lie in both Russian and Chinese territory. The known mining district lies entirely in the foot-hill region and chiefly on the western side of the Russian Altai, east of the Irtysh river.

Notwithstanding the great distance from the sea (Semipalatinsk is about 1200 miles south of the head of the gulf of Ob and the distance following the windings of the river is much greater), the elevation above sea-level as given by the Government engineers is not great. Semipalatinsk is only 686 ft., Ust-Kamenogorsk, 804 ft., Ust-bukhtarminsk, 1309 ft., and Lake Zaisan, 1356 ft. above the level of the Baltic sea. The mines are mostly among the hills, which seldom attain an elevation of above 3000 ft., the highest elevation in the immediate neighborhood of important mines being those to the east of the Ridder group, where the summits reach to about 6000 ft. The mines themselves however are generally on the lower slopes at elevations of between 1000 and 2000 ft.

Prehistoric Mining. When the Russians in the middle of the 18th century first undertook the exploitation of the metalliferous deposits of the Altai, they found at many places evidences of ancient mining. Thus Pallas, who traveled through the district late in the 18th century, writes: "The traces of former mining, which were observed at Zmeinogorsk are much too notable to be passed over in silence. The surface ores as well as those in the deeper part of the hill (Schlangenberg) were known to the ancient miners whose industry in working the Altai deposits was so remarkable. They extracted not only the rich surface and soft oxidized ores but also sank shafts to the depth of five or more fathoms. In the hard ores they generally failed to penetrate far, from lack of means and tools. Yet one can see in one of their open-cuts a caved excavation where they appear to have attempted to extract the hard spathic ore, and really sank in the hard rock a funnel-shaped pit. In recent operations tools used by these ancient miners have been found under broken ore. A pick and other mining implements, made of copper, were uncovered at a depth of 10 fathoms. From this it appears that iron was unknown to them; as is also indicated by the copper daggers, arrow-points, etc., found in their oldest graves in the mountains and on the steppes. Instead of hammers, they used hard rounded oblong stones in which a groove was cut, probably for fastening a strap with which the stones were held. At any rate, such stones are found in their graves. Moreover, a few years ago, under ore in a caved shaft, an entire skeleton, half mineralized, was found and by it a leathern sack full of rich ore."

Evidence was still extant, at the time of the visit of Pallas, of the former washing of the Zmeinogorsk ores for gold, in heaps of tailing situated along the neighboring stream.

These ancient workings, evidence of which was found at many of the important mines, are generally ascribed to a race called the Chuds (meaning, in Russian, queer or odd people) and Pallas was of the opinion that this race was not of Mongolian or Tartar origin, since those tribes in ancient times, and later, knew well how to smelt iron, but did not understand the winning and smelting of either copper or the precious metals. Convincing evidence of the existence of a former race is furnished by the graves or tumuli that are scattered all over the Irtysh basin but are said to be best developed along the Yenesei. Repeated investigation has shown these mounds to be burial places of an ancient race now entirely gone. The mounds contain not only skeletons but ornaments and implements made of copper and gold, as well as stone images.

Besides Russians, the present inhabitants of the Irtysh basin are chiefly the Kirghese, who are mostly a nomadic and pastoral people with herds of cattle and horses and flocks of sheep. It is an interesting fact that hunting

with falcons is still practised by them. They are an ignorant but useful people, good horsemen and drivers; and they make good servants and are in evidence as cabdrivers in all the large towns of the Irtysh basin. There are also all throughout the region, from Lake Zaisan north, numerous Cossack reservations, made in former years when there were frequent incursions of hostile tribes from Mongolia. My information is to the effect that the Cossacks own the reservation lands in perpetuity, it being required in return that they give their services for military duty immediately on being called and they also have charge of post-stations on their reservations. They are brought up with the idea of becoming cavalrymen, which explains why they are so independent and reckless in their demeanor. Many from this district are now in the great European conflict. The Cossacks not only own the reservation lands in perpetuity but also the mineral deposits that they may contain.

FIG. 1. GEOLOGICAL MAP OF COUNTRY NORTHWEST OF THE ALTAI.

THE RUSSIAN ALTAI. We return now to the Russian Altai, which lies chiefly in the Tomsk province. No reliable information is at hand regarding the geological formations and ore deposits, if there be any, of the higher Altai mountains. The mining region lies in the foothills. Here the formations, following the Russian geologists, comprise chiefly Carboniferous and Devonian sediments, mostly tilted and more or less metamorphosed, with intrusions and flows of igneous rocks: granite, diabase, porphyry, and numerous greenstone dikes. The Carboniferous strata contain beds of coal as in the Koosnetsk basin and at Kalchugina to the north and east of Barnaul, while the Devonian strata, chiefly graywacke, clay slate with lenses of limestone and beds of tuff, contain many of the important lead-zinc deposits. In the porphyries are many copper deposits, a few of which have been quite productive. There are also important deposits of copper, lead, and zinc in schist of igneous origin. In general the granitic areas are barren of metalliferous deposits. The general distribution of these formations is much the same over the entire mining district, but the geology is complex, as may be seen from the geological map of the neighborhood of Zmeinogorsk. Nevertheless a study of the district as a whole shows

two important NW-SE lines of mineralization. The eastern belt, although broken and displaced by granitic intrusions, is the more important and in it are found the Zmeinogorsk, the Ridder, and the Zyrianovsk groups of mines; from these has come the chief production of lead and silver, the zinc not having been recovered. Separating the eastern group from the western there is a broken belt of granite. The western belt lies along the lower foot-hills and has to date been most productive in copper, although there is some lead and zinc in nearly all of the deposits.

From the data at hand it would appear that the first serious mining in the Altai was undertaken about the middle of the 18th century under Demidoff with serf or convict labor. Records of production as early as 1747 are to be found at Barnaul. Later the best mining areas were taken over by the Czar as his private domain, and these areas have since been administered by the Cabinet, the name given to the group of officials having charge of the private Imperial lands. The headquarters of the Cabinet are at Petrograd and the local headquarters for the western Altai district are at Barnaul, whither one must go to get any reliable information as to past operaitons and production. Incomplete statistics from the records at Barnaul show the Barnaul district to have produced 45,550,000 ounces of silver and 30,000 long tons of copper. There was also a notable production of lead, probably in excess of 500,000 tons. The above statistics do not include the important output of the Zyrianovsk mine nor of the Salair, and of many prospects, the data for which are not at hand. The gold yield is not given. By far the larger part of the silver, lead, and copper was produced prior to 1866, about which time the production began to decline.

It may have been for this reason that in 1868 Bernhard von Cotta of the Freiberg Mining Academy was commissioned by the Czar to visit the Altai, where he spent about two months, returning home with extensive collections. Von Cotta made the following observations and recommendations:

1. To search for new orebodies and exploit the existing mines more thoroughly.

2. Since the forests had disappeared from the vicinity of the mines and smelters, to re-forest the devastated areas.

3. On account of the lack of fuel, to search in the Altai for beds of commercial coal or to connect the known coal basin of Koosnetsk with the smelters by a railroad.

4. To improve the method of transport of ores; for then as now, the ore was hauled in open carts and sleds of rude construction and small size, resulting in considerable losses as long distances were frequently traveled, up to 150 miles or more.

5. To endeavor to recover the zinc. Since many of the Altai ore deposits contain not only zinc-blende but also *galmei* (an old name for oxidized zinc ores) in large quantity, which are not used, so he pressed the question whether this metal content could not be used. With the winning of the zinc, one must naturally go further and manufacture zinc products in order to make the zinc useful and desirable to the people. Von Cotta suggests the making of sheet zinc for roofing houses and churches, zinc pipes for water-conveyance and zinc castings in the form of ornaments as well as brass for buckles and harness ornaments, which in this region of a plenitude of horses should find a ready market.

It would appear that only the first of these recommendations was heeded. There was vigorous prospecting after the date of von Cotta's visit, but no re-foresting was done, no coal mines were opened up, no improvements in transportation were made, the production and beneficiation of zinc apparently was not attempted, and certainly not accomplished. So far as known, von Cotta was the first to call attention to the importance of the Altai as a field for zinc production and it remained for English mining companies 45 years later to begin seriously the mining and beneficiation of zinc ore. The smelter of the Irtysh Corporation is now being built, and spelter or zinc products will no doubt be on the market in 1917, while the Russian Mining Corporation, which began operations later, will also be a producer in the near future. This delay in the production of zinc was due to the lack of knowledge of zinc smelting as well as to the difficulty of separating the zinc from the other constituents by the then known methods of concentration. It is evident from the report of von Cotta that the existence of large amounts of zinc in the Zyrianovsk mine was well known, but the great size and high zinc-content of the Ridder deposit remained to be proved by the Russo-Asiatic Corporation. As a matter of fact, zinc is the most abundant metallic constitiuent of the Ridder ore (14.7% on average), moreover its assay-value at Russian prices equals 42% of the total gross value of the average Ridder ore. The same is true of the ore of the Zyrianovsk mine, where zinc is present in somewhat greater quantity. That we have in the western Altai a new and important zinc-mining district is further shown in the finding of zinc, often in commercial quantity, in the old workings and on the dumps of nearly all the prospects and mines that were worked for copper and lead by the Russians. Mixed sulphide ores are thus the rule in this portion of the Altai.

Recent Operations. Early in the present century, a concession was granted to Prince Thurn and Taxis of Vienna. This comprised the three most prolific districts of the western Altai, the Zmeinogorsk, the Ridder, and the Zyrianovsk. (See Fig. 2). The Ridder district later passed to the Russo-Asiatic Corporation and the Zmeinogorsk and Zyrianovsk to the Russian Mining Corporation. Both of these companies have developed large and valuable bodies of complex ores by drilling.

A general geological map of the Altai will require first a topographic base and then some years of careful fieldwork. Such work is ordinarily undertaken by the general government. A survey has already been initiated and many of the hills of the mining region are surmounted by triangulation stations, indicating the considerable triangulation work that has been done. Maps of the entire Irtysh basin have been issued, but these will require revision before accurate geological maps can be con-

structed. Geological work has also been started and G. von Petz, a Russian geologist, constructed a geological map of the quadrangle in which Zmeinogorsk is situated. From a copy of this map, scale, one inch to 10 versts, as yet unpublished, I prepared the map shown in Fig. 1. Such maps would be valuable for general reconnaissance, but what is needed for mining purposes are maps on a more detailed scale of the known mining belts, which comprise but a portion of the mining region, as the granitic areas appear to be devoid of valuable mineral deposits. But little work has as yet been done and that chiefly by the English companies. During the year 1914, the chief work of my own party was necessarily the investigation and sampling of the old mines, the study of the mine-plans and the collection of statistics of past production, for the purpose of determining the best

THE FOOT-HILLS.

THE ZMEINOGORSK MILL.

places for drilling under the old workings and elsewhere, so that only the formations immediately adjacent to the known ore deposits were examined.

A considerable number of the silver-lead-zinc mines are found in bedded and schistose rocks. Frequently on one wall or other of the deposits there are lenses of a fine grained flinty rock, locally called 'hornstone.' This hornstone is pretty certainly a silicified limestone, and von Cotta records the finding of impressions of fossil shells in this flinty rock, which often contains gold and silver. The silicification of this rock presumably occurred at the time of the formation of the ore deposits themselves, although evidence of subsequent mineralization is seen in some of the mines. In places there are clear indications of fissuring and faulting of the beds preceding the deposition of the sulphides, but the great mass of the ores are replacement deposits and are without doubt of epigenetic origin. At nearly all of the mines there are greenstones dikes, which sometimes carry chalcopyrite. Whether or not this chalcopyrite is of magmatic origin or was introduced later by solutions has not been determined. Accepting old analyses as correct, these dikes have in some cases approximately the chemical composition of diabase. These greenstone dikes cut all the other formations, both sedimentary and igneous, and even the ore deposits themselves in some cases. They represent presumably the last indication of igneous activity in this mining region, there being no evidence of Tertiary volcanic action.

In the Zmeinogorsk mineral belt, there are zones of chlorite-schist underlying the Devonian slate and graywacke. This schist is presumed to be the product of metamorphism of clay slate by the magma of the adjoining intrusive granite.

In the Zyrianovsk concession, there are extensive belts of schistose quartz-porphyry and of greenstone-schist. These probably represent surface flows of lava of Devonian time folded and compressed within the Devonian sediments. In the western and central part of Zmeinogorsk mineral belt, however, the porphyries show no such compression and metamorphism, and are plainly intrusive in the Devonian sediments.

THE ZMEINOGORSK BELT. The main product of this belt has been silver and lead, but the small mines in igneous schist in the east portion of the belt, like the Lazursky, produced chiefly copper.

The Zmeinogorsk lode and the enclosing formations, taken as a whole, dip northerly at about 60° with numerous irregularities due to porphyry intrusions and faulting. The formations in brief are as follows, beginning at the south with the foot-wall formations: Chlorite-schist, clay-slate, hornstone, then the barite lead-silver lode, with clay-slate penetrated extensively by porphyry for the hanging wall. The hornstone lens thus forms the direct foot-wall of the baritic lode, which was the source of the chief ore-supply of former times. Cutting all of these formations, including the baritic vein, there are greenstone dikes. The hornstone forms a huge mass, presumably wedging out in depth; and for some years it has been mined for gold and silver, the ore being treated in a stamp-mill and the tailing cyanided. This lens of hornstone probably contains 7,000,000 tons of rock, all of which contains some gold and silver, but the amount of commercial ore is as yet undetermined. For some years the chief supply of gold ore has been taken from the surface along two greenstone dikes, as the ore is here of higher grade and if the old records are correct the main ore-shoot of the baritic vein pitched with one of these dikes, suggesting that this intrusion was followed by a renewed circulation of heated waters causing a concentration of valuable mineral along the dikes or an additional deposition of the precious metals, for the baritic vein itself was certainly formed before the intrusion of these dikes. The Zmeinogorsk mine is credited with a production of 30,000,000 oz. silver and a large tonnage

of lead up to 1855. The gold production is not given in the records available.

The geological formations at the Karamishevsk, Petrovsk, and other mines of the western part of the Zmeinogorsk belt do not differ greatly from those at Zmeinogorsk.

The Ridder Mine. Following the published description of this deposit by H. H. Knox, the Ridder lead-zinc deposit dips steeply in the old upper workings, flattening in depth as shown by the bore-holes. The hanging wall consists of clay-slate and ancient tuffs. At the date of his report, Mr. Knox estimated that a total of 2,448,000 long tons of ore had been developed containing gold 0.54 oz., silver 4.46 oz., copper 0.7%, lead 8.21%, and zinc 14.7%. Since that date additional drilling is reported to have largely increased the tonnage of the complex ore, and sampling in the old workings has revealed 100,000 tons of oxidized gold ore containing 18 dwt. per ton. On this concession the old Sokolni and Krukovsky also look promising for development.

The Ridder mine is under a 72-year lease to the Irtysh Corporation, a subsidiary of the Russo-Asiatic. The Ridder complex ore will be separated into two products at the mine by water-concentration, yielding a zinc-copper and a lead product. The concentrates will be shipped by railway to Ust-Kamenogorsk on the Irtysh; thence by barges to Ermak; thence by railway to Ekibastus, about 75 miles west of the Irtysh river, where the smelters are now being erected. It is expected that the first units of the zinc-smelting plant will be in operation in 1916.

The Zyrianovsk Mine of the Russian Mining Corporation lies about 50 miles south-east of the Ridder, to which it is in many respects similar. The croppings occur on a low hill at the west end of the lode. This hill consists chiefly of clay-slate and other sedimentary material with nearly vertical dip, with layers or intrusions of quartz-porphyry and numerous greenstone dikes with some quartz veins. The central and eastern parts of the lode are buried under alluvium. The strike of the lode is approximately east-west. Bore-holes from the north side show that the country on the hanging-wall side is composed of two layers of a fine grained micaceous silicious tuff with intervening bands of quartz-porphyry schist.

The ore deposits consist of a series of lenses of complex sulphides. Many of the lenses, as indicated on the old charts, fork upward, downward, and horizontally, and some are apparently otherwise irregular, while on the whole they conform in strike and dip with the enclosing schist. These lenses are grouped into two series or zones, which for the purposes of description may be called the north and south ore-zones. The two series unite at the west end of the mine and diverge going easterly on the strike and to some extent going down on the dip, the north zone dipping northerly at about 60° and the south zone southerly although irregular (see cross-section of deposit through the Staro-Vostochny and Severny shafts. See insert within Fig. 3). The south zone up to date has produced the most ore, but the north zone has been followed to a greater depth and been recently penetrated by two bores showing material extension of the previously known orebodies, one bore passing through 70 ft. of complex sulphide ore at a depth of about 120 ft. below the lowest level of the old mine or about 870 ft. vertically below the collar of the Severny shaft (see Fig. 3). There is also a zone of impregnation near the bottom of the bore. About 30,000 tons of ore is accumulated on the dump and according to the report of R. A. Varden made some years ago there are exposed in the mine about 133,000 tons of commercial ore. Repeated series of assays of the different exposures of ore indicate the following contents:

Ore on dump:	Ore, long tons.	Gold, Oz.	Silver, Oz.	Copper, %	Lead, %	Zinc, %
Sorted	10,700	0.65	15	2.5	13	23
Unsorted	19,400	0.3	8	2.0	10	18
Ore in mine.....	133,000	0.35	19	2.6	11	23
70 ft. of ore in bore No. 2....		0.023	8	1.9	10	18

Numerous other old mines on the Zyrianovsk concession merit attention; one of these, the Zavodinsky, produced lead ore high in silver with a limited amount of telluride ore. In this connection it is interesting to note that Fritzsche found the rare metal indium in the sphalerite of Zyrianovsk.

The Copper Belt of the Zmeinogorsk concession stretches along the western edge of the foot-hills of the Altai for a distance of 90 miles in a north-westerly direction, begining with the Belousovsk mine near the Irtysh river. The belt in addition to copper contains silver-lead and zinc ores. The records show that this belt has produced over 3,100,000 oz. silver, 7000 tons of lead, and 25,500 tons of copper. It thus forms an important line of mineralization.

While the various mines of the belt are nearly in a line, they do not occur in a definite lode or shear-zone like the Broken Hill lode in Australia or even the Mother Lode in California. The different mines are in different formations and no fissures or shear-zones continue even approximately from one to the other. The Belousovsk copper mine is in a belt of clay-slate and igneous schist: the Berezovsk lead mine is in clay-slate and igneous schist: the Titovsk copper-lead mine is in slate, quartzite, and graywacke; the Gerichovsk lead-silver prospect is in slate and limestone; the Nikolaevsk silver mine is in porphyry, so far as can be told from fragments on the old dumps; and the Chudak, Sugatovsk, Zolotushinsk, and Loktevsk copper mines are in porphyry and felsite.

The Kalbinsky Mountains. Between lake Zaisan, near the head of the Irtysh, and Ust-Kamenogorsk the Irtysh river has cut a rugged canyon through the south-western Altai foothills. The ragged ranges situated to the west of the Irtysh are known as the Kalbinsky mountains. According to J. Hergenreder, these mountains consist of Devonian and Carboniferous beds with intrusions of granite. The Carboniferous formation prevails and is composed of clay-slate, sandstone, limestone, and conglomerate. The sedimentary beds show evidence of contact-metamorphism near the granite, showing the granite to be intrusive. Gold placers were formerly worked in these mountains and more recently some gold-quartz mines, some of which are indicated on the map,

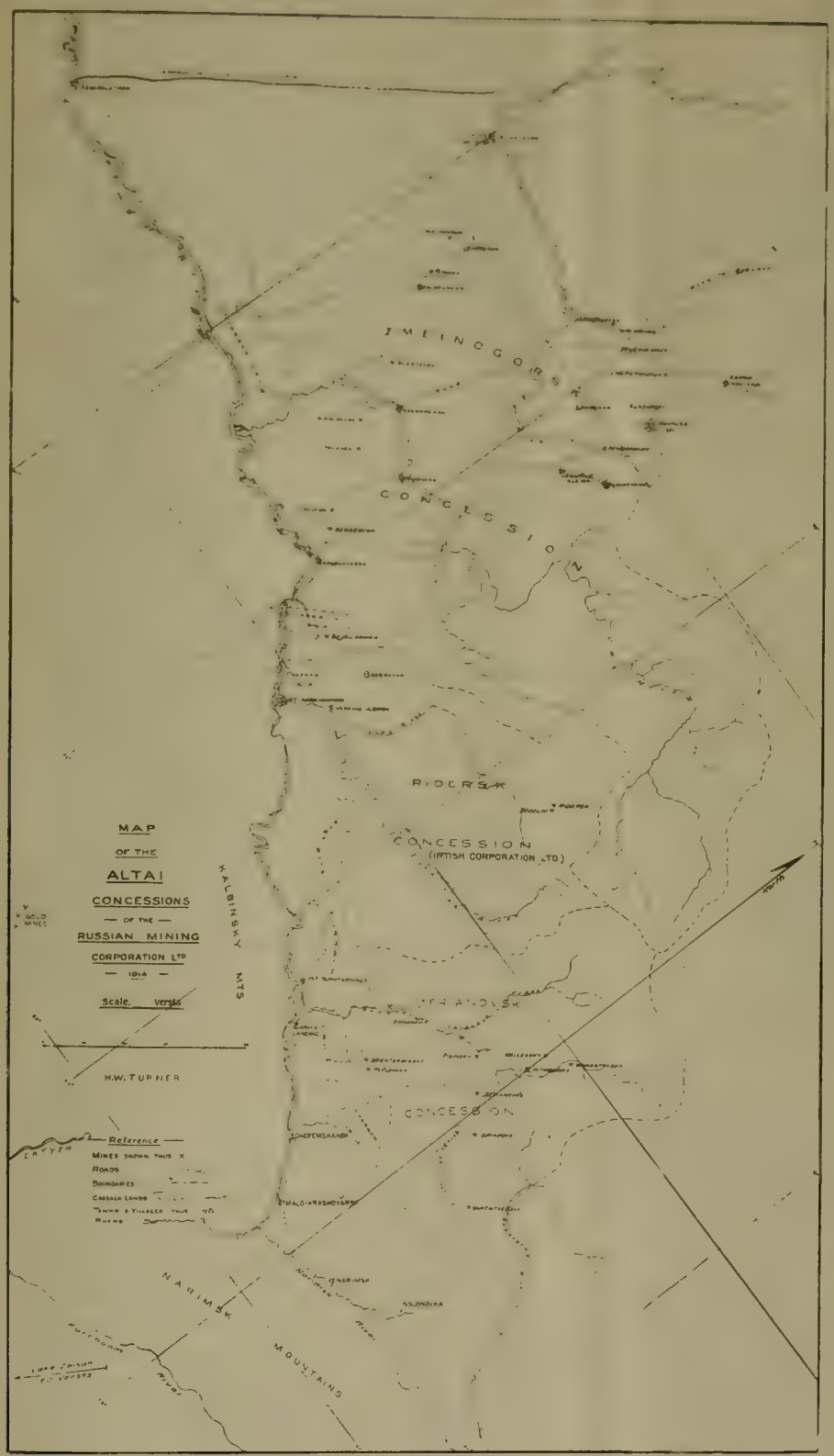


FIG. 2.

Fig. 2, have been opened up by the Russians with some success. There are also iron and manganese deposits in this district.

TRANSPORTATION. The western Altai is most easily reached by going to Omsk on the railway and there taking a comfortable Irtysh river-steamer to Semipalatinsk, Ust-Kamenogorsk, or other convenient point. The same steamer runs to Lake Zaisan, near the Mongolian frontier.

The Irtysh river is open for navigation, between Omsk and Ust-Kamenogorsk, from May to the middle of October. In the autumn the freezing of the smaller tributaries lessens the quantity of water in the main river and it is due to this rather than to the freezing of the Irtysh itself that navigation usually closes down in October. This, however, can be remedied by dredging at the shallow places. Both bucket and hydraulic dredges are now in use, although thus far only for deepening the water at landings. Navigation on the Irtysh should be practicable in most years until the middle of November when proper channels have been excavated.

The new 5-ft. gauge Government railway from Novo-Nikolaevsk to Semipalatinsk is now nearly finished and will presumably be open for traffic as soon as the bridge over the Ob river at Barnaul is completed. A railroad paralleling the Irtysh from Semipalatinsk to Omsk is also projected by the Government.

The private railway of the Irtysh Corporation from Ermak to Ekibastus is now available and the line from the Ridder mine

to Ust-Kamenogorsk will probably be finished in 1916.

At the present time most of the land transport is done on small four-wheeled carts in the summer and on sleds in the winter, at a cost of 10 kopecks (5 cents) per ton-mile, the price depending on the quantity of freight and the season of the year. Formerly much ore was transported 150 miles or more by this method.

Labor. Considerable portions of the mining region are under cultivation and Russian labor is cheap and plentiful, except during the planting and harvest season. The men now employed at the operating mines, both for surface and underground work, are chiefly Russians. There are lignitic deposits along the Irtysh and this coal is now being used by the Irtysh steamers. Near Lake Zaisan also lignite beds are said to abound.

The main coal-fields, however, lie to the north and east of Barnaul, of which the Koosnetsk basin and the mines at Kalchugina are the most important for mining purposes since they are near. These coal formations are said to be of Carboniferous age and to include fine coking and anthracite seams. A French company is opening up the Kalchugina mine, which will be connected with the Semipalatinsk and Novo-Nikolaevsk railroad.

Food-Supplies. Nearly all kinds of vegetables and

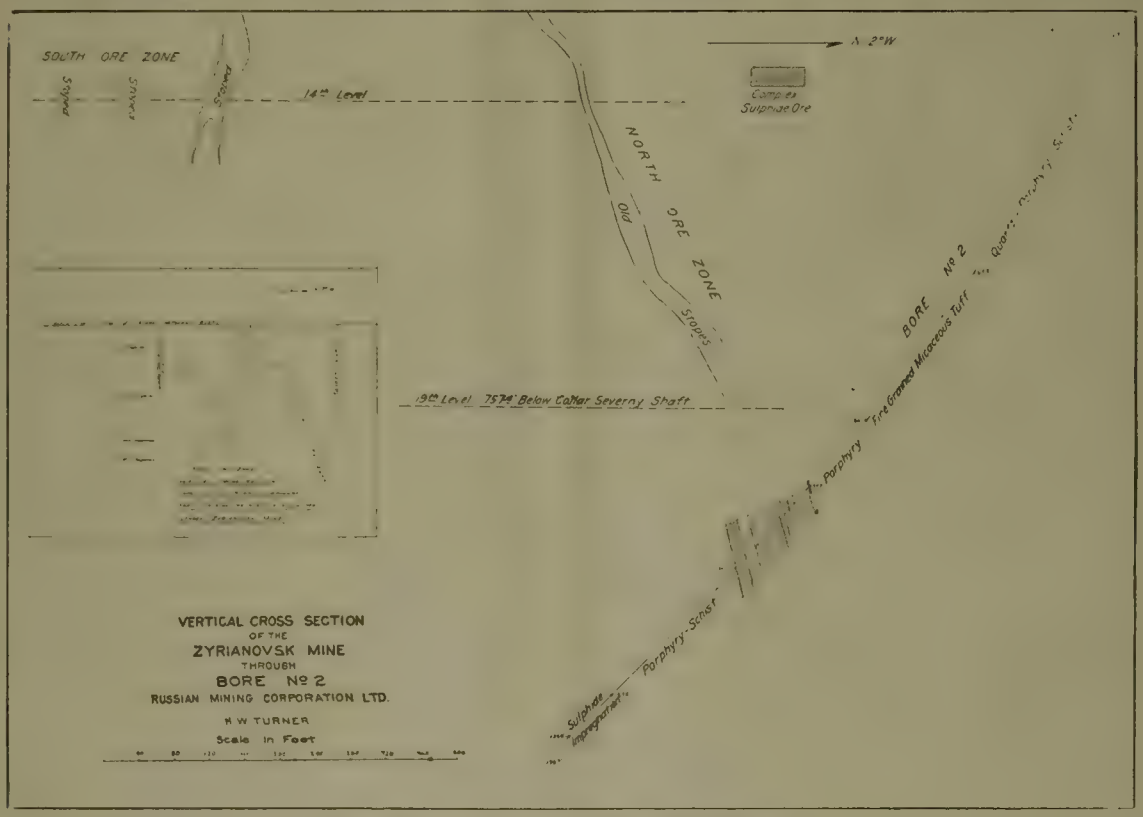


Fig. 3. Cross-section of the Zyrianovsk mine.

but when extensive underground operations are undertaken it will be found better, as at Kyshtim in the Urals, to use Tartars or other Russian or Siberian natives for this work. The average pay of a Russian miner at present is about one ruble (51.5 cents) per day.

Fuel Supply. The smelting of former years was done chiefly with charcoal; this, with the extravagant use of timber in underground works, for building houses and for domestic fuel, has decimated the forests that formerly covered the hills near the mines.

In those districts where wood-fuel is now too expensive the peasants use manure, which is cut into bricks and dried in the summer.

The fuel of the future will be coal and coke. The extensive deposits of Ekibastus are being opened up by the Irtysh Corporation not only with the object of supplying their own needs but for placing coke on the market.

some kinds of fruits are grown in the Irtysh basin. Cattle, sheep, and hogs being plentiful, fresh meat is cheap, as well as poultry, eggs, butter and milk. Fresh fish likewise is available. North-east of Pavlodar, there are large deposits of rock-salt. An increasing quantity of grain is grown and hay is cut to an enormous tonnage.

Mining Supplies and Machinery. While nearly all mining supplies and machinery must be imported, considerable stocks of iron and steel are kept at Ust-Kamenogorsk, where there are likewise machine-shops, a foundry, and small saw-mills. This town is rapidly growing in importance. Along the Irtysh, the traveler will note the oil-tanks of the Russian petroleum companies.

Conclusion. While the Russian laws require that certain examinations be passed before a man is qualified to take direct charge of any given mine, there are no difficulties interposed by the Government to prevent the

actual control and direction of operations from being in the hands of foreigners.

Some of the requirements seem foolish and such will in time no doubt be abolished, but even these are not difficult of fulfilment. In the promotion of a mining property, a Russian company must be formed; but the entire shares of such a company may be owned, and all operations controlled, by foreigners. There are many old prospects and mines in different parts of Siberia that deserve further exploitation and no doubt many ore deposits that are as yet totally unknown. In the Urals the English copper companies have been particularly successful in opening up deposits of pyritic copper ore that previously were not known to be valuable for copper or were not known at all.

The higher price of the base metals in Russia makes this a very attractive field for this branch of mining. Thus copper is worth over 5 cents per pound more in Russia than in London, and lead and zinc also obtain higher prices. The higher prices of the base metals is caused by import duties and the fact that, up to the present time, the domestic supply does not equal the demand.

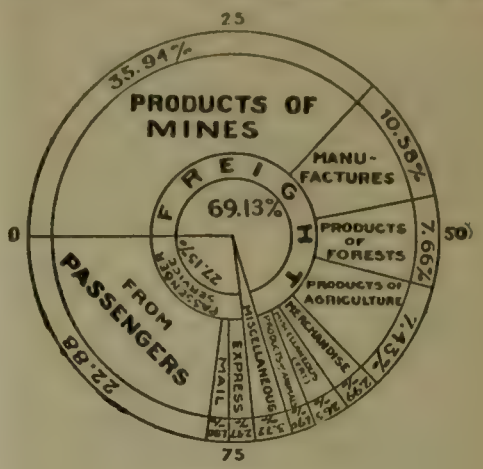
EXPERIMENTS on the treatment of Elm Orlu ores, Butte, Montana, covered a period of seven months. The ultimate aim was to make at the least expense the following marketable products: (1) A product for the copper smelter, containing, as nearly as possible all the copper, with some iron and a minimum amount of lead, zinc, and insolubles. (2) A product for the lead smelter, containing, as nearly as possible, all the lead, with some iron and a minimum amount of copper, zinc, and insolubles. (3) A product for the zinc smelter, containing, as nearly as possible all the zinc, with a minimum amount of copper, lead, iron, and insolubles. The gold and silver contents of the original ore were permitted to go with each of the above products in varying quantities. Treating about 450 tons per day, the average analysis of crude ore, concentrates, and tailing is as follows:

Product.	Copper, per cent.	Silver, oz. per ton.	Gold, oz. per ton.	Iron, per cent.	Zinc, per cent.	Lead, per cent.	Insoluble, per cent.
Original ore	0.73	6.23	0.013	3.29	18.52	0.75	62.23
Copper-iron conc.	2.25	21.01	0.04	19.78	22.78	13.01	2.30
Lead-iron conc...	1.13	18.91	0.04	9.99	9.15	50.60	5.05
Coarse-zinc conc.	1.96	14.74	0.035	9.15	47.77	1.88	3.47
Fine-zinc conc...	2.22	16.84	0.036	4.45	52.44	1.72	5.05
Tailing	0.07	0.60	0.0017	0.44	1.20	0.05	95.42

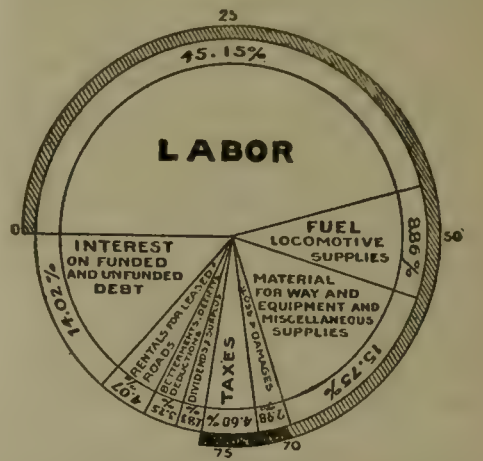
A comparison of the tonnage of concentrates and their analysis with the tonnage and analysis of the crude ore milled, shows an extraction of about 96% of the zinc and about 92.6% of the silver content of the original ore. The copper-iron concentrate goes to the Washoe works at Anaconda, Montana; the lead concentrate to the lead smelter of the United States Smelting Co. at Midvale, Utah; and the zinc concentrate to the zinc smelters at Bartlesville, Oklahoma, and Argentine, Kansas.

The Railway Dollar

WHERE IT CAME FROM IN THE YEAR ENDED JUNE 30, 1914



AND WHERE IT WENT,



AS COMPILED BY SLASON THOMPSON OF THE BUREAU OF RAILWAY NEWS AND STATISTICS.

In the period represented by the above chart the total revenue of railroads (225,486 miles) in the United States was $2,991,398,735. Freight contributed $2,061,262,870. In 1912, the aggregate capacity of 2,215,549 freight-cars was 82,965,418 tons, or 37 tons each. The railroads in 1912 moved products of mines totaling 566,538,387 tons. Of this, 315,581,446 tons was in the Eastern, 97,535,577 tons in the Southern, and 153,421,364 tons in the Western districts.

OILS from various regions are so well distinguishable by odor that it is frequently possible to detect their origin in this way. California oil has a smell somewhat like that of coal-tar oils; Pennsylvania oils have a gasoline odor; Texas and Russian products are similar; in the East Indies oil, an odor like that of cedar is detected; while Indiana, Ohio, and Ontario oils have a distinct sulphur smell.

Degree of Crushing to Free the Economic Minerals

By D. P. HYNES

MINERALS PRESENT. As a preliminary, all the important metallic and non-metallic minerals should be determined. A list can then be prepared showing the properties and the relative abundance of the minerals. Analyses are helpful. Qualitative and micro-chemical tests and petrographic investigation aid in identifying the species.

DEGREE OF CRUSHING. The crushing must be carried to the stage where no important quantity of the economic minerals remains included in grains of material from which the economic minerals are to be separated. Of course, the particular problem must fix the limit of the important quantity. In common practice, the stage at which the middling product disappears is taken as the degree of crushing necessary. When middling is composed of grains that include particles of economic minerals not freed, then the vanishing point of the middling is the degree of crushing. In many cases the middling is not composed of such grains, and this is usually true of fine material.

SCREEN-ANALYSIS. The first step is a screen-analysis of a sample of the ore crushed to a size somewhat larger than that which is likely to be the limit adopted. A set of screens having known openings should be used, and it is much preferable to use screens having a constant relation between the successive sizes, such as the Tyler standard testing-sieves.

CONCENTRATION TESTS. By making a series of concentration tests on a small scale by means of a little hand-jig and a pan, taking the products of the screen-analysis one at a time, with the object of making a tailing, a middling, and a concentrate for each size, the point of disappearance of the middling may be fixed. This may or may not correspond with the degree of crushing required, depending on the size and on the material.

SORTING TESTS. A method that will yield definite results in all cases consists in sorting the dried products of the screen-analysis, taking them one at a time. On material too fine to be sorted rapidly, a microscope is used for counting the grains of different classes.

For sorting, the apparatus required is a square of plate-glass six or eight inches on a side and a reading-glass mounted on a ring stand or other support. The method of procedure is as follows: Weighed samples are taken, decreasing the weights of the samples as the size becomes smaller. A sample is placed a little at a time on a glass plate and sorted into the several desired classes, which are accumulated in piles on separate pieces of paper or in receptacles distributed around the edges of the plate. From a small pile on one corner of the plate a number of grains are moved under the magnifying glass and examined rapidly. As the grains are determined, they are slid by the finger into the proper piles. When all the sample has been sorted, the classes are weighed. By this method, the waste obtained is clean waste, the concentrate is clean, and the middling consists only of included or mixed grains. By separating carefully a pile of each important mineral, and making a specific-gravity determination of each, useful information may be obtained.

When samples of all the sizes it is thought necessary to investigate have been sorted, the percentage of included grain material should be calculated for each size, and the results plotted to make a curve.

Sorting in this manner can be done on sizes down to 0.589 mm. or 28 mesh. Beyond this point counting is resorted to. A small sample is carefully prepared from each size. It is well mixed and small portions are spread on microscopic slides, one layer deep and not too crowded. A slide is placed under the microscope and examined with appropriate magnification. Taking a restricted portion of the field, say a quadrant defined by the cross-hairs, the total number of grains is counted and a note made; then the included grains are counted and the number recorded. The slide is moved and another field studied. When one slide has been finished others are examined in the same way. The work is trying, and the observer will have to rest at intervals, during which he will find it convenient to add the numbers set down for each class. The percentage of included grains may be calculated by number; and as only relative results are needed, the error introduced by considering numbers of grains instead of weights will not be serious. Counting should cover a sufficiently large number of grains to make the error of observation reasonably small. This may be checked by comparing the first half of the 'score' with the second half from time to time. When the results correspond within limits considered reasonable, work on that particular sample is stopped.

When the microscope is equipped with a mechanical stage, this may be used to advantage in counting the grains. The stage should be set so that its movements will be parallel with the cross-hairs. A slide is set on the stage and moved slowly parallel with the horizontal cross-hair. Only the grains that touch the cross-hair are counted. Several classes may be counted at once and the numbers recorded by scoring at the end of travel of the stage. The slide is then shifted by the other movement of the stage one or two millimetres and again moved parallel with the horizontal cross-hair.

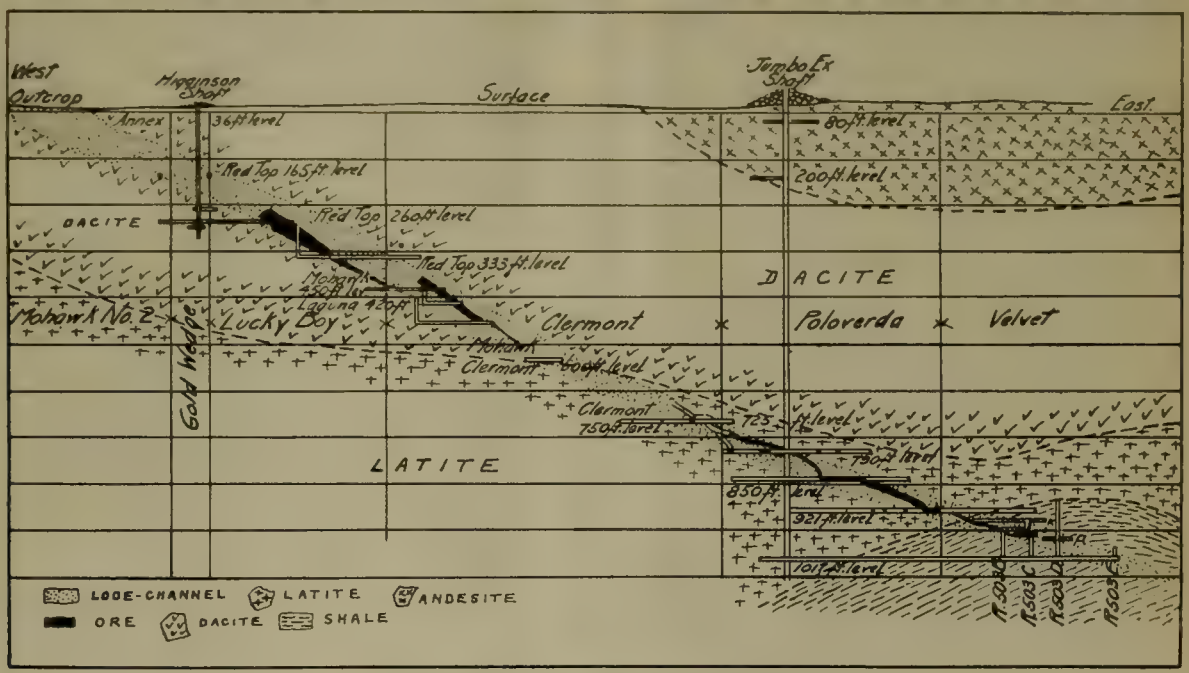
In making the sorting and counting tests, no work need be done on sizes that are far from the size likely to be fixed as that to which crushing must be done. It is, however, essential to draw conclusions from curves and not from isolated observations. I have used these methods, and find they yield very useful information.

Mining in the Shale at Goldfield

By J. K. TURNER

The discovery of pay ore in the contact-zone between the shale and latite has opened a new field for exploration in the Goldfield district, since the conditions revealed at the contact during the past few months were not heretofore known to exist. This condition, no less than the more recently ascertained fissuring of the shale, is likely to have an important bearing upon future operations in the district. Whereas until late in 1914 only one or two instances of fissuring extending into the shale, or below the shale surface, had become known here and no fissuring of the shale had been observed, more recent development has shown fault-action displacing the shale at varying angles, together with wide fissures of ore-bearing material extending far within the shale. Apparently, however, there is no essential analogy between the fault-plane and the fissuring of vein-matter, though an exception is found in the case of what has been described as the fold-fault in the Jumbo Extension mine, where the fissure has the dip into the shale of only 20 to 30 degrees.

Shale is found throughout the Goldfield district at varying depth overlying the basic alaskite or granite. On Vindicator mountain, in the north-central area, both the shale and alaskite are found outcropping near the peak of the mountain. In the southern part of the district the surface of the shale is found at a depth of 1750 ft. The shale, a sedimentary deposit, has offered a surface impermeable to mineralizing solutions, except where fissuring has taken place, although some silicification is apparent, for a negligible thickness, where the shale surface is in contact with vein-matter. Here silicification gives the shale the appearance of quartzite, and it is so classified by some authorities. There is no well-grounded supposition that the shale-latite zone will be found to contain pay-ore over the entire district, but developments up to the present time encourage the belief that valuable deposits will be found at many points in this zone where even low-grade lodes or ore-channels come in contact with the shale or extend within the shale.



CROSS-SECTION OF THE MOHAWK-JUMBO LODE.

The overlying volcanic flows, latite, dacite, andesite, and rhyolite, this being the order of their effusion, are more extensively fractured and show a considerable degree of fault disturbance, while the shale, being more compact in structure and apparently fractured only at wide intervals, offers, with its impermeable surface and comparatively flat bedding-planes, a condition favorable to the greater concentration of the metals.

The lode itself, with a dip of about 30°, follows, for varying distances, the contact-planes between the andesite and dacite, between the dacite and latite, and between the latite and shale, finally breaking through each in turn, but continuing for a greater distance along the shale-latite contact. This bears out the theory of greater resistance to solution and therefore a higher degree of concentration of the metals, in the sedimentary than in

the igneous formations of this and other districts.

Throughout the enriched area in the shale-latite zone, where it has been explored in the Jumbo Extension mine, the rich ore is found on the hanging-wall side. Between the rich ore and the shale is a mass of silicified latite, varying in width from 2 ft. to over 30 ft. A large part of this material is ore of commercial grade. Foot-wall seams of the rich ore have been found at a number of places in the mine, near the shale. Judging from the results of development work thus far in the contact-zone, it is apparent that the ore-channel upon coming in contact with the shale, seeks the deeper depressions or ravines in the shale's surface. The contour of this surface is most irregular and is marked by hills, ridges, and gullies, entailing a complex system of development.

In the Jumbo Extension mine the condition is presented of two distinct ore-channels, one overlying the other; the first extending along the contact-zone between the latite and shale, and the second in the form of a wide fissure, within the shale. The dip of this fissure is so nearly that of the bedding-plane of the contact that raises are driven from the workings in the fissure to develop the ore in the contact-zone, and this dip is so nearly flat that it is necessary to drive raises at frequent intervals to secure economy in stoping.

Further opportunities for interesting developments are offered at the contact of the shale and granite, the latter having been exposed at a depth of 1750 ft. in the St. Ives claim of the Merger Mines Co. Owing to its exceeding density it seems reasonable to expect an even greater concentration at the surface of the granite than upon the shale or in the other contact-zone near the surface.

AIR COOLING AND DRYING, whether the object be temperature or humidity control, has passed through the stages of free water contact, which in most important cases has been abandoned in favor of mechanical refrigeration. Numerous systems are in use where this cooling and drying has been performed by surface, city, or well water, and because the results have not been uniformly satisfactory either in obtaining the desired temperature or in reducing the humidity in the air to the proper degree for all seasons and weather conditions, they have been replaced by refrigerating equipment. All uncertainties and variations are removed by the substitution of mechanical refrigeration and yet its use is far from being as universal as it should and could be. In some classes of factory operation it has been found that the amount of labor performed by the workmen, especially in the summer months, was increased so much by mechanically-cooled breathing air that the expense of this cooling is more than offset by the greater output of the operators. For humidity control, by far the largest example of air-cooling by mechanical refrigeration is the Gayley process equipment for steel furnaces, the success of which is beyond question, and yet the application of similar equipment to other industries where humidity control is necessary or desirable is painfully slow.—*C. E. Lucke.*

Apex Litigation at Goldfield

As our readers are aware, the claim of the Booth against the Jumbo Extension has been compromised in an amicable spirit, which does credit to the two principals, Messrs. George Wingfield and Charles S. Sprague. In his geological report to the Jumbo Extension Mining Co., Mr. Horace V. Winchell summarizes the main facts in an interesting manner. We quote him as follows:

The principal veins of the productive portion of the Goldfield district occur about as shown on the above mentioned map.* Some of these veins have been large producers near the surface, and to the depth of about three hundred feet. The main vein is mineralized in lenses or shoots and has been followed downward upon its dip to the eastward for a horizontal distance of about two thousand feet and to a vertical depth of about thirteen hundred feet, thus indicating roughly an average dip of thirty-five degrees. The minor or subsidiary features, such as the old Jumbo vein, are about vertical and either die out or unite on dip with main dip. This main vein has a curved and irregular line of outcrop which is on the whole crescent shaped, and lies in the ground something like a saucer. In the case of such a vein it might be possible to start on the rim at more than one point and follow on the vein downward to the same orebody in depth. Legal rights depend upon the existence of a vein or lode and not upon the existence and position of shoots of high-grade ore within it. The vein may dip northeasterly and the ore shoots rake or pitch to the southeast within it, or the outcrop upon which the location made may have quite a different direction from that of the true strike of the vein; but the claim may still have extra-lateral rights so long as the vein can be followed generally downward between its end-line planes.

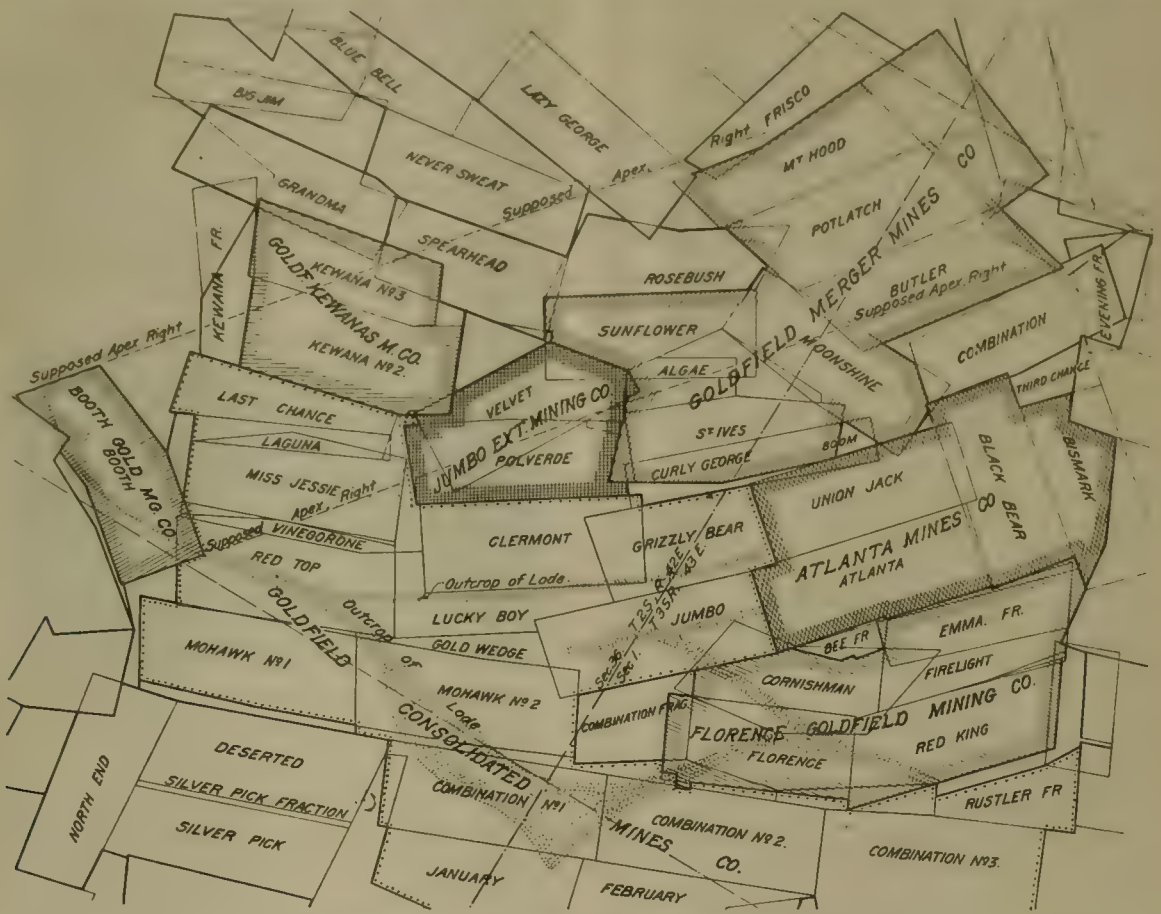
The horizontal distance from the outcrop of the vein on the Booth claim to the stopes in the Jumbo Extension ground is between 2000 and 2500 ft.; and the vertical difference in elevation is from 800 to 1200 ft., indicating (if we have the same vein in both) either a dip as low as 22 degrees or else that the vein is being followed downward on a course which is neither dip nor strike, but between the two. Observations in the ground show that the latter is the true situation. It is possible to pass downward through the Booth workings, to see the vein on the surface and on the various levels (not always well connected by raises on the vein) and to follow it along the strike with occasional interruptions due to faulting, through the workings of the Goldfield Consolidated by a devious and extended line of travel, to a connection on the vein with the Jumbo Extension mine. Absolute continuity has not been proved, and perhaps does not exist. Moreover, we travel for more than 1500 feet substantially on the strike of the vein, and pass out from the stretch of ground included within the extended Booth end lines, and yet our average course is downward; we arrive at stopes which are

*See next page.

within the Booth end lines extended, and we cannot doubt that we are on the same vein as that which outcrops on the Booth where we started. Throughout all this long belt of territory much time, money, and labor must be expended by the Booth in order to make its case positive, but it can probably be done.

Decisions in similar cases in Idaho which have repeatedly allowed extra-lateral rights more on the strike than on the dip, and have been affirmed by the higher courts, do not offer you much encouragement for contesting on that ground; and the uncertainly both as to the extent of the vertical displacement of the vein where it is seen to be faulted and as to the vein which the courts would take even if such faults were proved to be of considerable magnitude does not justify you in resting heavily on that hypothesis.

From the map it will be seen that an indefinite number of locations could have been made on the outcrop of the main vein in such a way as to include orebodies beneath the surface of the Jumbo Extension claims. As a matter of fact, such locations were made in the Mohawk No. 2 and Combination No. 1 claims, as well as in the Booth; and slight change in the direction of the east lines of the Florence, Combination Fraction, Red Top and other locations on the outcrop might have pointed them all, like the leaves of a fan, to one common centre or axis. In such cases it is held by the courts that seniority governs the oldest location has unquestioned right of way through all the others. Here the Booth has the advantage, for it was located on May 10, 1903, at least ten days before any other on the outcrop, and nearly four months before the Velvet (located Sept. 1, 1903) and more than five months before the Poloverda (located Oct. 17, 1903).



MAP OF THE CENTRAL PORTION OF THE GOLDFIELD DISTRICT.

DAKOTA SAND, on account of its uniform character and thickness over wide areas in North America, is not considered a prospect horizon of the first class for the finding of oil, except in some limited districts, according to L. G. Huntley in Bulletin 102 of the A. I. M. E. Where structural and other conditions are favorable for concentration of oil, the relatively more lenticular bodies of sand above the Dakota, particularly in the Benton and Niobrara, are more promising for the development of production than is the Dakota sand itself, save in several regions in Canada, where the most favorable areas are in the region underlain by the sand where it begins to play out and become lenticular.

Concentrates

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Petroleum is from the Latin, meaning rock-oil.

Pine-tar oil is the most efficient flotation medium for Bisbee copper and Cobalt silver ores.

Normal faults are those in which the country-rock has moved downward on the hanging-wall side.

In the use of leather belting, the soft flesh side should be run against the pulley, giving a more pliable grip.

Casings of starting-rheostats for motors in gassy mines must be explosion-proof, as well as the motors.

Simultaneous blasting is estimated to be 25% more effective in breaking rock than the firing of holes consecutively.

The efficiency of a rock-breaker decreases rapidly when a reduction exceeding 4 to 1 is attempted, and the same holds true for rolls.

The simplest form of ore-dryer is a series of cast-iron plates over a flue, so that they can be heated by the hot gases from the fire-place.

Platinum is not used in tungsten filament incandescent bulbs, but its decreased use for this purpose has been more than compensated for by its use in jewelry.

Stope engineering covers the work of efficiency in underground mining, and in making reports and suggestions from time to time for betterment in operation.

Heavier wire, as a general rule, is better in screens when treating coarse gritty ore, but in the crushing of soft clayey ore it is advisable to employ screens having fine wire.

Nitroglycerin is a powerful heart stimulant; that is why the fumes cause a severe and prolonged headache when inhaled. The same effect is produced by handling dynamite cartridges with bare hands in hot weather.

Removal of rust from iron products is frequently necessary. Experiments in England prove that all chemicals tried for this purpose failed, as none would remove the rust without also dissolving some of the iron.

The terms 'drilled in' and 'completed,' when applied to oil-wells, are synonymous, and refer to a well that has been drilled through all the oil-bearing layers of sand so as to demonstrate that it is either a producer or a dry hole.

The cost of excavating earth with pick and shovel, and loading it, is about 40 cents per cubic yard for hard-pan; 20c. for tough clay; 15c. for ordinary clay, gravel, or loam; and 12c. per yard for light sandy soil—wages being reckoned at 15c. per hour in each case.

Water-pipes in cold regions should be laid in deep trenches to prevent freezing. In Nye county, Nevada, the Round Mountain company has just completed 45,336 ft. of 30 to 15-in. rivetted and lap-welded pipe for its gravel area. This was laid in a trench 42 inches deep.

Shovelers in the zinc mines of Missouri are paid by the number of cans filled. A can holds 1000 lb. The shoveler is paid about 10c. per can. At present some men are making $60 per week. One last week received $75. He must have handled about 375 tons of ore to 'can' this amount.

Geology was only taught in this country in 1830 at Yale, where Benjamin Silliman was professor, and at Columbia, South Carolina, where Lardner Vanuxem was appointed in 1821. The only textbooks available were reprints of Bakewell's geologies, annotated by Silliman, which appeared in 1829.

When employees wear proper clothing they feel comfortable and can work at their best. Many workmen readily recognize the common sense of thus adding to their efficiency while protecting themselves from injury. Others, however, will need to have these advantages pointed out to them in a friendly way; in some cases the foreman must use more forcible measures.

Asbestos is a potential life-saver. We do not realize, perhaps, that the fire-proof theatre curtain is made of asbestos, which is rock matter, but nevertheless almost as soft and pliable as cotton or woolen fabric. Asbestos has, of course, many other uses. Its incombustibility and its fibrous structure make it one of the most useful minerals for many and various structural purposes. It is used in making lumber, roofing, plaster, and stucco. Houses that are built largely of asbestos afford their occupants not only complete protection from fire because it is a non-conductor, but assure them also the comfort of freedom from extreme heat and cold. The asbestos-producing industry of the United States is growing. Some good mineral was discovered in Arizona last year.

Sub-level system of mining is only applicable in sections of a mine in which the orebody covers a considerable area, and has a height exceeding 100 ft. The development of the stope-laterals is necessarily expensive; the timbering is costly; and considerable expense is incurred in equipping and maintaining the drifts for motor-haulage. Unless the orebody is of sufficient area and height to repay the cost of the initial large expenditure, the sub-level system should be abandoned in favor of the hand-tramming system. The great advantage of the motor-haulage system is that it is capable of producing a comparatively large tonnage, not only in the operation of putting up the active stopes in the section, but more especially when reserve-drawing operations are started.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

WEAVERVILLE, CALIFORNIA

Dredging and Prospecting Gravel.—Golden Jubilee.—Asbestos Mining.—East Fork District.—Other Mines.

The Marysville Dredging Co. is testing the Valdor placer claims, below Junction City, with two Keystone drills. Several parts of the channel have given encouraging results. If the main deposit is worth it a dredge will be constructed before next winter. A. M. Elliott is in charge of the work.

The Trinity Dredging Co., operating the largest dredge north of Oroville, is digging good gravel near Lewiston. It is reported that new ground yields a higher average. H. E. Chesebro is manager.

Ten men are working in the Golden Jubilee quartz mine, at

CARRYING TIMBER TO THE GLOBE MINE, TRINITY COUNTY, CALIFORNIA.

Coffee. Ore is being extracted preparatory to a mill run. This mine was formerly a good producer. It is equipped with a good plant.

The Trinity Asbestos Co. is shipping material to its mines near the old centre of Cinnabar. It expects to start the sawmill soon. A large plant is contemplated. The company expects to start shipment of asbestos to San Francisco before the end of October. Seventy-five men are building a wagon-road from the mines to Castells, on the Southern Pacific railroad. It is officially stated that a large reserve of high-quality asbestos is blocked out. The company is largely composed of Oakland people. H. A. Mecum is manager.

The East Fork district, tributary to Helena, is attracting more interest with the arrival of warm weather. The Enterprise continues to produce well, and the 10-stamp mill is running on ore of excellent grade. The vein is about eight feet wide. Arrangements are being made to open promising ground below the main workings. Water-power facilities have been improved. R. A. Skinner is manager.

Developments are proceeding at the Bonanza, Oversight, Yellow Jacket, Hoodoo, and other properties. Most of the new work is designed to intersect at fair depth rich shoots exposed near the surface. Large quantities of mill ore are developed at several mines. A custom mill is being urged by operators.

The Marysville Dredging Co. has started another Keystone drill at work prospecting the ground of the Valor Gold Mining Co. below Junction City.

CRIPPLE CREEK, COLORADO

District Quiet but Sound.—Dump Mining.—Sharpe, Ajax, and School Lessees.—Milling.—Dividend.—Split-Check Leasing.

During the past 10 days the Cripple Creek district has been quiet. Nothing new has occurred in the way of mergers and the regular producers have been operating without making any new discoveries. The warm weather has brought out a great number of surface and dump lessees, so that the tonnage is undoubtedly increasing, though the average value of the ore shipped will be lower for June than it was in May.

The old Gold Coin dump, the site of the old Economic mill, has been fitted up with a loading device and 100 tons per day is being shipped to the Copeland sampler. This material is averaging about $5 per ton, so that unless the indirect advantage of keeping the sampler busy is calculated, it is hardly profitable at the minimum freight and treatment charge of $4 per ton.

The Sharpe lease on the Elkton mine dumps is doing well, the sorted ore averaging nearly $20 per ton. This is probably the best dump lease here.

Lessees on the School Section No. 8, at Cameron, are shipping steadily from the 400 and 500-ft. levels a good tonnage of medium-grade ore. This property has been a consistent producer for the past five years. Judging from present conditions it will continue to do so for some time to come.

On June 10 the Golden Cycle Reduction & Mining Co. paid its regular dividend of $30,000 from May earnings. This is the promised 2% per month. It is hinted that from the present volume of business this earning may be increased in the near future.

Lessees on the 1200-ft. level of the Ajax mine have cut a body of ore two feet wide, assaying $60 per ton. This is greatly encouraging to the management, as the property was recently opened to lessees after the company had ceased work. A number of lessees are now at work in various parts of the mine and good earnings are expected.

Lessees on the Blue Bird are doing well, a good production is being maintained. Here an interesting variation of the 'split-check' system is being tried out. The mine is leased from the owners at a flat royalty of 20%. The lessees then sub-lease on the split-check basis. On the net returns, then, to any certain sub-lessee, 20% is first deducted for the owners, then the balance of the check is divided equally between the lessees and the sub-lessee. The lessee furnishes all supplies, while the sub furnishes labor only. It is fairly obvious that a good grade of ore must be produced to stand such a charge.

LEADVILLE, COLORADO

Dredging Near Leadville.—Possibilities of Prospect Mountain, the Valley Adit.

It is officially stated that the Derry Ranch Gold Dredging Co. was incorporated here a few weeks ago to operate the first dredge in Lake county and in the Leadville district. The company is composed of A. C. Ludlum of New York, R. F. Lafferty, general manager, O. M. Lafferty, John Nisbet, and Frank E. Purple. The capital is $100,000. The property includes the old Derry ranch, south of Leadville. A dredge has been under construction for some time, and is now nearly complete. The

boat is patterned after those in California. The hull is 107 ft. long and 42 ft. wide. The buckets are of 5½-cu. ft. capacity, 22 dumping per minute. Great interest is being taken in the results of this dredge. The ground has been well tested, and those interested consider the area in the Arkansas and Lake Creek valleys will prove to be the richest in Colorado. Dredging is expected to commence at the end of August.

The Valley adit that is being driven into the foot of Prospect mountain by Warren F. Page is an important work for the district. The course of the adit is toward an immense and unprospected area lying immediately north of Big Evans gulch, comprising a territory about six miles square in what appears to be the richest mineralized portion of the camp. The portal of the adit is on the famous Valley claim which has produced a good deal of money within the past few years, and continues to add materially to the output of the district. The ground immediately south of the adit includes such mines as Silver Spoon, New Monarch, and Cleveland. Mr. Page who is one of the best known mining men of the Leadville district has been active in the Big Evans region for many years, and recently had charge of the operations on the Valley and Silver Spoon. From these mines he had diamond-drill holes driven into the formations to the north, which lie under Prospect mountain and the upper reaches of Canterbury hill. In these holes ore was cut in several places. He immediately started driving the Valley adit along the course of the drill-holes. The adit is now in 1150 ft., in the porphyry and mineralized formations of the district.

Ore is expected almost any day now. Work in the adit is being done in a modern and efficient manner. Electric power will be installed and all of the transporting of material will be done with locomotives. Mr. Page is especially careful about timbering, stating that he wants every stick of timber that is erected to be in good condition 10 years hence. If this work discovers important orebodies, the effect on the mining situation in the Leadville district will be considerable. Something new is wanted. Prospect mountain is full of possibilities. It lies in a direct line with the ore-shoots mined on Fryer hill, Evans gulch, and on Jonny hill. What veins are found will of course be deeper.

AUSTIN, TEXAS

NON-METALLIC MINERALS, GRAPHITE, SOAPSTONE, IRON OXIDE.—STATE MINERAL PRODUCTION.

Development of the mineral deposits that are known to exist in the Llano region, north of Austin, is being urged by William B. Phillips, director of the Bureau of Economic Geology and Technology of the University of Texas. He directs particular attention to the possible commercial importance of the graphite deposits. These deposits occur along the line of the Austin & Northwestern railway from Austin to Llano, between Kingsland and Llano. Good graphite also occurs in Burnet county a few miles west of the town of Burnet. At neither locality has anything been done, although some of the material is flake graphite, a variety that always commands a ready and profitable market. Another mineral in Llano county is soapstone. This is suitable for stationary wash-tubs, laboratory and chemical desk-tops, stones for fireless cookers, etc. One of these deposits is north of the town of Llano and east of Valley Springs. The other is east of Llano about seven miles and near the Llano river. Some of these stones have been under examination. They saw easily, have close and dense structures, and a crushing strength of 3000 lb. per square inch, with a weight of 169 lb. per cubic foot. They are practically fireproof.

Beautiful purplish red oxide of iron occurs in Mason county. This makes good paint. It grinds to an impalpable powder, has a soft and greasy feel, takes oil well, and has a fine appearance.

The total value of the mineral products of Texas from 1882 to the end of 1914 is nearly $300,000,000. Of this, petroleum accounts for about 36%, clay products 16%, and stone 4%. No other mineral amounts to 4%.

MIAMI, ARIZONA

INSPIRATION NEW MILL.—MIAMI ALTERATIONS.—OLD DOMINION MINES, MILL, AND SMELTER.—IRON CAP AND COLE.—FERRY ON SALT RIVER.

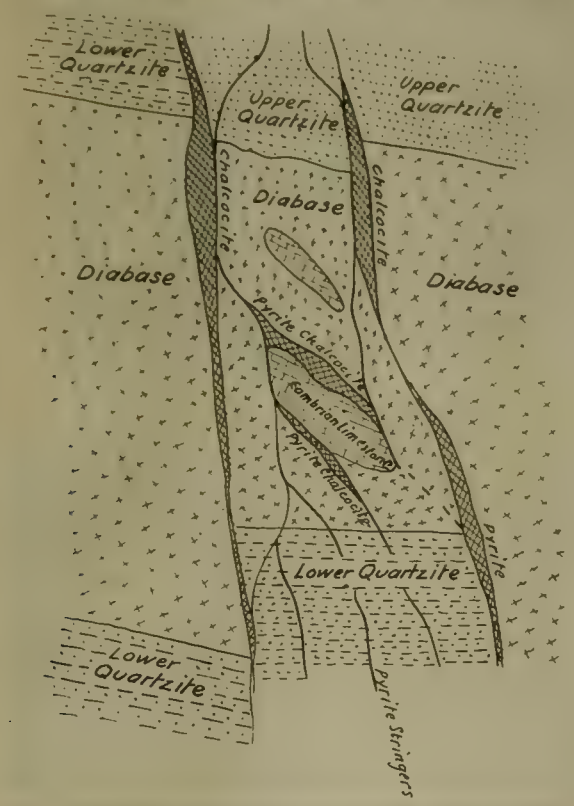
Probably before the end of June three of the eighteen units of the Inspiration concentrating plant should be treating about 850 tons each per day. The other units will be started as they are finished. It is reasonable to assume that the operation of the first units will have a decided influence on parts of the treatment scheme and equipment in the units to be put into commission later, so it is likely that there will not be the same rush in starting the last ones that has characterized those nearly ready. The 600-ton test mill that has been in steady operation for the past 17 months has admirably fulfilled the purpose of its erection and operation, namely, determination of the most economical flow-sheet it was possible to install in the main concentrating plant. Yet this can be made with greater accuracy by operation of one of the units of the mill proper.

A parallel case can be noted in late reports as to the part remodeling of certain units of the Miami Copper Co.'s mill. In No. 6, as a result of modifications of the flow-sheet, it has been found that a better recovery of copper can be made than is possible in any other units, with all working on the same class of ore; consequently the others are to be made to conform to the flow-sheet of No. 6. Considering the high recovery anticipated at the Inspiration mill, the flow-sheet may be regarded as extremely simple compared with those of the porphyry copper mills that have been erected in recent years. Apparently oil flotation and improved grinding methods have been the potent factors in developing this simplicity.

The Old Dominion company had two furnaces in blast up to June 10. A third was then started. Copper production of the plant has been averaging over 40 tons per day. Most of the smelting ore has been from the Old Dominion and United Globe mines. This is hoisted through the A shaft. There is an ever-increasing tonnage from custom ores and from lessees. The basic converter-shell, if it remains in blast for the remainder of the month, will have completed a campaign of two years without having been off the stand. In the concentrating plant over 600 tons of ore per day has been treated through June. Most of this is from the A shaft. There is also some concentrating ore being received from the Arizona Commercial. During the present week a new type of shaking-screen will be installed below the trommels at the head of the mills. In the near future extra compartments will be added to the Woodbury jigs. Recent changes made in the flotation machine have allowed of a considerably larger tonnage being treated. In the mine department the tonnage hoisted this month has averaged between 900 and 1000 tons per day. The flow of water in No. 12 level has decreased to about 6,500,000 gal. per day. This decrease has enabled the shutting down of the Prescott pump on the No. 10 level, so that all of the water is now being handled on No. 12. Considerable increased exploration work has been started since the first of June. The 10th level east is being driven to connect with the Gray shaft. The 14th east foot-wall drift is also being advanced east as rapidly as possible to explore new country. The haulage shaft off the Buffalo cross-cut has been connected from the 12th level of the Old Dominion to the 7th level of the Gray, thereby greatly improving ventilation and expediting the handling of ore and waste in that territory. The work on the pocket below No. 16 level is progressing well, the steel pocket is now being put in. It is expected to have this work completed and ready for use early in July. All waste is now being hoisted in skips and the new installation is working satisfactorily. A

small churn drill is putting down a hole from No. 16 to No. 18 level for ventilation. It is expected to commence unwatering the 18th level at the A shaft within the next two weeks. As soon as the electric pumps are working again the extraction drift going west on No. 18, which is already over 400 ft. from the shaft, will be started. A drift will also be started toward the centre orebody. A sump below the shaft on No. 18 level still remains to be cut. The Buffalo mine is maintaining its normal output. Advantage is being taken of higher copper prices to sort over and ship any ore still remaining in the old surface dumps. On the surface the water-well west of Pinal creek is nearing completion, and an air-lift will be installed in the near future to test the capacity of the hole. The necessary air-line has already been laid to it. A new slime-pond, for settling slime from the mill, is nearing completion west of Pinal creek, below the Miami road.

The Iron Cap is shipping 200 tons of 10% ore per week to



IDEAL CROSS-SECTION THROUGH THE OLD DOMINION IN THE LOWER LEVELS OF THE CENTRAL PART OF THE MINE.

the smelter at El Paso. On June 14, shipments of high-grade ore to that place was begun with a carload that averaged 25% copper, 25 oz. silver, and a small amount of gold. The mine's force numbers about the same, but development work now beginning will probably result in employment of more miners in the near future. A winze is being started down from No. 8 level for the purpose of prospecting that level. If the winze remains in ore the shaft will be sunk to that level and the property opened thoroughly at the latter depth. Between the winze and the end-line (identical with the west end-line of the Arizona Commercial) the ground opened has an excellent appearance. In one place the high-grade ore averages six feet in width. The stope on the 8th level looks good.

At the Cole Development a few men are employed at present, their work being devoted wholly to extracting shipping ore. Work is being done on No. 1 and 4 levels. Fine chalcopyrite ore is being taken from the lower level.

Supplies for a cable-ferry that he will install across the Salt river to Camp Sunset, at the mouth of Buckhorn canyon, about 4½ miles below the Roosevelt dam, have been secured in Miami by Mr. Baker. The ferry will consist of a flat-bottom boat, 20 ft. long and pointed at both ends. As its work increases, a scow-ferry will be used that will carry a team and wagon across the river. A 900-ft. cable will be used. It will be arranged in such a manner that the current will carry the boat and its burden across in either direction. Excavation and leveling for the new campsite has been completed. A site for a blacksmith shop has also been provided for. Sufficient room for a small planing-mill also has been arranged. Work at Camp Sunset to date has been mostly of a preparatory nature, but after the ferry has been completed regular development of the gold and copper claims owned by Baker and Ferryman will be advanced steadily. The gold prospects owned by them in Buckhorn canyon have encouraging surface showing. They have been worked over an extensive area in a superficial manner by early miners. Some of the free gold brought in from the district resulted in many locations of claims there by Globe and Miami people.

TORONTO, ONTARIO

PROSPECTING AND DEVELOPMENT CURTAILED BY FINANCIAL DEPRESSION.—HOLLINGER, MCINTYRE, AND PORCUPINE IMPERIAL.

The effect of the War and financial depression on the mining industry has been very noticeable in connection with the recording of claims in the mining areas in the West, under the jurisdiction of the Department of Mines at Ottawa. Prospecting has fallen off greatly. Last year it was active. Experienced prospectors had no difficulty in getting grubstaked. During the year ended May last 12,000 oil claims, and over 2000 mineral claims were filed with the Department. These were all for discoveries made before the War, and there is now a marked decrease. Another indication of how the industry is being retarded for want of capital, is the large number of applications which are being received for an extension of time for the work on claims required to be done during the first year. Important discoveries of oil have been made around Great Slave lake, but for want of capital the claims remain undeveloped.

The earnings of the Hollinger for the four weeks ended May 20 show a considerable falling off from the average, due to the shortage of power in April, which retarded development at that time. Since then, the endeavor to keep up development has resulted in the extraction of considerable quantities of low-grade ore, reducing the average value of the ore treated. Gross profits for the period were $139,187, from the treatment of 23,821 tons that averaged $9.56 per ton. Working costs were $3.54 per ton. In addition to this tonnage the Hollinger mill treated 10,291 tons for the Acme.

Directors of the McIntyre recently visited the mine. They returned well satisfied with its prospects. At the 600-ft. level from No. 4 shaft, the orebody is 26 ft. wide. It is reported to average $10 per ton. On the north side of the property No. 5 shaft is down 400 ft. The vein, which has been opened up for 150 ft., is 30 ft. wide in some places. The diamond-drill has proved the vein to a further depth of 100 ft. The shaft is being sunk deeper. Production during May was approximately $59,000.——At the Porcupine Imperial the vein on the 100-ft. level has been opened for 25 ft. from the old workings. It shows an average width of 5 ft., assaying about $13 gold per ton. The orebody will be prospected at depth by diamond-drilling. Thomas Sloan, formerly of Nevada, is mine manager. ——The vein of the Porcupine Crown has been found beyond the second fault on the 200 and 300-ft. levels. Driving is under way in high-grade ore. The vein has also been cut on the 500-ft. level.——The Chambers-Ferland has made connection with the northern workings of the Nipissing at 350 ft. This will give ventilation to the drifts of both companies.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press.

ALASKA

Though it is the purpose of the U. S. Geological Survey to extend its investigations to all parts of Alaska, it sometimes happens that it is impossible to do geologic work in advance of actual mineral discoveries by the prospector. The Survey, however, attempts to follow up the reported new discoveries of valuable minerals by surveys and investigations as soon as means permit. A report on work inspired by the discovery of gold in the Innoko district in 1906 has been issued as Bulletin 578, entitled 'The Iditarod-Ruby Region, Alaska,' by Henry M. Eakin. The investigation seems to have developed the fact that geologic conditions favorable to the occurrence of auriferous deposits are repeated in many places in this part of Alaska. This augurs well for the future of the mining industry in this region, notwithstanding that the workable gold placers so far developed are limited to comparatively few small areas.

Chisana

There are about 250 men at Chisana. New deposits of gravel have been found to encourage them, especially the deep ground on Dry creek. It is said that Dawson will get the Chisana business this season, as freight can be hauled cheaper than from Cordova.

Juneau

On June 11 the 2500-ft. adit for the Alaska Gold Belt company, in the upper Sheep Creek basin, was started. Thirty-five men will be needed. Arthur Riendeau is in charge. The general manager, A. B. Dodd, will have from 40 to 50 men at work prospecting and constructing.

On June 15 a large cave-in occurred at the Alaska Treadwell mine. The bottom of the old 750-ft. level dropped to the level below. Waste that had been dumped into the old open-cut for 10 years went through into the old workings. Over 100,000 tons of ground fell, resulting in a decided shock to the district. Not much damage was done. Pumps at 750 ft. were put out of commission.

Seward

The geology and mineral resources of Kenai peninsula have been investigated by expeditions of the U. S. Geological Survey since 1898, and results have been made public in several reports. All this information has now been co-ordinated and summarized in a new publication entitled 'Geology and Mineral Resources of Kenai Peninsula, Alaska,' by George C. Martin, B. L. Johnson, and U. S. Grant, issued as Bulletin 587. Kenai peninsula contains auriferous lode-bearing areas of some promise, though deep mining has so far been done on only a small scale. Auriferous gravels are widely distributed in the northeastern part of the peninsula and have been mined in a small way for 20 years. The future of placer mining on the peninsula depends on the exploitation of many large bodies of gravel containing too little gold to permit development by the simple methods thus far chiefly used. On the Cook inlet side of the peninsula there are very large deposits of lignitic coal which, though now almost entirely unused, are a possible source of power, and hydro-electric developments are also possible at several places on the peninsula. Seward, the principal town on the peninsula, has been chosen for the coastal terminal of the Federal Government railroad which is to be built to Fairbanks.

Valdez

The valley from Keystone canyon to the head of Lowe river has been staked by prospectors. A Keystone drill is to be used. Good prospects are expected.

ARIZONA

Cochise County

The Copper Queen company is to concrete the Sacramento central hoisting shaft from the 1700-ft. level to the surface. Hoisting will not be interfered with. The compressed-air system of laying the concrete will be used. Work will be aided by skips and cages, no platforms being necessary. George Meyers, master mechanic, will be in charge. At the Uncle Sam shaft the new steel head-frame is complete. An engine-house is under construction.

Mohave County

Dividends paid by the Tom Reed company in the year ended March 31, 1915, totaled $554,828, or 61c. per share. Since September 1910, the company has paid 57 dividends, totaling $2,401,311, or $2.61 per share issued. This sum represents approximately 4½c. per share per month for a period of nearly five years.

The Orion Mining & Milling Co. has acquired the Victor-Virgin property. Over 3500 ft. of work has been done. The main shaft 550 ft. deep, is to be unwatered. Several other deep shafts have been sunk.

CALIFORNIA

Nevada County

The new steel head-frame at the Central shaft of the North Star mine is being erected. It will be 100 ft. high. Foundations for the hoist are being prepared. It will haul 4-ton skips. Steel bins and a sorting plant are included in the new structures.——Work is to be resumed at the Columbia mine where three men were killed two weeks ago.——Vigorous development of the Cassidy continues. The veins in this property are parallel with those in the Empire and Pennsylvania.

Placer County

Development at the Mayflower near Forest Hill is encouraging.——The Rossi, in the Iowa Hill district, is being examined for sale.——Canada Hill claims are being investigated by Grass Valley people.——The old Black Oak near Weimar is being re-opened.——Placer miners continue washing on the American and Bear rivers.——Some rich gravel has been opened by the Federal Drift Mining Co., operating near Dutch Flat.

Plumas County

A nugget worth nearly $600 was unearthed by B. Turney on Squirrel creek last week. The same claim yielded good nuggets last year.

Shasta County

On June 19 the Noble Electric Steel Co. shipped 60 tons of ferro-manganese from its smelter at Heroult. Seventy-five men are employed.——It is reported that the Bully Hill company will soon be ready to produce a fair quantity of zinc.

Tuolumne County

(Special Correspondence.)—Development of the Knox and Boyle, Miller and Holmes, and Gray Eagle and Nyman claims of the Nyman Consolidated Mines Co. is very encouraging. The Knox and Boyle vein was recently leased for development. Ore from the 300 and 400-ft. levels has been mined and milled. As a result of the first mill-run in May $8.52 per ton was recovered by amalgamation. Work extended to the 600-ft. level has opened a vein showing good ore across the full face of the drift. A stope has been started south of the

shaft where the work is being done on two shifts, and ore is sent to the mill. The unwatering of the main three-compartment shaft was begun last week. The Nyman or west vein will be developed from the 600-ft. level, thereby opening two additional orebodies. C. E. Shafer is in charge.

Jamestown, June 18.

YUBA COUNTY

The Yuba Construction Co. at Marysville has secured a contract from the Yuba Consolidated Gold Fields Co. to construct a dredge. It will be larger than No. 14 now operating on the Yuba river.

BUCKET-LINE OF YUBA NO. 14 DREDGE.

COLORADO

CLEAR CREEK COUNTY

A large number of miners and lessees are busy at the Capital mine. Bruce & Co. has 18 in. of galena, 13 tons from which netted $100 per ton. DeMasters & Co. had 150 tons treated at the Capital mill. Hummer & Son continues to ship $25 ore to the Salida smelter. Connection between the Kane adit and Capital adit is an event in which all are interested. It will improve ventilation and open new ground.

The Terrible-Dunderberg Mining & Power Co. has outlined a big development scheme for the season at Silver Plume. The mill is being overhauled for 100-ton capacity.

The mill at the Mineral Chief on Democrat mountain is nearly ready to start.

DOLORES COUNTY

In May the Rico Wellington company shipped 42 cars of ore. The profit was about $5000. The Rico Consolidated marketed 14 cars.

GUNNISON COUNTY

There is considerable mining activity in this county.——At Ohio City the Carter Mining Co. is employing 55 men. Some leases have been let, and good ore is being extracted.——The Anaconda company, near Spencer, is shipping regularly.——Arrangements are under way to resume work at the Vulcan and Good Hope at Vulcan.——The shoot in the Carbonate King above Ohio City is producing 40% zinc ore.——A large body of zinc carbonate has been opened in the Doctor mine, 20 miles north of Gunnison.

LAKE COUNTY (LEADVILLE)

On June 13 pumps in the Penrose shaft were down 380 ft. They are lowering the water 5 ft. per day of 24 hours. The flow is about 2500 gal. each per minute. Everything is working well.

Owing to the pipe from the furnaces of the Western Zinc Oxide Co. to the bag house becoming nearly choked with oxide, the plant has been closed for a clean-up. Twelve tons of oxide was saved.

Lessees at the Ponsardin are endeavoring to find a market for the ore from their new shoot. Samples were sent to several smelting interests.

SAN JUAN COUNTY

The Silverton district shows the following activities: at a meeting of county mining men it was decided to organize a cyaniding company with a capital of $50,000. Of this, $10,000 would be raised to purchase machinery to be installed in one of the plants in the district. For a start the capacity would be 40 tons per day.——Lessees at the Silver Lake are ready for a busy summer. The mill has been started.——At the Bagley, above Animas Forks, lessees have a good deal of ore ready for the mill.——The Peerless San Juan company's property was examined last week by G. T. Milliken.——Work is encouraging at the Queen City, Bandora, Golden Fleece, and Pride of the West.

IDAHO

SHOSHONE COUNTY (COEUR D'ALENE)

Lead, zinc, and copper mines around Mullan are in good condition. Included are the Morning, Hunter, Snowstorm, National, Reindeer-Queen, and Carbonate Hill, all properties with excellent futures.——The Hercules-A. S. & R. smelter contract dispute is still unsettled, and the mine and mill remains closed.——Lead and zinc ores are being mined in the Terrible-Edith near Murray.——The Frisco is shipping a carload of zinc concentrate daily.——Good progress is made with the H. E. M. mill building near Wallace.——After paying its June dividend the Success company had $61,492 cash on hand. The main shaft is down to 1200 ft.——In the Pandora-Snowstorm dispute, the former company was allowed to inspect the latter's mine without an order from the district court, as was asked. The 600-ft. level of the Snowstorm was found to be 180 ft. into Pandora, with north and south cross-cuts 50 ft. each way.

MICHIGAN

HOUGHTON COUNTY (THE COPPER COUNTRY)

On June 12 the Calumet & Hecla distributed its promised bonus to employees of $500,000. Over 8000 people were recipients. It was also pay-day, and about $1,000,000 was circulated.

Isle Royale is shipping 2500 tons of ore per day to one head of its own mill, and at the Tamarack, Franklin, and Allouez-Centennial plants.

At the Osceola the power-plant at No. 3 North Kearsarge shaft has been re-constructed. The shaft is being repaired.

The Hancock mine is producing 300 tons of ore per day. Shipments to the Franklin mill have been doubled since the beginning of June.——Another large lot of mineral (60% copper) has been sent from the White Pine mill to the C. & H. smelter at Hubbell.

MISSOURI

JASPER COUNTY

The record output of ore from the Missouri-Kansas-Oklahoma district was during the week ended June 12. The total was

$1,048,349. A year ago this week's yield was worth $259,703. Average per week for 16 years is $238,863. As high as $135 was paid for zinc concentrate assaying 60% metal, $82 for calamine, and $75 for lead. The output was as follows:

District.	Blende, pounds.	Calamine, pounds.	Lead, pounds.	Total value.
Webb City-Carterville	6,557,350	63,090	838,260	$442,318
Miami	2,697,280	.....	721,330	153,260
Joplin	1,894,090	65,000	181,800	122,680
Duenweg	1,098,760	52,280	.....	70,757
Galena	1,156,700	.....	11,510	66,830
Granby	1,248,220	295,690	.....	59,900
Alba-Neck City-Purcell	626,830	.....	.....	37,320
Oronogo	649,820	.....	.....	31,812
Lawton	523,910	.....	.....	24,246
Belville-Klondike	356,870	.....	.....	19,580
Aurora	.....	249,100	.....	7,440
Spring City-Spurgeon-Saginaw	13,720	125,000	.....	5,310
Cave Springs	65,460	.....	.....	3,520
Wentworth	56,840	.....	.....	2,800
Peoria	.....	.....	16,900	576
Totals	16,945,850	850,160	1,769,800	$1,048,349

For the first 24 weeks of 1915 the total value is $10,086,668.

On June 10 the Longacre-Chapman mine at Neck City was flooded with water and mud. Seven men were working. One escaped the rush. A large number of miners worked to rescue the others. Four of them spent 120 hours in a small drift nearly full of water. They were saved. The other two were in the mine up to last reports.

Last week three miners were killed and two injured in the Little Martha company's mine at Joplin. Above the 160-ft. level a huge slab of lime and flint fell, with the above result. Eleven others had narrow escapes.

Owing to the tremendous activity in new and old mines in the district, underground work is likely to become more carlessly done in the effort to extract zinc ore for the high market. The mine inspectors will therefore be busy for some time keeping workings up to the mark.

MONTANA

Silverbow County

The Western Federation of Miners is entitled to control the property of the Butte Miners' Union No. 1, but is restrained from disposing of any of the property, money, or records belonging to the union, according to a decision of district Judge J. B. McClernan made at Butte on June 12. The decision defeats the attempt of local union officials to oust the officials of the Federation from any participation in the affairs of the Butte organization.

While the Poulin shaft of the Anaconda company is being sunk and development done, hoisting of ore will be suspended. This shaft is 1500 ft. deep, and has supplied 250 tons per day.

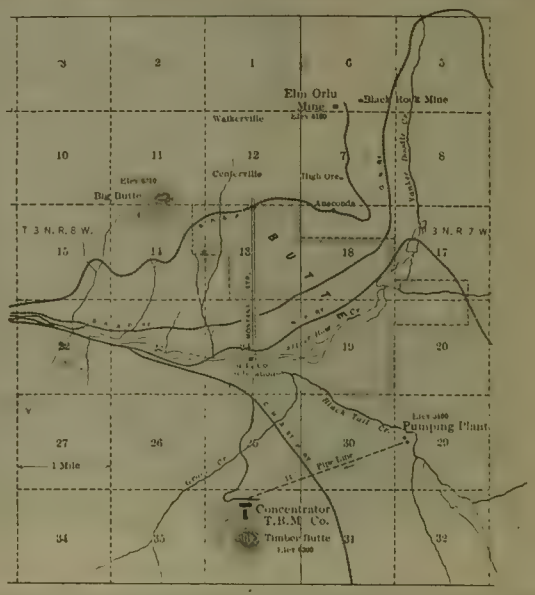
In its statement to the County Assessor for the year ended June 1, 1915, of the Anaconda Copper Mining Co. the following is included: ore extracted, 3,311,488 tons; gross value, $8.941 per ton; operating costs, $6.137; net profit, $6,468,439. Out of the total revenue of $29,608,185, employees received $11,779,233.

The North Butte companies statement shows that 262,815 tons of $9.828 ore gave a profit of $333,740.

It is planned to start work again at the Tuolumne. Butte people, headed by the mayor of the city, have acquired the Bonanza claims in the Walkerville district. Some good ore was opened in the property a few weeks ago. The shaft will be sunk 200 ft. deeper.——The Lexington mine is to be re-opened. ——Lessees in the district are busy.

The concentrating plant at the Timber Butte Milling Co., is described in Bulletin 102 of the A. I. M. E. by Theodore Simons of Butte. The mill was erected to treat ore mined at the Elm Orlu mine of the Elm Orlu Mining Co. This ore contains zinc and lead in sphalerite and galena; copper in bornite, chalcocite, tennantite, and tetrahedrite; and gold and silver either free or chemically combined with the sulphides of the base metals. The gangue is chiefly quartz, barite, fluorite, rhodonite, and rhodochrosite. The iron in the ore occurs as iron pyrites.

The Elm Orlu mine is situated near the northern border of what is locally known as the Butte sulphide-copper belt, about one mile north of the Anaconda mine, and adjoining the Black Rock zinc mine of the Butte & Superior company on the southwest. The mill is on the northern slope of Timber Butte, a



MAP OF BUTTE AND SURROUNDING AREA, SHOWING PLANT OF TIMBER BUTTE MILLING CO. AND ORE AND WATER-SUPPLY.

prominent topographical landmark in the Butte district. This site permits to a large extent the gravity system of ore flow; it presents a convenient and extensive area for a tailing-pond; and it is comparatively near to the source of water-supply and to existing railroads.

The mill is 4.5 miles from the mine in an air-line, or 13 miles by rail. The ore is loaded on railroad-cars at the mine, taken over the B., A. & R. Ry. high line to Rocker, and thence by the Chicago, Milwaukee & St. Paul railroad to the Timber Butte exchange, a siding on the Milwaukee line where it crosses Montana street, a distance of 11 miles. From this siding the cars are hauled, two at a time, to the mill by an electric 400-hp. Baldwin locomotive, a distance of two miles. The concentrate is taken from the mill to the sidings of the Milwaukee or the Northern Pacific line where the respective railroad companies receive it for transportation to the smelters. A description of the mill covers 20 pages, and is of great interest.

NEVADA

The report of the Nevada-California Power Co. for 1914 has been published. Power is generated at Bishop, California, and transmitted to Goldfield, Tonopah, and other Nevada districts. The revenue was $960,431; operating expenses, $515,897; surplus after adding other income and deducting interest, $319,964; dividends, $200,000; surplus at end of 1914, $1,504,784; and surplus at end of 1913, $1,451,263.

Churchill County

At Job's Peak, 35 miles from Fallon, Cirac Bros. have discovered ore. The ground is encouraging. A number of claims have been staked.

Esmeralda County

(Special Correspondence.)—The Jumbo Extension mine is

shipping 100 tons per day to the local sampler of the Western Ore Purchasing Co. Thirty 50-ton cars had been shipped in June on the 21st, mine assays giving an average value of $58 per ton. Up to that time the controls were $5000 above the mine assay value of production for the month.

In the main stope of the Atlanta mine, at an approximate depth of 1620 ft., ore averaging $30 per ton is being broken across 15 ft., with an additional 15 ft. exposed that assays from $10 to $20 per ton. Shipments are made at the rate of 50 tons per day.

The Merger M. company is driving east at a depth of 1175 ft. in the northern part of the St. Ives claim, following the shale contact in quest of the southern projection of the Jumbo Extension ore-channel. Work is advancing rapidly at this point. Better assays are being obtained in the drift.

Goldfield, June 20.

At 300 ft. in the Black Butte at Goldfield, a cross-cut has entered the vein for 12 ft. in dacite formation. The ore assays $2 to $5 per ton. Faulting displaced the vein at 100 ft.

At the Pioneer Consolidated, 56 miles south of Goldfield, the outcrop of a good lode has been found 500 ft. from the main shaft. The mill will be ready in a week or so.

Humboldt County

The report of the Seven Troughs Coalition Mining Co. for the term ended June 15, 1915, has been issued. The income from gold was $362,540, other revenue made a total of $364,904. Mining cost $136,186, milling, $13,435, and all charges $199,749. Deducting administration and general expenses, etc., the net profit was $145,036. The surplus at the end of March, 1914, was $7554. Deducting dividend No. 2 of 2½%, or $36,076, and discount and brokerage $45,300, the surplus at April 30, 1915, was $71,629. The general manager, L. A. Freidman, states that the physical condition of the mine has never been excelled.

Lander County

Placer mining is yielding profitable results at Copper basin, Willow creek, and Copper canyon. A number of men are working, some getting rich returns. Up to June 1 the Rochester Mines Co.'s property has yielded 33,492 tons of ore valued at $826,944. This is from lessees and on company account.

Lyon County

In the suit of F. May *v.* the Nevada-Douglas Copper Co. for $40,000 for injuries received, the plaintiff was awarded $3000.

Nye County

Six mines and lessees (215 tons) at Tonopah last week produced 10,387 tons of ore valued at $212,926. Some May returns were as follows:

Mine.	Tons.	Ounces.	Profit.
Belmont	15,582	288,009	$92,587
Jim Butler	4,882	.....	48,793
Tonopah	12,300	216,300	62,175

The Jim Butler profits are a record for the mine. On June 21, Judge Averill heard a motion for a new trial in the Jim Butler-West End suit.——A new compressor has been installed at the Midway. Sinking has been resumed. Lessees (90 men) produced 130 tons last week.——Three sets of lessees are at the Montana. They shipped 190 tons last week.

The report of the Montana-Tonopah Mines Co. for the term September 1, 1913, to December 31, 1914, contains the following abstract from the superintendent's, A. H. Lowry, report: Work was continued at full time until November 15, 1914, when the mine and mill were closed, save for development. This was the result of the low price of silver and the grade of the ore mined. An agreement was made with the Midway company to enable work to be carried on in the old workings of the east part of the Midway ground. Development of the period totaled 11,793 ft., 1228 ft. being done in the Midway. The mill treated 63,755 tons of ore averaging $8.991 per ton. The revenue was $545,459 and net profit, $47,737, or 74.6c. per ton. Total costs were $7.784 per ton. Cash, silver advances, investments, and supplies were worth $338,431 at the end of 1914.

At Manhattan the organization meeting of the company to take over the Dexter White Caps Mining Co. has been held. At 270 ft. depth in the Little Grey claim the Nevada Mining & Development Co. lessees have opened the orebody for 100 ft. long and 30 ft. wide. The Manhattan Milling & Ore Co.'s 10-stamp mill is crushing the ore mined. New machinery for the Big Pine mill is arriving. When all is installed the daily output of ore will be increased to about 500 tons, of which 40% will be treated. The coarse material is screened and discarded, only the fine being tube-milled and amalgamated. The open-cut is 300 ft. long, 200 ft. deep, and 70 ft. wide. Recent developments have proved the ore-shoot to be 900 ft., averaging 40 ft. wide, and 200 ft. deep. The Big Four mine is to be re-opened. Kendall and Bragg of Goldfield have secured a lease on it. Prospects seem fair. The equipment includes a 10-stamp mill.

Storey County

At Gold Hill, on the Comstock lode, the Jacket-Crown Point Belcher Mines Co. has changed over its pumping plant from the Jacket incline to the joint incline in Belcher ground. This was well done, the water only rising a little. The pump is working smoothly at its new location and the water stands at about the 1500-ft. station. Considerable debris and muck remains to be removed at this point, after which the station will be timbered. When this is completed, the water will be lowered in the joint incline to a point below the 1600-ft. level, and the pumps recovered that have been submerged since the fire of last year. This work will make possible soon the starting of work again on the 1600-ft. of the Belcher, where an extensive body of quartz had been opened, and a large tonnage was being extracted daily.

White Pine County

According to the president of the Consolidated Copper Mines Co., C. H. Boynton, it is proposed to raise about $1,000,000 by sales of bonds, etc. Shipments of ore are being made to the Nevada Con. An experimental plant is to be installed in the old Giroux mill.

There were more accidents than usual at the Nevada Consolidated company's works in May. At Copper Flat were five disabling accidents in steam-shovel mining. Some were due to flying rock during blasting. Four men were injured at the mill, and ten at the smelter.

OREGON

Jackson County

(Special Correspondence.)—At Gold Hill the new Hardinge conical mill, with a capacity of 250 tons daily is working at the Braden mine. This is the only pebble-mill in southern Oregon. Its operation is creating considerable interest in the district. So far the machine has worked admirably. There is a large ore reserve in the Braden, and the new mill will be kept busy in the future. The old stamp-mill had a capacity of 150 tons. In addition to the new crushing-plant, much other machinery has been installed, including concentrators and cyanide plant.

Most of the Gold Hill placers have cleaned-up for the season. Though the run was short this year, the ground washed was unusually rich, giving as large a return as in former seasons. Among the larger hydraulic properties still in operation is the old Sterling, of Forest creek. This mine will have water till the middle of July. The Sterling has now been operated 50 years. The clean-up this season will be up to the usual value.

The French syndicate that owns the Bill Nye and adjoining claims is doing little development or other work this year, owing to the War.

The success of the Beaver Cement Co., operating the limestone quarries at Gold Hill, in the manufacture of lime and cement, together with the reports of the State Bureau of Mines on Jackson County limestones, has created an additional

interest in this industry. Practically all the cement used in the extensive hard-surface road building under way in southern Oregon comes from local manufacturers. This product had formerly to be shipped from distant points. The large quantity of limestone and marble in southern Oregon assures a big future for this industry.

Upper Applegate properties, in the vicinity of the Blue Ledge camp, are being given more attention this season than for the past five years. A number of claims that were abandoned two or three years ago, are again in the hands of original owners, and are being developed. Renewed activity in the Blue Ledge district, just over the line in California, has been largely responsible for this renewed interest. Most of these properties are low grade, the ores containing copper and gold.

Attention is again being given the cinnabar properties on the upper Rogue, near Trail. These veins contain commercial quantities of mercury. A difficulty has been a suitable method of reduction. The Butte Creek company was obliged to close on this account. Owners of upper Rogue cinnabar properties hope to solve the problem and ultimately operate the mines at a profit.

Gold Hill, June 20.

UTAH

The following dividends will be paid in July: on 1st, Daly-Judge (with extra) $75,000; Silver King Coalition, $187,000; Silver King Consolidated, $63,000; and Utah Copper, $1,648,000; and on the 26th, Utah Consolidated, $150,000. The total is $2,123,000.

Juab County

The Tintic district produced 142 cars of ore last week.

An electric hoist has been ordered for the Eagle & Blue Bell at Tintic. It is similar to that at the Daly West at Park City. The capacity is 50 tons per hour from 2500 ft. depth. Developments at 1750 ft. are excellent.

The May Day company has arranged another zinc contract. Zinc and lead-silver ore is being mined. The output in May was about $22,000, including lessees. The financial situation is satisfactory.

A cave about 30 ft. wide has been found in the Iron Blossom at 600 ft. It contains some lead and copper ores.

Piute County

For the $200,000 potash plant at Marysvale, Westinghouse, Church, and Kerr have secured a contract from the Mineral Products Co. Tenders have been received for a 7½-mile tramway from the mine to the mill. The F. C. Richmond Machinery Co. was given an order for three oil-driven air-compressors of 292-cu. ft. capacity each. They are made by the Chicago Pneumatic Tool Co.

Salt Lake County

With the flotation plant being installed, the Utah Apex company should increase its lead output from 30,000,000 to 40,000,000 lb. per year.——With the 50c. dividend to be paid on July 26 by the Utah Con., equal to $150,000, makes a total of $9,960,000.

The Cardiff mine is producing 100 tons of ore per day. Development continues highly satisfactory.——The Tar Baby adit is in 1716 ft. The advance is at the rate of 80 ft. per month through a quartzite formation. Copper stains are visible in the face. The quartzite-limestone contact is expected at any time.

Summit County

On July 1 the Daly-Judge will pay an extra dividend of $20,000. With the regular quarterly the total distributed will be $75,000. From 300 to 1400 ft. stoping is being done on the Daly vein. The mill is working two shifts. As high as $150 per ton was paid for the best zinc concentrate made.

Ore assaying up to 229.6 oz. silver, 56.4% lead, and $1.20 gold has been opened in the Revelator mine, in the Snake Creek district, south of Park City. The shoot occurs at a quartzite-limestone contact.

WASHINGTON

Spokane County

Dividends paid by companies operating in what is called the Inland Empire region of British Columbia, Idaho, and Washington, totaled $3,905,584 for the first half of 1915. They are as follows: Idaho—Bunker Hill & Sullivan, $490,000, Caledonia, $312,600, Federal, $240,000, Hecla, $90,000, Hercules, $1,000,000, Interstate-Callahan, $690,000, Stewart, $371,508, and Success, $105,000, a total of $3,299,608. British Columbia—Canadian Consolidated $232,176, Granby, $225,000, Hedley, $120,000, and Le Roi No. 2, $28,800, a total of $605,976.

Stevens County

The Copper King mine, near Chewelah, was put up for auction by the Receiver on June 12. J. W. Douglas bid $225,000, and Danson, Williams & Danson, $75,000. The mine has been well developed, has good equipment, and a 100-ton oil-burning smelter. The company has been in financial difficulties.

CANADA

British Columbia

A report of the Rambler-Cariboo Mines Co. for the year ended April 30, 1915, has been issued. Owing to the metal market situation it was decided to shut down in August 1914. The new superintendent, W. A. Cameron, reports that since January 1, 1915, 250 ft. of development has yielded good results. The mill is now working 20 hours per day, crushing about 2000 tons of ore per month. This yields 175 to 200 tons of lead concentrate, and about the same of zinc concentrate. Revenue during the period totaled $99,944, and all charges $94,619.

Spokane people with C. M. Smith have purchased the Portland-Lilly B. group of silver-lead claims at Slocan City, for $30,000. Development will commence in July, machinery being already installed for sinking to a depth of 1000 ft. The company is known as the Portland Silver-Lead Mines Co. It is authorized to issue capital stock to the amount of $250,000.

The British Columbia Copper Co. has started blowing-in its furnaces at Greenwood. The mine was closed just before the War started, but not on account of it, the reason being the low grade of the ore, and copper prices.

On June 30 the Hedley Gold Mining Co. will pay a dividend of 3%, and an additional one of 2%.

Ontario

A carload of ore weighing 43.58 tons, containing about 308,000 oz. silver, was shipped from the Temiskaming last week. This ore is from a new vein found during the winter.——The Nipissing company is to start hydraulic prospecting to the east side of Cart Lake. Work has been done on the west side of Peterson lake. In May the high and low-grade mills treated 177 tons and 7016 tons of ore respectively, yielding $175,522. The refinery shipped 553,007 oz. silver. Hydraulicking uncovered a narrow low-grade vein 50 ft. long, with a good deal of silver in the wall-rock.

The Tough-Oakes at Kirkland Lake is treating 80 tons of $20 ore per day. The May output was 2400 tons for over $55,000. Fourteen machines are working underground. Sinking to 400 ft. is underway.

In May the Alexo nickel mine shipped 982 tons of ore.

The Crown Reserve company will continue to negotiate for the property it had under option in Nicaragua. It contains large low-grade ore deposits.

For the year ended April 30, 1915, the Buffalo Mines Co. reports that the output was 822,791 oz. silver. The income was $460,657; surplus after dividends, $27,059; and total surplus, $379,969. Corresponding figures for 1913-1914 were $974,082, $270,219 (deficit), and $352,809.

YUKON

The Canadian Klondyke and Yukon companies have their dredges and hydraulic plants in full operation

KOREA

The Seoul Mining Co., operating the Suan concession in Whang Hai province, reports the following results for May

Ore treated, tons	7,020
Mill operating, days	29.25
Total recovery	$80,580
Operating expenses	27,500
Net earnings	53,080

The May clean-up of the Oriental Consolidated yielded $154,231. Details of April return are as follows ore treated, 22,564 tons; total bullion recovered, $139,298. Taracol cyanide-plant extraction, 92.1%; Maibong tube-mill plant, 95.2%; and there is still trouble with the freight bulls with the foot-and-mouth disease.

MEXICO

CHIHUAHUA

On September 7, 1914, the American staff of the Batopilas Mining Co. arrived at the property. Operations have been continuous since. Bullion shipments have been made regularly. Reports for the years 1913 and 1914 will soon be available.

SONORA

A number of small mining properties in this State, supplied by the Nacozari railway, are short of explosives. This line has been closed temporarily, and the Moctezuma Copper Co. will not sell any more powder until the road resumes. There is food in Nacozari for about a month. The United Mines Co., operating the North Tigre has closed.

It is reported in Douglas that two blast and one reverberatory-furnace at Cananea have been blown-in, after a stoppage of 10 months. L. D. Ricketts left Bisbee for the smelter on June 16. The concentrating plant is not in operation yet.

NICARAGUA

H. P. Henderson, F. H. Sistermans, and D. M. Munro were in Bluefields at the beginning of June, on their way to the Potosi mine. They will examine it for the Tonopah Belmont Development Co. of Nevada.

PHILIPPINE ISLANDS

In the Philippine *Journal of Science* for January, a preliminary check list of Philippine minerals is given. This was compiled by Warren D. Smith, F. T. Eddingfield, and Paul R. Fanning. There are 113 mineral species known to occur in the territory. The list briefly describes them and their occurrence.

Schools and Societies

PRINCETON UNIVERSITY held its 168th commencement on June 17.

The UNIVERSITY OF CALIFORNIA summer session commenced on June 21. About 4900 students are enrolled.

The UNIVERSITY OF WASHINGTON has issued a bulletin dealing with its College of Mines. The faculty of the department consists of 36 instructors and assistants. The summer session opens June 21 and ends July 31.

The UNITED ENGINEERING SOCIETY has established a Library Service Bureau which will furnish to engineers accurate abstracts and reliable translations of articles appearing in any language; to compile bibliographies on any engineering subject; to supply copies of articles, and to make photostatic prints of diagrams, maps, plates or printed pages. To save bookkeeping, engineers are invited to subscribe to the Bureau, and the subscription will be credited to service rendered. A list of charges will be sent in request, addressed to 29 West 39th St., New York.

PERSONAL

JOHN B. FARISH is here.

THOMAS T. READ is at Engels.

H. R. PLATT is at Stewart, B. C.

A. MCARTHUR JOHNSTON is in London.

W. S. NOYES has returned from Texas.

C. W. MERRILL has returned from New York.

T. WALTER BEAM, of Denver, is at Camp Hedley, B. C.

H. W. DUBOIS sails from Seattle for Alaska on June 30.

H. C. WILMOT is in New York city on professional work

W. J. ELMENDORF has left Fairbanks to go to Kantishna, Alaska.

JOHN B. HASTINGS has returned from Yellow Jacket, Idaho, to New York.

CHARLES JANIN will leave next week for an extended professional trip.

OSCAR H. HERSHEY is expected at Kellogg, Idaho, on his return from Alaska.

JAMES MACTEAR has resigned from the firm of W. R. Feldtmann & Co., London.

EDWARD A. CLARK and CHARLES HAYDEN, of Boston, are at the St. Francis hotel.

B. H. DUNSHEE has been spending a holiday at Berkeley and has gone to San Diego.

D'ARCY WEATHERBE sails from New York for Liverpool by the *Tuscania* on June 26.

A. D. MILES, president of the Canadian Copper Co., has been visiting San Mateo, California.

M. E. PURCELL, manager of the Centre Star and War Eagle mines, Rossland, visited the Exposition.

H. E. CRAWFORD, of the Cinco Minas, and WILLIAM HOWARD, of the Amparo mine, are in San Francisco.

GEORGE E. FARISH is on his way from New York to examine the Copper Basin group in southern California.

ROBERT I. KERR, of Jackson, has been appointed secretary-treasurer of the California Metal Producers Association.

E. C. KLINKER, manager for the Columbia Consolidated Mines Co., near Nevada City, was in San Francisco recently.

G. H. COX, in the department of geology, the Missouri School of Mines, is spending the summer in visiting the oilfields of California.

TAKESHI KAWAMURI, metallurgist for the Mitsu Bishi Co., passed through San Francisco on his way to visit steel plants in the Eastern United States and England.

SAMUEL W. COHEN has just returned to Cobalt from a three months' trip to Nicaragua, where he was engaged in the examination of gold mines under option to the Crown Reserve Mining Co. Assisting him in the examination were E. L. STEINDLER, A. BURNETT, H. BISCHOFF, and G. MILLER.

Obituary

J. G. PARMENTER, of Los Angeles, was assassinated at the El Favor mine, near Guadalajara, Mexico, on May 26.

WILLIAM C. HUNTER, who was examining the Columbia Consolidated in Nevada county, California, was killed two weeks ago by the explosion of a misfired hole.

JOHN A. FINCH, aged 61, well known in mining circles in Idaho, Washington, and British Columbia, died suddenly of apoplexy at Spokane on June 20. He was born in England, arriving in the United States when three years old. In 1881 he started in mining business at Denver and Leadville, going to Idaho six years later. His interests recently included the Gem mine and Federal company in the Coeur d'Alene, Standard, Enterprise, St. Eugene, and War Eagle in British Columbia, and the Kendall in Montana; also in several California properties. His wife survives him.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, June 24.

Antimony	—35¾
Electrolytic copper	20½—20¾
Pig lead	6.00— 6.95
Quicksilver (per flask)	$95
Spelter	25 —25¼
Tin	39½—41
Zinc-dust, 100-kg. zinc-lined cases	30

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, June 24.—Copper is quiet and waiting; lead consumers are now offering to sell; spelter has few buyers, but is firm.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending	
June 17	49.12	May 12	50.06
" 18	49.12	" 19	49.93
" 19	49.12	" 26	49.77
" 20 Sunday		June 2	49.40
" 21	49.00	" 9	49 35
" 22	48.87	" 16	49.31
" 23	48.62	" 23	48.97

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	67.58	48.85	July	54.90	....
Feb.	67.53	48.45	Aug.	54 35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58 52	50.25	Oct.	51.12	....
May	58.21	49.87	Nov.	49.12	....
June	56.43	....	Dec.	49.27	....

The above quotations indicate a decided weakness. London advises that the market has had a relapse into dullness. It would seem as if the bullish activity in the Indian Bazaars has not acquired as yet much staying power, more especially as it has had to absorb not only the ordinary volume of sales in London, but also an amount of selling from China as well. On some purchases for China the price rallied recently, but as inquiries were not maintained, prices receded. Up to June 3 exports of silver from London to the East were approximately 11,500,000 oz. less than in the same period of 1914. On June 19 there was about 40,000 oz. sent from San Francisco to China. The feature of the market has been the small amount offering at the present level. If continued, this may have some effect upon the price, for Continental demand is not absent—though certainly slight just now—and in these circumstances, there is not much available for other quarters.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31 60	....
Feb.	39.76	37.23	Aug.	50.20	....
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	39.28	Nov.	33.51	....
June	30.72	....	Dec.	33.60	....

On June 23 tin was dull in New York at 41 cents.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
June 17	20.00	May 12	18.75
" 18	20.00	" 19	18.68
" 19	20.00	" 26	18.50
" 20 Sunday		June 2	18.67
" 21	20.00	" 9	19.39
" 22	20.00	" 16	20 12
" 23	20.00	" 23	20.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13 60	July	13.26	....
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13.60	....	Dec.	12.75	....

The Copper Range Consolidated has sold 1,000,000 lb. at 20.5c. and 2,000,000 lb at 20.25c. Anaconda has declared a dividend of 50c. per share, an increase of 25c. Osceola will distribute $3 per share.

Exports of copper during the week ended June 5 totaled 13,180,318 lb., valued at $2,396,030. Of this, 6,251,444 lb. went to France, 4,318,068 lb. to Italy, 2,232,933 lb. to England, and 224,036 lb. to Switzerland. Imports of ore, matte, pigs, bars, etc., amounted to 9,161,398 lb., valued at $1,329,421.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
June 17	6.25	May 12	4 20
" 18	6.00	" 19	4.20
" 19	5.75	" 26	4.20
" 20 Sunday		June 2	4 69
" 21	5.75	" 9	5.44
" 22	5.75	" 16	6.66
" 23	5.45	" 23	5.82

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3 80	....
Feb.	4 02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	....	Dec.	3.80	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
May 27	75.00	June 9	90.00
June 2	80.00	" 16	90.00
		" 23	95 00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60.00	Aug.	80.00	....
Mch.	39 00	78.00	Sept.	76.25	....
Apr.	38.90	77.50	Oct.	53.00	....
May	39.00	75.00	Nov.	55.00	....
June	38.60	....	Dec.	53.10	....

Exports of mercury from San Francisco during May totaled 220 flasks, against 240 in that month of 1914. Of the former quantity, 200 went to New York, 14 to Korea, 3 to Nicaragua, 2 to Mexico, and 1 to Canada. London price is now £14, equal to $67.20 per flask.

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
June 17	20.00	May 12	14.33
" 18	19.50	" 19	15.08
" 19	18.50	" 26	17.79
" 20 Sunday		June 2	22.10
" 21	18.25	" 9	26.17
" 22	18.00	" 16	22.83
" 23	18.00	" 23	18.71

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	5.22	9.05	Aug.	4.45	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9 78	Oct.	4.75	....
May	4.91	17.03	Nov.	5.01	....
June	4.84	....	Dec.	5.40	....

On the next page it is mentioned that the U. S. Steel Corporation will erect a zinc smelter near Pittsburg. This concern uses about 75,000 tons of spelter in a normal year.

In May the Butte & Superior mine had the following return: ore treated, 42,380 tons; average zinc content, 16.58%; concentrate saved, 11,870 tons; average assay, 52.11% zinc; contents of concentrate, 12,371,000 lb. of spelter; and recovery, 88.03%.

The United States consul at Yokohama reports that the Mitsui Bussan Kaisha has arranged for supplies of zinc ore and will erect a smelter. Two plants are in operation at present.

ANTIMONY

Consular advice from Hankow, China, states that shipments of antimony regulus and crude antimony during the first three months of 1915 were 1067 and 2560 tons respectively. In 1914 the district totaled 25,413 tons, valued at $768,935.

Eastern Metal Market

New York, June 18.

The week brought surprises in the steady decline of spelter, and in the collapse of the lead market. There are now more offerings of spelter than there are buyers, and the same is true, only to a more marked extent, in lead. In the latter, consumers who had heavily over-bought while in a state bordering on panic, were later almost as frantic in their efforts to sell. Brokers were loaded with commissions to sell at the best price they could get. The situation in both metals savors of artificiality. The United States Steel Corporation announces that it will build a smelter at Pittsburg, to be ready for operation at the end of this year. The course of copper, which has softened a little in a dull market, is the most sane of any of the metals. In the opinion of careful observers, those interested in the metals should remember that fulfillment of the tremendous orders which have been placed in this country for shrapnel, explosive shells, and other munitions of war is only just beginning to get into full swing. Some of the big plants to be devoted to that form of work are not yet completed, while others are not yet organized. Of course, much depends, so far as the metal markets are concerned, on how far contracts have been made for the copper, lead, and spelter, also antimony, which will be required.

The makers of hand and automatic screw-machines, much used in making small parts, including shrapnel fuse-timers, from brass bar-stock, are sold up for months to come, and turning business away. Firms which do a jobbing business with such machines are reaping a harvest. Collections were never better with the machinery trade, with the war order substantial amounts are paid cheerfully in advance. It is satisfactory to note that the war business is steadily extending to other lines. More interest in equipment and supplies is being shown by railroads.

COPPER

Buying to fill war requirements was fairly active in the latter part of last week, but since then an admitted lull has settled over the market. With the better activity prices of electrolytic advanced until 19.87½c., cash, was reached June 10 and the quotation exceeded 20c. cash New York, two days later. When buying ceased there still was a large amount of inquiry in the market, and presumably it represents demand that yet must be satisfied. The lack of interest brought about lower quotations both here and abroad, but offerings of re-sale lots at concessions did not tempt buyers to any appreciable degree. The quotations for prompt delivery June 18 were 19.87½ to 20c., cash, New York. Good brands of Lake were quoted June 18 at 20.25c. Very choice grades, which are out of the market, are nominally quoted up to 23c., and even 24c. While copper shows some temporary weakness it is unquestionably in a better position than spelter or lead. The exports this month total 11,700 tons.

LEAD

On Monday of this week the lead market collapsed. The American Smelting & Refining Co. was holding, on that day, to its price of 7c. New York, which had been established June 12. Up to this day the outside market was extremely strong, and up to 7.75c. was asked by independents. On June 14, all kinds of holders of lead—producers, retailers, jobbers, and even consumers—took it into their heads to sell, and the numerous offerings caused the price to decline. The metal could easily be bought at 6.25c., June 16, and the following day the largest interest reduced its New York quotation to that figure; while outsiders came down to 6c. On June 18, the quotation of the largest interest was 6c. and those of independents, 5.75 to 6c. For days the New York price was above St. Louis parity. Despite the curious trend of prices it is still insisted that surplus stocks have been greatly reduced, and that current consumption will be henceforth drawn upon to a greater degree to meet demand. Again that statement is challenged. Whatever the causes of the market's course, old observers say they have not seen its like in 40 years. The excitement was started by heavy European buying followed by a rush on the part of domestic consumers. Many of the latter over-bought and so were eager to sell when the tide turned. The exports up to June 19 totaled 5088 tons.

SPELTER

E. H. Gary, chairman of the board of directors of the U. S. Steel Corporation, issued the following statement June 18: "We have decided to build near Pittsburg, probably at Donora, a new plant for the manufacture of zinc and by-products, including sulphuric acid, at a cost of from $2,500,000 to $3,000,000. We have, for some years, been considering the building of such a plant in order to supply materials for our own use. We have been buying of other manufacturers but as there has been some difficulty or, at least, delay in supplying our necessities, we have reached the conclusion to proceed at this time.

"The market for the products of the plant is largely in the Pittsburg district, and for this reason and the further reason that it is a good point for the assembly of raw materials, we have selected this location. We hope to be able to start operations on or before the first of next January."

For the present, at least, the tide has turned in the spelter market, and since June 9 the trend of prices has been steadily downward. The producers have shown no anxiety to sell, but second-hands and consumers have made offerings at lower and lower prices, until yesterday 19.50c. was quoted. The entire situation is one where buyers, in a state of panic bid the market up on themselves, then turned round and offered the metal at successively lower prices. First there were many buyers and few sellers, then many sellers and few buyers. It is interesting to note that on June 14 an English buyer offered 23c. for 100 tons of September and October delivery, but a producer to whom the offer was made was willing to sell but 50 tons on that basis. Sales for July delivery were made early in the week at 21c. Despite the decline in the market the makers of galvanized sheets seem to have found no relief. On June 17 they advanced their quotations $5 per ton, making the total increase of $10 within a week. Meanwhile more plants are withdrawing from the galvanizing trade. The prevailing price of 5c. for No. 28 galvanized sheets is prohibitive for many uses. An advance in galvanized pipe is predicted. With the decline in spelter, sheet zinc was reduced June 14 from 33 to 30c. The exports of spelter, up to June 19 totaled 1021 tons.

TIN

The feature in tin at this writing is the scarcity of spot stocks, which caused the quotation for prompt delivery metal to advance to 24.25c., June 15. Late last week there was a good business in early shipment from London and from the Straits. Immediately after interest subsided and prices declined. The quotation June 14 was 41.25c., and yesterday it was 41c. The market is irregular because of the variations in the value which different holders place on the metal. There are not many sellers at this time. Few arrivals of importance are promised for this month. The aggregate up to today is 1530 tons. There is afloat 6182 tons.

ALUMINUM

Quotations range from 30 to 32c., but it must be understood that large consumers got their supply at lower figures, probably around 20 cents.

MINING DECISIONS

Mining Partnership—Termination

Where joint owners of an oil and gas lease unite in operating the demised premises thereunder without any special agreement as to the character of their relation to each other, they constitute a mining partnership, and such partnership is not terminated by the execution by one partner of a deed of trust on his partnership interest to secure his co-partner in a loan based on a transaction outside of the firm business.

Wetzel v. Jones (West Virginia), 84 Southeastern, 951. April 20, 1915.

Oil Lease—Abandonment and Cancellation

Where, in a suit to compel defendants to drill an oil-well, or abandon the premises comprised in an oil and gas lease, it appeared that the lessee, after drilling one well, failed for 13 years to explore the premises further, and had no intention of drilling additional wells, even though the lessee was of the opinion that such wells would not be profitable, it was held that the lease should be cancelled as to all but a small area surrounding the drilled well.

Highfield Co. v. Kirk (Pennsylvania), 93 Atlantic, 815. January 11, 1915.

Mining Lease—Construction of Covenants

A covenant to explore and mine is not necessarily implied in a lease of property to be paid for in royalties. But even if such a covenant were implied and the lessee failed to perform, it does not follow that the right to forfeit the lease arises. The right of forfeiture is confined to the failure of the lessee respecting covenants and conditions which are 'expressed in the lease,' and does not arise upon the non-observance of an implied covenant or condition.

A covenant for 'thorough exploration' for iron ore does not require the lessee to operate the mine, but merely requires a complete search to determine whether the land contains ore, and if so, the boundaries and character of the deposits. The right to remove ore which has been mined may be implied from the terms of the lease providing for methods of weighing, payment of minimum royalties, etc.

De Grasse v. Verona Mining Co. (Michigan), 152 Northwestern, 242. April 19, 1915.

Assessment Work—Resumption Prior to Forfeiture Re-location Notice

Where the owner of several mining claims failed to perform assessment work thereon for the year 1912, but early in 1913 expended large sums in constructing trails and cable lines leading to the claims, the performance of this work sufficed to prevent a forfeiture to a subsequent re-locator, even though said trails and cable lines were also intended to be used in the construction of a railroad to carry the ore to market. The location notice posted by the would-be locator was fatally defective because it did not contain a statement that he was relocating forfeited or abandoned ground. It is insufficient if only the recorded notice contains this statement. The Federal law contains no provision for the recording of notices, but the State laws, placing additional requirements upon locators are to be construed as 'statutes of peace and repose intended to prevent disorder in claiming and holding mining claims,' and must be followed. Hence, owing to the resumption of work by the original locator prior to the alleged re-location, and to the insufficiency of the posted notice of re-location the re-location was held invalid.

Florence-Rae Copper Co. v. Kimbel (Washington), 147 Pacific, 881. April 17, 1915.

COMPANY REPORTS

DOME MINES CO., LTD.

Accompanied by plans and photographs of its property, the Dome Mines Co., Ltd., has issued a report for the year ended March 31, 1915. The statement of the general manager, C. D. Kaeding, includes the following: Development to No. 6 level amounted to 12,098 ft., including 5875 ft. of diamond-drilling. Stations, enlarging drifts, etc., totaled 85,000 cu. ft. This work cost $173,319, equal to 69.7c. per ton of ore treated. Development was distributed within a zone 400 ft. wide by 1500 ft. long. Ore reserves are estimated at 2,782,811 tons, averaging $4.15 per ton. There has been developed a body of better grade ore on No. 4 and 5 levels, similar to that originally milled from the so-called 'dome.' The apex is at No. 3 level, 260 ft. from the surface. On No. 4 level it is 120 by 330 ft., and on No. 5, is 60 by 160 ft. Drilling below this to No. 6 a vertical distance of 130 ft. indicates more ore. A system of shrinkage stopes has been prepared on No. 3 and 5 levels.

In August, additions to the mill were completed, and connected with the old units. The plant treated 248,550 tons averaging $4.68 per ton. The recovery was 90.6%, bullion extracted being $1,055,497. Costs were 99c. per ton, including some alterations, a reduction of 45c. per ton.

Mining, treatment, and other charges totaled $2.967 per ton, a decrease of $1.23 per ton. The operating profit was $315,179. Deducting depreciation, repairs and improvements, there was left $175,578. The surplus on April 1, 1914, was $486,520, and on that date of 1915, $665,099.

SEOUL MINING COMPANY

The 52 pages of the detailed and interesting report of this company for the year ended December 31, 1914, includes the directors' report, balance sheet and accounts, reports of the general manager, A. H. Collbran, electric-power by H. Maki, Tul Mi Chung mine by E. W. Mills, prospecting progress by E. W. Mills, and the Soctaire and other prospects by K. I. Yun.

To erect the mill at the Tul Mi Chung and for further development, the company borrowed $250,000 from shareholders. Dividends amounted to 50% of the capital, equal to $250,000. The year commenced with a balance of $188,412, and ended with one of $252,106.

Development at the Suan mine covered 7138 ft., making 35,701 ft. to date. A large flow of water was encountered on No. 6 level, making work impossible, so a new pump is being installed. It was also necessary to draw on the broken ore reserves, reducing them from 53,335 to 35,606 tons. Ore reserves are estimated at 236,536 tons having the following metal content: gold, $9.13 per ton; copper, 1.12%; and bismuth, 1.7 lb. per ton, the total value being $12.86 per ton at normal prices of these metals. The central orebody is worked out. The western shoot was reduced from 19,750 to 7670 tons. Mining cost $1.38 per ton, a decrease of 46c. per ton. The mill worked 338.6 days, or 92.77% of the possible time. It treated 74,550 tons of ore, yielding gold, copper, and bismuth worth $563,348, $91,859, and $35,974 respectively. Recovery of gold and copper was 85.98% and 56.24%. Flotation is now increasing this extraction. Treatment cost $1 per ton. All costs were $3.90, a reduction of 43c. per ton.

At the Tul Mi Chung mine development totaled 11,958 ft., making 22,172 ft. to date. Two new orebodies were developed, making seven. Reserves amount to 963,600 tons assaying $8.14 gold, 1.59% copper, and 0.8 oz. silver per ton, a total value of $11,904,645. Grading for the new 300-ton mill was finished in April 1915.

A considerable amount of work was done at many districts on gold-copper and silver-lead-zinc ores.

New Machines and Devices

Information based on letters and catalogues from manufacturers

Mining in the City of New York

The illustration below is not of open-cut operations on the Michigan iron ranges nor the starting of a shaft in a Western mining district, but shows mining going on within a few blocks of Wall Street. So far as mining operations, rather than products, is concerned, New York is one of the great districts of the world, for its water-supply system, now nearly completed, and the numerous subways now in course of construction involve an amount of underground work which for extent compares favorably with the largest mining operations, and introduces many complex problems through the necessity of carrying on work without interfering with the traffic of the city. The illustration above shows drilling in progress in an open-cut for the new subway system, and was furnished by the courtesy of the Ingersoll-Rand Company.

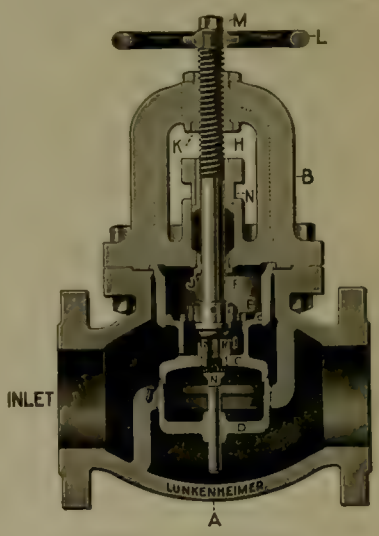
MINING IN NEW YORK CITY.

An Improved Balanced Throttle-Valve

A valve of exceptionally free and easy operation combined with efficiency is necessary for engine-throttle purposes. The valve illustrated was designed, with this important object in view, by the Lunkenheimer Co., Cincinnati. Its construction embraces all the essentials necessary for the highest type of engine throttle, and is claimed as being a most reliable valve of exceptional durability. An important factor of this valve is in the simplicity of its design. No small parts of uncertain reliability or strength are embodied in its construction. There are practically but three moving parts, the main disc, by-pass disc, and stem. These being of large proportion, will safely withstand the hardest service to which valves of this type are subjected. With ease of operation, follows lack of friction, and as practically no force is required to open or close the valve, wear on all moving parts is reduced to a minimum. This ease of operation is directly attributed to the improved by-pass construction, which equalizes the pressure on both sides of the disc.

The operation of the valve is as follows: assume that the valve is closed and under pressure. As pressure will enter the balancing cylinder, by passing the piston-ring and also entering through the small hole in the bottom of the disc-cylinder, the pressure above the disc is equal to that in the inlet of the valve. This pressure aids materially in holding the disc C tightly to its seat, but unless some provision was made to relieve this pressure, the valve would be extremely difficult to open.

The method of relief lies in the by-pass I, the opening through which is covered by the bottom of the stem H when the valve is closed. A slight turn of the hand-wheel, however, uncovers this opening and the steam above the piston will then pass through the holes in the retaining ring E, thence through the hole in the by-pass disc I and holes in the main disc guide stem N, immediately relieving the pressure above the piston. Any pressure that may escape past the piston ring or through the small hole in the bottom of the disc-cylinder, is also quickly relieved while the valve is being opened. There being practically no pressure above the disc, the operation of opening the valve is therefore an exceedingly easy one.



BALANCED THROTTLE-VALVE.

The main object of the small hole in the bottom of the disc-cylinder, is to drain water from condensation that may accumulate when the valve is connected in a horizontal position, with the hand-wheel up. When in a horizontal position, any water in the disc and balancing-cylinders will drain past the piston-ring.

Both the main and by-pass disc are operated simultaneously by one movement of a single hand-wheel, which not only facilitates the quick operation of the valve, but insures the opening of the by-pass valve at the proper time. Provision is made for re-grinding both the main and by-pass disc seating-surfaces, should they become worn. As all parts are renewable, the durability of the valve is increased. Expansion or strains may slightly distort the seat, but owing to the annular extensions

on both the seat and disc, which provide spring seating-surfaces, they will regularly accommodate themselves to any slight irregularity, and therefore a tight valve is at all times assured. The body may be tapped anywhere above the seat or inlet end for drain connection, so that any water from condensation can be removed before the valve is opened. For the lubrication of the engine-cylinder, the body can also be tapped on the inlet or outlet end, to which lubricator connection may be made.

This improved valve is made in sizes ranging from 4 to 10 in. inclusive. To suit various conditions of superheat and pressure and to meet the specifications of engineers who differ as to the materials used for the different parts, they are made in six combinations.

The manufacturers have issued an attractive booklet illustrating and describing the new valve.

Mining Machinery Exhibitors at the Exposition

In the Palace of Mines and Metallurgy the following firms are represented: Braun-Knecht-Heimann Co., San Francisco, assaying apparatus; Joshua Hendy Iron Works, San Francisco, safety mine-cage; Denver Engineering Works, head-frame and electric-hoist; Koehler Manufacturing Co., Marlboro, Massachusetts, safety-lamps; Byron Jackson Iron Works, San Francisco, centrifugal mine pump and winze pump; General Machinery & Supply Co., San Francisco, single-stage air-compressor and receiver; Goodyear Tire & Rubber Co., Akron, Ohio, air and water hose; Hendrie & Bolthoff Manufacturing & Supply Co., Denver, drill-column; Coast Manufacturing & Supply Co., Livermore, California, safety fuses; Hercules Powder Co., Wilmington, Delaware, explosives; Westinghouse Electric & Manufacturing Co., East Pittsburg, storage-battery mine locomotive and trolley-gathering locomotive, and motors; Baltimore Enamel & Novelty Co., Baltimore, enamel signs; Hockensmith Wheel & Mine Car Co., Penns Station, Pennsylvania, mine cars; Pyrene Manufacturing Co., New York, fire extinguishers; American Blower Co., Detroit, mine fans; American Mine Door Co., Canton, Ohio, automatic mine doors, manway doors, and plain swinging doors; Riverside Portland Cement Co., Los Angeles, cement for floor and walls; Ensign-Bickford Co., Simsbury, Connecticut, safety fuse; MINING AND SCIENTIFIC PRESS, San Francisco, technical publications; Western Electric Co., New York, portable electric mine telephone; Concordia Safety Lamp Co., Pittsburg, Pennsylvania, electric mine lamps; Life Saving Devices Co., Chicago, artificial respiratory apparatus; Jeffrey Manufacturing Co., Columbus, Ohio, breast turret coal mining machine, and truck and turret coal-cutting machine; Linde Air Products Co., New York, oxygen for rescue demonstrations; Superior Oxygen Co., Pittsburg; Dunham, Carrigan & Hayden Co., San Francisco, wheelbarrows, picks, and shovels; Cyclone Drill Co., Orrville, Ohio, working model; John Simmons Co., New York, carbide hand and cap lamps; Denver Rock Drill Co., Denver, stoping, sinking, and drift drills; Ingersoll-Rand Co., New York, Jackhamers, stoping-drills, water-feed hammer-drills, piston-drills, stretcher-bar hoist, drill-sharpener, and oil-fired forge; Draeger Oxygen Apparatus Co., Pittsburg, three sets artificial breathing equipment and oxygen pump; Gould Manufacturing Co., San Francisco, electric ditch pump; Mine Safety Appliances Co., Pittsburg, artificial breathing apparatus, safety-lamp testing and demonstrating box, recording volumeter, recording hydro air-pressure gauge for fan, and first-aid materials; The White Co., Cleveland, rescue auto-truck; H. R. Worthington, San Francisco, vertical direct-connected sump pump; Thos. A. Edison, West Orange, New Jersey, electric mine lamp, approved by the U. S. Bureau of Mines; Senn Concentrator Co., Oakland, California; Oliver Continuous Filter Co., San Francisco; Hardinge Conical Mill Co., New York; Dorr Cyanide Machinery Co., Denver; and Merrill Metallurgical Co., San Francisco; and the L. C. Trent Engineering Co. of Los Angeles, apparatus for ore-treatment. The Trent tanks are made by the Redwood Manufacturing Co. of San Francisco.

Boilers at the Exposition

One of the most prominent features of the exhibit of Babcock & Wilcox Co., in the Palace of Machinery at the Panama-Pacific Exposition, is a boiler exhibited by the company in 1876 at the Centennial Exposition at Philadelphia. The boiler thus forms an interesting link between the two expositions, showing the progress in methods of construction of water-tube boilers in the interval. The exhibit includes three boilers to represent the land type, all with brick settings according to approved practice, half the setting being removed to allow an examination of the boiler. One of these is the well-known water-tube boiler with vertical headers. It is fitted with an oil-burning furnace. Boilers of this type now in use in different parts of the world are capable of generating 10,000,000 horse-power. Less common, but nevertheless, widely used, is the Stirling boiler. The Rust boiler has also been found satisfactory under a variety of conditions.

Commercial Paragraphs

The YUBA CONSTRUCTION CO. at Marysville has secured a contract from the Yuba Consolidated Gold Fields Co. to construct a dredge. It will be larger than No. 14 now operating on the Yuba river.

The TERRY STEAM TURBINE CO., Hartford, Connecticut, announces the appointment of Joseph Battles as district sales manager for Denver, covering the states of New Mexico, Colorado, Wyoming, and the western portions of Nebraska. His address is 326 First National Bank building, Denver.

The ROBINS CONVEYING BELT CO. has issued a folder on its 'Durabelt,' 'Everwear, 'Supreme,' and 'Equator' belts. A 36-in. Durabelt carried over 6,000,000 tons of coal, a 44-in. over 4,000,000 tons of limestone, while an 18-in. carried coal for 17 years.

The HOLT MANUFACTURING CO., Stockton, California, announces that it has been awarded two grand prizes, five medals of honor, and two gold medals for its exhibit at the Exposition. The medals of honor indicate scorings of 95% or over. A grand prize was given on the 'Caterpillar' tractor, well-known to mining men.

The INGERSOLL-RAND CO., New York, announces that on July 1 it will open a branch office at 139 Townsend street, San Francisco. H. L. Terwilliger will be in charge, his duties covering this and the Los Angeles districts. On July 22 the agency contract of Harron, Rickard & McCone expires, but arrangements have been made whereby they co-operate in the sale of I.-R. machinery after that date.

The Case low-pressure oil-forge for heating drill-steel is described in a leaflet issued by the DENVER FIRE CLAY CO., Denver, Colorado. It is claimed for this furnace that it uses less ounces of air pressure thoroughly to atomize the oil than other burners require pounds of air pressure. The constant pressure is 6 oz. The fan to supply the air to atomize the oil within the Case burner is direct connected to a General Electric motor. Other claims are as follows: no sulphur on drill being heated, drill under observation, drill holds edge longer, practically no noise or smoke, and no scale forms on drills.

The CHICAGO PNEUMATIC TOOL CO., with offices in the Fisher building, Chicago, and 52 Vanderbilt St., New York, has issued Bulletin 34-X, dated May 1915, relating to its class A-G 'Giant' gas and gasoline engines. The publication illustrates these engines in six sizes, ranging from 16 to 130 hp. The engines are similar in general design to the well-known Giant fuel-oil driven engine manufactured by the same company, with the exception that they are designed for operation with manufactured or natural gas. The firm claims that the enclosed self-oiling features, extreme simplicity, and perfect automatic regulation should recommend them throughout the field where manufactured or natural gas is available for power purposes.